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THE MECHANICAL ENGINEER.

DEVOTED TO

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APPLIED MECHANICS,

AND THE ALLIED ARTS.

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* INDICATES ILLUSTRATED ARTICLES. † DENOTES THE EDITORIALS.

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ENGINES OF THE "EXCELSIOR" S.S.

Designed by **Herman Winter, Esq.,**
Cons. Engineer Morgan Line S.S., New York.
Constructed by the Harlan and Hollingsworth Co., Wilmington, Delaware.

(AMERICAN MARINE ENGINES.)—No. VI.

Through the courtesy of Herman Winter, Esq., Consulting Engineer of the Morgan line of steamships, we are enabled to lay before our readers the engravings herewith. As will be seen, the proportions of the engines are massive, and the general arrangement, as far as can be shown by our engraving, exceedingly good. They stand in an engine-room of ample size, and are easily accessible all round.

The plan is variously known as the "steeple engine" at the West, and in this vicinity as the "tandem," compounded, with cylinders 38 in. H. P. and 76 in. L. P., with 54 in. stroke. The valves are plain slides, with cut-off valves on the back of the high-pressure valve, worked from a "sword-arm" or fixed link as shown. The low-pressure cylinder has a double-ported valve seat, while that of the high-pressure is single-ported, both main valves being on one stem—4 in. diameter at centre and $5\frac{1}{2}$ in. where it passes through the low-pressure cylinder steam-chest. The valves are handled by a steam cylinder, shown at the left, lying horizontally near the main platform and directly connected to the links: it hauls them over from forward to back, or to mid-gear instantaneously, so to speak, or with as much facility as a man would handle a locomotive reversing-lever.

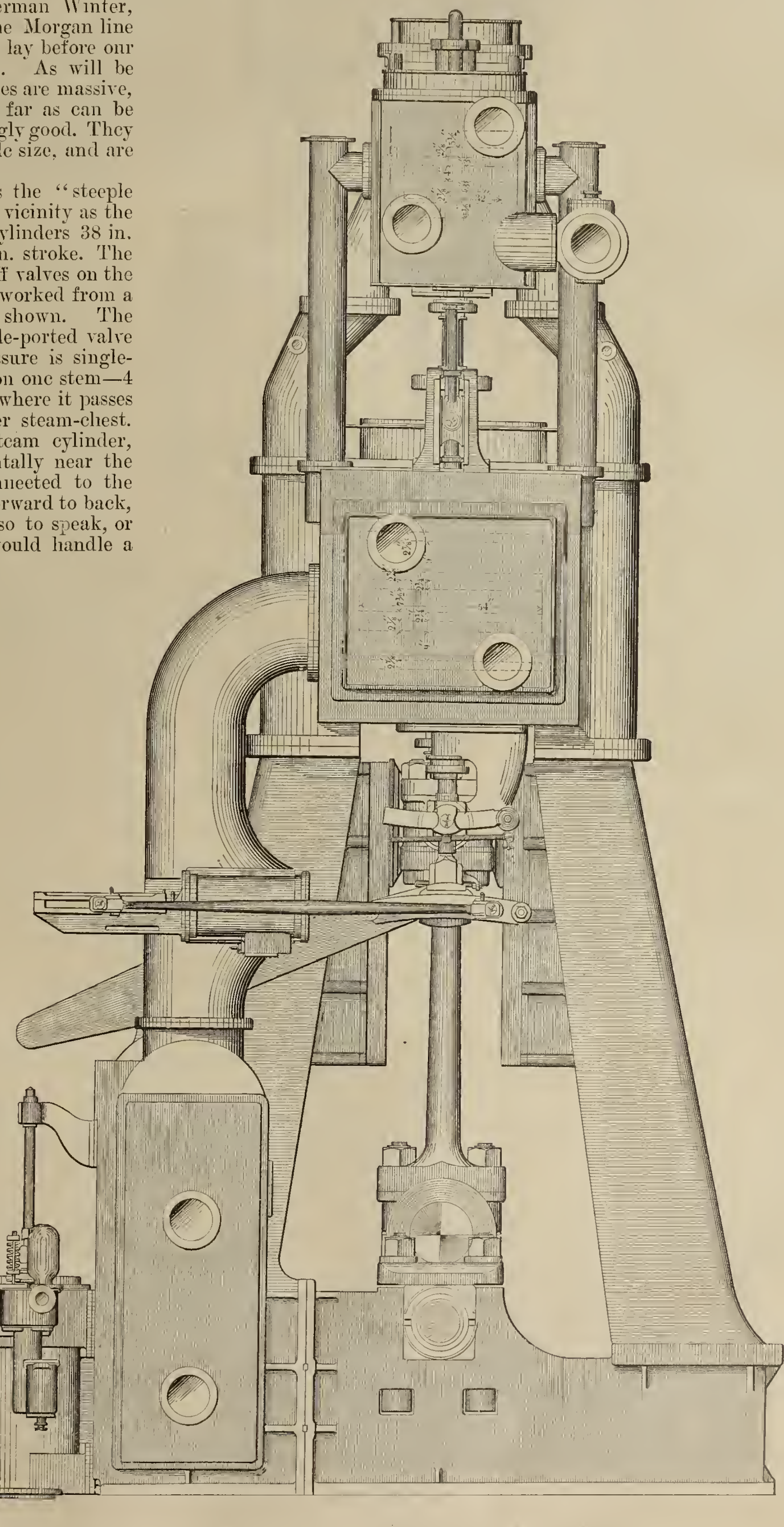
The engines have counter-balanced cranks, and drive a screw 17 ft. diameter by 23 ft. mean pitch at $57\frac{1}{2}$ revolutions with 80 lbs. steam. This is her performance when entirely new, and without the best point of cut-off, or working, adjusted. There were on the first trip some defects in the packing of the low-pressure cylinder by which it was prevented from exerting its full power. These troubles, as all engineers know, are incidental to new machinery and will disappear after a short time.

The main guides of these engines are very large, as may be seen, approximately, from the engravings, and the driving side, or that on which the cross head bears hardest, is fitted with a water-back, through which water is kept circulating constantly.

The engines are handled, when cold, by a novel device shown in the engravings on next page. It consists of a large wheel, 11 ft. diameter, fixed on the main shaft, just aft the main bearing, and clear of the engine-room gangway. The face of the wheel is recessed, and in these a pawl engages. The pawl is connected direct to the piston rod of a horizontal cylinder, 20″ diameter, above the wheel, on one side and when steam is given it the engines are turned over very quickly. A man can stand on the platform and work the main engines with this device, a complete stroke in about five minutes we should say, and in either direction. The whole gear is simple, strong and rapid.

The thrust-block is of the usual description (ring and collar), and has packing-boxes on each end to keep the oil from working out. The shaft alley is very fine, having ample head room, and the shaft is easy to get at. The shaft is not in the centre of the alley, as in many ships, but on one side, leaving, for a given space, much more room to work in. The diameter of the pins in the crosshead is 12″ by $16\frac{1}{4}''$; the crank-pin 18″, and of the shaft, 17″. The piston-rod for the low-pressure cylinder is 10″ diameter, and the high pressure $5\frac{3}{4}''$.

The high pressure ports are $2\frac{7}{8}''$ by 32″, bridges 3″, exhaust 4″. The low pressure ports are $2\frac{7}{8}$ by 54″, bridges $2\frac{1}{4}''$; exhaust $7\frac{1}{2}''$. Ample provision is made for access to all parts for packing, and our readers will notice that the glands of the packing boxes are all cupped, so that the water of condensation can be drained out, a very neat arrangement that will be appreciated by engineers everywhere. The engines are finely finished, even the shaft, in every section, having a handsome water-polish all over, couplings and bolts and nuts as well.



ENGINES OF THE "EXCELSIOR" S. S—AMERICAN MARINE ENGINES, NO. VI.

The emblem on the seal of the *National Association of Stationary Engineers* is a full-stroke card and an expansion card; signifying no doubt, that the Association works up to its full power when necessary, and can expand to take in all that may apply!

There are a good many new departures in our paper this issue, particularly in our advertising columns. They are put up in very attractive style, and will well repay perusal. We have shed our skin, but all the new business was obtained upon the old one! The new one is better, but it is not the limit of possibilities.

INSTRUCTIONS FOR FIRING.

"Keep coal wet as much as possible. When a shovel of coal is thrown into the fire-box, keep door open partially until smoke is consumed. Regulate the closing of door by watching stack. If black smoke escapes it is a sure indication that door is closed too soon after firing."

WM. BUCHANAN,
Sup't of Motive Power.

The above notice is posted in every locomotive cab on the New York Central and Hudson River R. R.

A QUESTION IN HYDRAULICS (PNEUMATICS ?)

Suppose a draft tube 20 feet in height be set up 13 feet from standing water below, and connected by a pipe carrying a valve, then allowing the atmospheric pressure to be 15 pounds to the square inch, and equal to the pressure of a column of water 33 feet high, if we exhaust the air from this tube, there will be a collapsing strain upon the tube of 15 pounds to every square inch of its surface. Now, should the valve be opened, the water will rush up through the pipe and fill the tube. Question: Will the filling of this tube with water relieve the strain upon it, or will there still remain the 15 pounds per square inch over its entire surface?

This is from a correspondent of the *Northwestern Miller*, and we take the liberty of answering it without an invitation. The pressure will still remain 14 7-10th pounds per square inch, at the surface of the earth, on the outside. This never can be removed. Nature abhors a vacuum, and so do we. When a man has gone about six hours without food, he has a realizing sense of atmospheric, or some other pressure, inside and out!—ED.

COMPRESSED FUEL.

Within late years a number of processes for the production of artificial fuel from coal dust have been brought to public notice, and it is somewhat surprising to note that though some of them have given very successful results, the use of such fuel is confined within very narrow limits. In mining coal large quantities of coal dust are naturally produced, and this is allowed to remain in the workings or is heaped up around the mouths of the shafts, and forms an item of considerable loss, as by proper means it might be converted into serviceable and highly efficient fuel. There is no necessity whatever for using coal in its ordinary form, the success of compressed fuel having been fully demonstrated on various occasions.

In Europe, especially along the shores of the Mediterranean, compressed fuel manufactured from such coal dust appears to be in great favor, and in France there are several large works in connection with mines where the dust is converted into bricks, which are now quite extensively used in the French Navy. It would appear that this coal is preferred for several reasons to the coal in its lumpy state, and if it is found serviceable for the purpose of raising steam there seems to be certainly no reason why it should not be suitable for ordinary household burning as well. Among its various advantages the fact that it occupies less room than the ordinary coal is worthy of note, and the storage capacity may therefore be limited to a much greater extent than is now the case. In addition to this there is no dirt and dust, which are inseparable from the coal as it is now delivered and used; and, finally, there is said to be a great difference between its price and that of coal, with very little as regards its heating power for all ordinary purposes.

The necessary machinery for producing bricks is, moreover, comparatively inexpensive, and at a coal mine there is always sufficient power for carrying on the work, while the ordinary brickmaking machines, some of which are capable of producing from 12,000 to 15,000 blocks per day, could be used without any serious objection.—*Unknown source.*

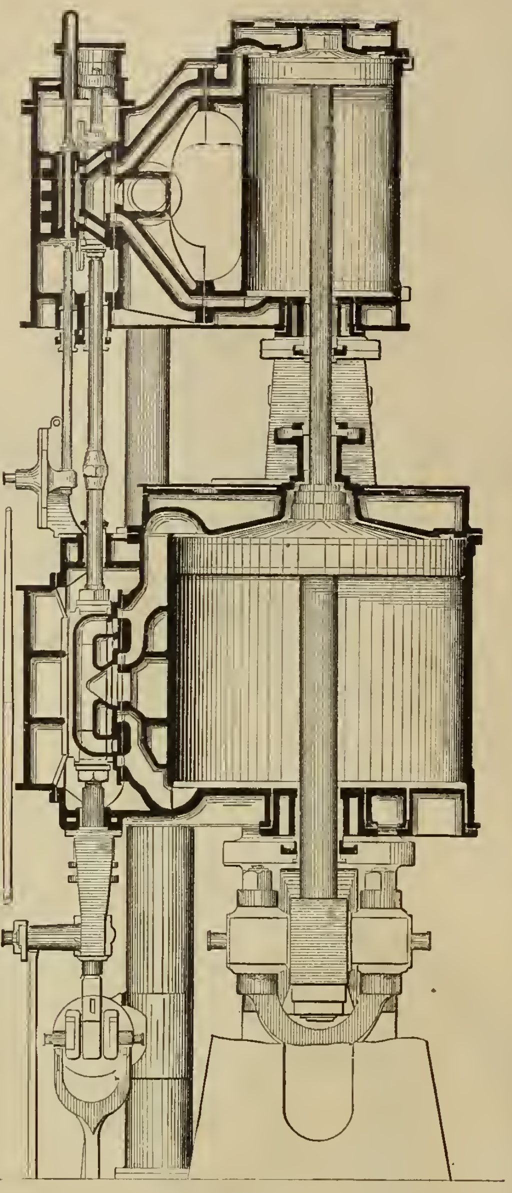
◆

The Baldwin Locomotive Works of Philadelphia, made last year 570 engines; close upon two complete locomotives daily. That is a good many!

The *Boston Journal of Chemistry* says many thousand headaches are experienced every morning that have been caused by kerosene lamps "turned down low," for a small flame in a lamp chimney does not cause enough draft to ensure complete combustion. Slumberers breathe carbon and carbonic acid gas as literally as if they stood over the chimney of a petroleum refinery.

If a little light is necessary in a bedchamber it may be supplied by a specially prepared taper, by a candle, or by a wick floated in animal or vegetable oil; but the turned-down kerosene lamp is always a menace to life and health.

The market value of mica is great, and at the present time the demand is such that it cannot be supplied. A piece of mica four inches by four inches, five-eighths of an inch thick, will weigh one pound, and has a market value of $4. A piece three by six inches, one-half inch thick, will weigh one pound and has a market value of $4.60, and a like relative portion of value exists, except in the smallest pieces, say one-half by two inches, which have a value of fifty cents per pound, and all the trimmings are readily sold. It will thus be seen that in mica mining we have an industry worthy of development, and one which requires no expensive manipulation of the product subsequent to excavation. —*Arizona Herald.*



SECTION OF CYLINDER S. S. "EXCELSIOR."

THE EDUCATION MOST NEEDED.

It is a very fortunate thing that we have among us men who have taken effective steps to furnish the rising generation with that education which will be needed in the coming twentieth century. It is of no use to disguise that the eyes of mankind are beginning to be open to the fact that the study of the languages, history, and customs of people which occupied this earth long ago, is of infinitely less importance to the present race of mankind than the study of the world in which they live, and of that which has been discovered about it, by a class of hard workers: the pioneers who are inaugurating the new age which is neither the golden age, nor that of stone, bronze, or iron, but the age of science, in which steam and electricity have to play a most conspicuous part.

It is the Fultons and the Morses, the McCormicks and the Howes, the pioneers in steam navigation and telegraphy, in agricultural and cotton industry, and last, but not least, the men who founded institutions to raise new generations to the advanced level from which they may lead further progress. We mean men like Peter Cooper, of New York; John Stevens, of Hoboken; and Cornell, of Ithaca.—*Industrial News.*

◆

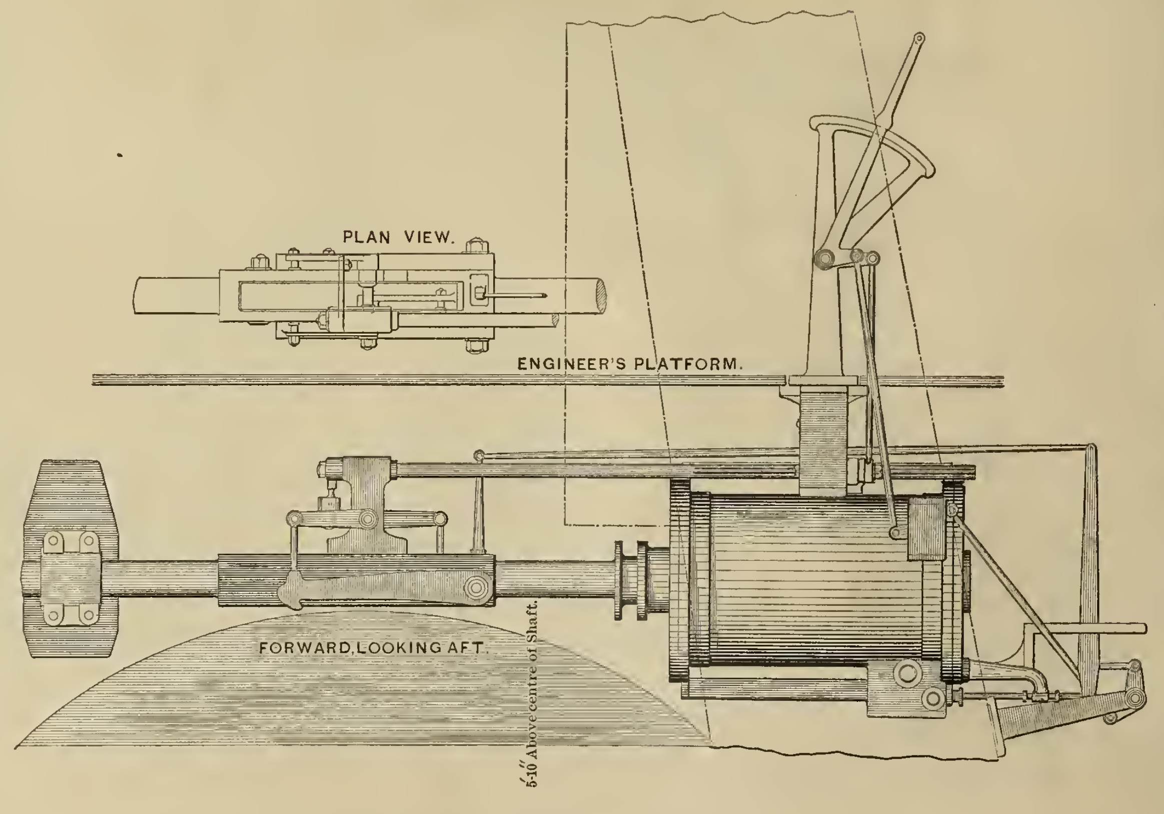
The number of locomotives in use in this country, January 1, 1879, was estimated at 16,445, valued at $164,450,000. The number of cars in use, not including palace cars, was estimated at 498,000, which would cost at least $600,000,000, making the value of locomotives and cars together, $764,450,000. Besides, as much as one-tenth of the total now running must have been rebuilt, say five times, since 1830, at a cost of $382,225,000, making a grand total of $1,146,675,000. But, besides this, we have built locomotives for export to all parts of the world, owing to the recognized superiority of the American locomotive.

The Baldwin Locomotive Works alone sent out of the country, from 1870 to 1880, over 520 locomotives, 152 of them to English colonies; and of all the locomotives used in the English colonies, from 95 per cent. to 98 per cent. were built in the United States.

The United States have exported since 1870, $20,000,000 worth of locomotives, and double that amount of cars.—*Unknown Source.*

Persons who fancy that wetting coal increases the heat in the furnace may be interested to know that a series of tests was made recently at Bochum, Germany, to determine the values of wet and dry bituminous coal in making steam. Washed slack, holding 18 per cent. of water, and 9.9 per cent. of ash, evaporated 5·7 pounds of water per pound of fuel; while the same coal, with only 3 per cent. of water, made from 8 to 8·5 pounds of steam. Making due allowance for moisture by reducing to a standard of like quantities of coal, free from moisture, there is found to be a direct loss, by using wet coal, of 14 per cent.

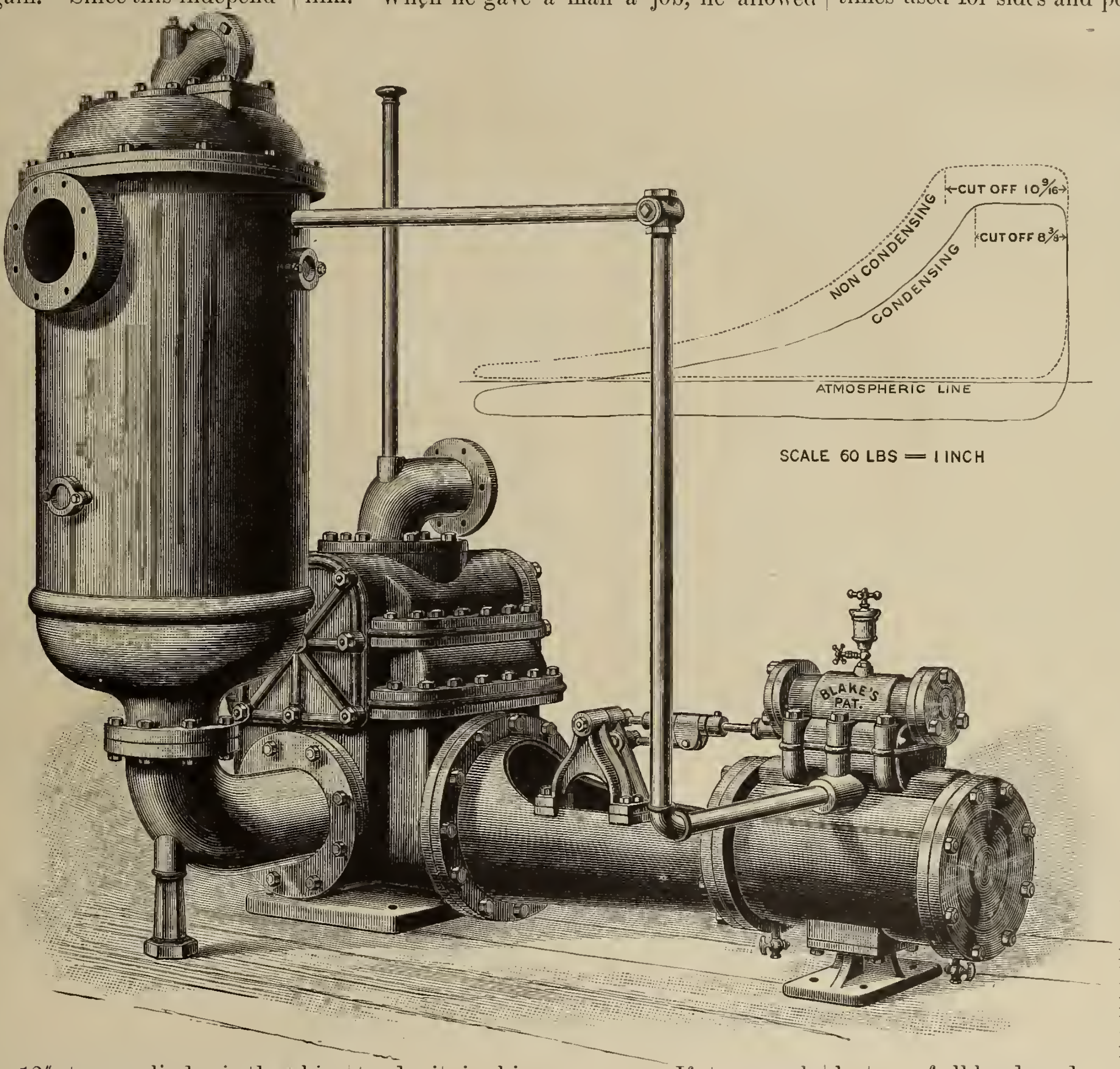
The best quality of charcoal is made from oak, maple, beech, and chestnut. Wood will furnish, when properly charred, about 20 per cent. of coal. A bushel of coal from pine weighs 29 pounds; a bushel of coal from hardwood weighs 30 pounds; 100 parts of oak make nearly 23 of charcoal; red pine, 22.10; white pine, 23.



TURNING ENGINE S. S. "EXCELSIOR."

BLAKE'S PATENT INDEPENDENT AIR-PUMP AND CONDENSER, FOR STATIONARY AND MARINE ENGINES.

The increasing use of condensers for stationary engines, has led to the adoption of independent apparatus for this purpose, as being more economical than when worked direct from the engine, and more available for maintaining a vacuum at all times, whether the engine is running or not. That this is a valuable feature in all cotton or grist-mills, and particularly with high-speed engines, will be admitted. It sometimes happens in stopping at noon that the fixed condensing apparatus gets hot, from leaky valves, and the vacuum refuses to form. This is a source of loss through delay, for the machinery cannot be put up to speed, from the start, until the condenser is cooled again. Since this independent apparatus has no mechanical connection with the engine, a vacuum can be maintained constantly if desired, and the main engine speeded at once.



Not the least valuable feature of this independent apparatus, is the annoyance, which frequently occurs with condensers and air-pumps connected with the main engine, from unknown leaks.

Where pipes are under ground, or in out of the way places, leaks are hard to detect, and a very trifling one is the source of great expense. All the connections to this independent apparatus are in plain sight, are faced joints carefully made, and air leakage is impossible; if it were possible it could be located in a moment.

Our readers, being engineers, can readily see the many advantages in the use of apparatus of this class without further mention. It goes without saying that they are well-built, All sizes can be had from 4½″ to 12″ steam-cylinder in the apparatus itself, or of any size demanded. It can be used wherever a vacuum is needed, for any purpose, and is as applicable to marine engines as to stationary. Large numbers of them are in use everywhere.

Geo. F. Blake Mfg. Co., New York and Boston, supply them.

◆

Messrs. Edw. P. Allis & Co., of Milwaukee, Wis., recently sold the Dayton National Home, at Dayton, Ohio, an 18 × 42 Reynolds-Corliss engine. Messrs. Laird, Norton & Co., the prominent lumbermen of Winona, Minn., have recently bought a 20 × 42 Reynolds-Corliss engine; and Messrs. Youmans Bros. & Hodgins, of Winona, Minn., have just ordered a 30 × 60 Reynolds-Corliss engine, with 42′ × 14′, Reynold's Patent feed-water heater and purifier. These parties purchased one of the first Reynolds-Corliss engines which were built by Messrs. Allis & Co., and after running it steadily for over three years, have shown their appreciation of its merits by ordering a second and much larger engine. In addition to the above Messrs. Allis & Co., lately received an order from Lambert & Bishop, of Joliet, Ill., for a 28 × 48 Reynolds-Corliss engine, to run their Barb Wire Fence Works.

◆

Mahoney's Patent Furnace has been fitted to two boilers 100 horse-power each, in H. B. Claflin & Co.'s large dry goods house; the Passaic Bleachery have also put in one, and will change their old boiler to Mahoney's system. Tarrant & Co. have also put in one, and credit the Mahoney system with large saving. Peter Adams, of Newburg, New York, has just sent a third order for the same.

◆

THE BEST FOREMAN.

The best foreman the writer ever knew was a man who had never served a day at the trade. He was a time-keeper, and put in his odd hours in assisting the draughtsman, making tracings, etc. After he had been employed by the company several years he was appointed foreman—for just what reasons I do not know. He was a man of good horse-sense, and never made the mistake of attempting to instruct a man under him. When he gave a man a job, he allowed him to do it in his own way. If too much time was used on it he knew it—his time-keeping came to his aid, and his knowledge of drawing helped him wonderfully. He visited large railroad shops and studied how they did work. He studied the capacity of new tools as he saw them, urged their adoption, and generally with success. If an engine was to be overhauled, he had a gang-boss look her over and inform him what was considered necessary. He then used his common sense and decided the question. He was a gentleman in every sense of the word, a good judge of human nature, and when a man under him needed a word of encouragement he got it. He was generous and kind, but never compromised his dignity by familiarity. He calculated the cost of repairing a piece of work and decided whether it would pay. If it would not, the piece was consigned to the scrap heap. The result was that the period of his formanship was the most efficient and economical of any in the shop management of the road.

Old locomotive engineers, too, who never worked a day at the trade, have been advanced from a round-house engine dispatcher to master mechanic, and have run their departments with more success than if a ten-year vise-hand had them in charge.—*National Car-Builder.*

◆

This number can be had, by those desiring to subscribe, only by immediate application. We do not keep back numbers.

WESTERN FARM WAGONS—WHAT THEY ARE MADE OF.

White oak is the great wagon wood. What is termed live oak is to some extent used, black oak is sometimes made into hubs, and red oak, though made into felloes occasionally, is generally rejected. In oak, the sap or white portion is comparatively small, and is avoided so far as possible, the heart alone being serviceable. Sawed oak felloes, shafts and poles are steamed and readily bent on forms by means of powerful modern machinery. The sides to a box are invariably of whitewood, the yellow variety being preferred. Pine generally goes into wagon bottoms, and whitewood in buggy bottoms, while ash bottoms are put into grain wagons, and in some other kinds, and the same lumber is sometimes used for sides and posts.

For sleds, oak is mainly used, and elm and basswood in cutters, the knees and beams being generally constructed of hickory. A great deal of bending is necessary in this class of stock, but the machinery used for the purpose is equal to the emergency. No splitting need be done, a stick five or six inches square being systematically handled. The raw material for a bob-sled can be bought for about $5 at a wholesaler's, and that for a cutter for about $4. A cutter ready for ironing is sold for from $10 to $15.

The various items of wagon and buggy stocks are generally turned out from green lumber, and subsequently thoroughly dried. About a year and a half of careful seasoning is necessary, and this must be in the air. Kiln-drying virtually ruins timber for this purpose, the heated sap soon scalding the life out of the lumber. This by many, is thought to be true of all hardwoods. After the stocks have been properly air-dried, the kiln may be safely brought into service sometimes to complete the job. Stuff that is kiln-dried while more or less green is bound to be rejected. The custom of kiln-drying sawed felloes, once in vogue, has been abandoned almost entirely.

A good many cheap buggies are made and sold. Cincinnati has made a record for cheap buggy manufacture, which constitutes an unenviable notoriety. There are makers of buggies in the country who will readily buy from manufacturers of stocks, poor and culled stuff which has been rejected by decent consumers, and has accumulated on the hands of the holders, and these goods are turned into buggies, though the wood is a small item compared with the other materials and labor going into a buggy. The usual run of prices for buggies is from $75 to $300, though the Cincinnati cheap make has been sold as low as $35. Lumber wagon sells for from $65 to $100. The wood for a buggy, exclusive of box, costs usually from $7 to $10, and that in a common wagon from $8 to $12. An important item in stocks is a patent wheel, which is furnished all ready for tiring, saving time and bother, and an immense number are sold to the smaller wagon and buggy-making concerns.

The most extensive wagon works in Chicago turn out about 7,000 wagons annually, while the largest factory of the Studebaker Brothers, at South Bend, Ind., will turn out probably 12,000 wagons in a year. It is estimated that Chicago makes annually about 15,000 farm wagons, and in the neighborhood of 25,000 wagons all told; the amount of lumber consumed in each vehicle running from about 150 to 400 feet.—*Northwestern Lumberman.*

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

THE LINK MOTION.

Editors Mechanical Engineer:

Having observed the patience with which you answer questions in your valuable journal, I take the liberty to ask a few.

What is the rule for ascertaining the circle and length of an engine reversing-link?

What is the rule for ascertaining the circle and length of a sword arm for a graduating cut-off?

What is the rule for ascertaining the size of boiler necessary to supply an engine of any given dimensions, allowing the engine to work at full power.

By answering the above you will greatly oblige a reader. J. B. Brown.

Cleveland, O.

[Our correspondent puts leading questions on the link-motion, not to be answered within the limits of this page Planning a link-motion correctly is an intricate process to describe, and cannot be disposed of in a few lines. Very many more things depend upon its correct design than are commonly supposed to. The lead, for example, and equalization of the cut-off at different points in the stroke. While it is possible to construct a mere curved connection between two eccentric rods, and hang it so that it can be shifted from go-ahead to back, yet unless attention be paid to the principles involved, the action is never satisfactory, or at least not what it should be. Auchincloss', "*Link and Valve Motions,*" is the best work on the link-motion extant, and we refer our correspondent to that for an able explanation of it.

Briefly the arc of the link is struck from the center of the main shaft, and its length governed by circumstances. That is to say, convenience for one thing; the shorter the link is, the greater is its angle, (with a given throw of eccentric), and the greater the disturbance of the motions caused by the two rods moving in contrary directions. Conversely, the longer the link is the less disturbance.

A sword-arm is a fixed link, and its arc (or curved surface), is described from the center of the pin in the cut-off valve-stem, to the center of suspension, or pin, the arm works on, when the main crank is on the center. The lead is distorted, however, to some extent at all points, except mid-gears, the same as with a shifting-link.

Conventional rule for boiler, for given engine, is: tubular boiler, per H P; 10 square feet heating surface; ½ square foot grate surface; 10 square inches sectional area of tube; 13 square inches flue surface, or area; 7 square inches chimney section; 8 cubic feet total capacity (steam and water,) of boiler; 2 cubic feet in steam room.—Eds.]

KIND WORDS FROM OVER THE SEA.

Editors Mechanical Engineer:

Inclosed find first of exchange for $2.50. I wish you would continue to send me The Mechanical Engineer. I am here manager of "Wiborg's Iron Works," and I am especially well pleased with your paper. It grows better and better. I hope to be able to send you, next year, some sketches and drawings that perhaps will interest you. I keep three American mechanical papers, but I really think yours the best, or at least the most interesting to me. We build a good many steamers, especially such as are adapted for river navigation and high speed.

Wiborg, Finland. A. H. Lindfors.

[We are sure our readers will join us in hoping that Mr. Lindfors will not forget his good intentions. The designs of foreign engineers interest us greatly. For his kind wishes we return sincere thanks —Eds.]

A LEAKY JOINT.

Editors Mechanical Engineer:

I have a joint under a steam-chest which I cannot keep tight. It was first made with paper, since then I have made it a number of times with putty and paper, once with sheet lead. I am now going to try rubber, but do not think it will stand. Please tell me what is best, and how to use it; if a copper wire, should there be a groove cut to lay the wire in, and what size wire by the rule, not gauge? I would rather not use a wire if I could get anything that would do.

Brooklyn, N. Y. F. A. Jones.

[Our correspondent should not have any trouble in keeping this joint tight, if the faces are in any sort of condition. Where they are not, Jenkins' patent packing answers well, as it accommodates itself to inequalities of surface. No groove need be cut for wire joints, but these are useless unless the joint-faces are planes When they are, a copper wire, annealed, one-tenth of an inch diameter answers well.—Eds.]

ROUND ENDS ON SLIDE VALVES.

Editors Mechanical Engineer:

You can't go behind the tests The rounded edge gives quicker steam.

The end of a slide valve *is* one side of a rectangular orifice, with irregular and shifting sides.

Philadelphia. Gamma.

[We have no desire to go behind anything; tests not excepted. Where are the tests? We are always pleased to hear from Prof. Gamma as he has something to say, but in this instance, if the end of the slide valve forms one (shifting) side of an orifice, and should be rounded, then the opposite end of the steam port is the other side, and that should be rounded! This might lead to complications.—Eds.]

LEVER CUT OFF.

Editors Mechanical Engineer:

There is a dispute in regard to the shape of Lifters or "Knockers" on Lever Engines working with eccentric cams. Some contend that they can be made to cut off steam at any desired point, the lifters being in contact with levers all the time. Others contend that the only way to cut off steam at ¾ or ⅞ is by giving lost motion, so that the lever will be at rest a portion of the time. The case in hand being a Lever Engine, 5½ feet stroke, eccentric 6" throw. I want to cut off at ¾ stroke. Clearance between lever and lifter 1½". Now there are some that maintain that a lifter can be shaped so that it will cut off without this space, or lost motion, between levers and lifters, with the eccentric cam.

Please give us your opinion of same through your paper and give the Marine Engineers using this kind of engine a chance to speak their minds on the subject.

Heretofore engines of this kind have had but little said about them, and I hope engineers on our Western waters will not be backward in ventilating this subject.

Pittsburgh, Pa. Orizma.

[Steam can be cut off at any point in the stroke by the "lifter" according to the manner in which it is adjusted with relation to the eccentric. The *time* of closing the valve (another matter entirely) varies with the shape of the face of the lifter Stevens Cut-off, as this arrangement is called in this vicinity, has the steam toes (or lifters) much longer than the exhaust toes (lifters), and the faces of them are also less curved. As a result the toes commence to lift the steam valves close to the rock shaft and drop it quickly, owing to the flatness of the faces on them. It is not necessary to have any lost motion between the toe, and the lifter on the lifting-rod, where an eccentric is used.

Custom on the Western rivers retains the cam in lieu of the eccentric, and some peculiarities in the valve gear. The cam, it is claimed, lifts the valves quickly and throws the steam right on the piston from the start. but this is no benefit, for the crank is not in position at that time to use the force of the steam. The cam possesses no advantage not obtained by the eccentric, as indicator cards, infallible tests of valve motions, show.

Steam "cut off" at three-fourths or seven eighths of the stroke is pretty near full stroke, is it not?—Eds.]

SOMETHING FOR NOTHING.

Editors Mechanical Engineer:

Notice.—Any parties who will write for particulars and give assistance, I will put in possession of three valuable and notorious inventions *for nothing.* Men of influence and business abilities wanted, makes no difference whether they have much money or not.

Vernon, O M. Kurtzeman.

HIT THE BULL'S EYE.

Editor Mechanical Engineer.

There is an article in The Mechanical Engineer, page 144, No. 12, Vol. IV., entitled "*Retailers of Engineering Information,*" which hits the nail square on the head.

I will give you an example of the "humbuggery" that is practiced on innocent inventors. There was an article written by one of the class named and published in *Mechanics*, persuading steam users to apply the plan of a net-work of fire-brick over the top of the bridge-wall. I have two patents on that principle and "smelt a mice!" A few issues subsequent I found six engravings setting forth my principle, but with the special feature of value placed *at the back end of the boiler* instead of where it would do good * * * *

I have another patent about to issue and if the re-inventors pirates, and other sharks, copy it I think I may as well abandon it.

John Mailer.

San Francisco, Cal.

A QUERY.

Editors Mechanical Engineer:

A belt will run off even a crowning pulley, if the shaft is sufficiently inclined in the same plane as the other shaft.

Let me ask what would happen if the shafts were inclined not only in one plane but in two?

Philadelphia. R. Grimshaw.

AN OBSERVANT CORRESPONDENT.

Editors Mechanical Engineer:

Inclosed please find my subscription for next year. I think every mechanic should support your valuable paper, and this is why: Because it instructs and does not mislead the inexperienced. When a mechanic writes to its Editors, relates his experience and asks for information, they do not insert his letter in their columns, using very bad grammar, showing up their correspondent's want of education, and then very cunningly inform him that he is ignorant, and half answer his questions in language which bewilders him, nor do they refer him to some book, which would, to him, be like Greek, for a more elaborate explanation. On the contrary, they point out his mistake in an inoffensive manner, and show him how to remedy it, using the simplest language.

The Mechanical Engineer does unto others as it would have others do unto it, and while it does it must flourish, and have the support of all honest-minded men.

Wishing you a merry Christmas and a happy New Year, I remain,

West Newton, Mass. James R Condrin.

[Mr. Condrin has a very clear idea of our creed, and his kind wishes are heartily reciprocated.—Eds.]

MARINE ENGINEERS OF CHICAGO,

M. E. A., No. IV.

ASHORE.

Andrew Ritter, Pres't, Foreman Excelsior Iron Works.
John Brown, Treas., St. Paul Elevator.
Dan Wise, Financial Treas., Iowa Elevator.
Geo. White, Carson, Perry & Co., Building.
Anthony Gillespie, Field & Co. Building.
Thomas Bryant, Bank.
Michael Stapleton, Clothing House.
F W. Whitehouse, Engineer, Large Distillery.
T. C. O'Connor, Rec Sec., Washington St. Tunnel.
William Lundy, ———.
James Donnelly, carrying on Steam-fitting business.
J J. Eaton, Wabash Ave.
E G Seavert, *Evening Journal* office.
John N. Schemaker, furniture business.
J. O. Neill, saloon.
William Ponsonby, } Star and Crescent Mills.
John McDonald, }
Joseph Young, St. Louis Elevator.
C. W. Bernard, Central Elevator.
Burt Bailey, } Tarrant's Machine Shops.
Robert Gale, }
Thomas Hogan, Thompson Block.
George Spearer, } Rolling Mills.
John Tinncanc. }
Morris Shay, Wool Cleaning Works.
Geo. Furness, in merchant business.

Not having the list before me, I may have omitted some of the brothers, but not intentionally. A large portion of the positions held by members are very responsible. In future I will give names of brothers sailing.

William Ponsonby.

FIRST CLASS RIVER ENGINEERS OF ST. LOUIS, MO.

We continue our list of marine engineers and their whereabouts, and shall be glad to publish any others that may be forwarded.

Wm. Albert, 20 Targe St., St. Louis, Mo.
W. Alford, 1409 St Ange Ave., St. Louis Mo.
Boon Allen, Upper Alton, Ill.
Jno. Ashton, 617 South Fifth St., St. Louis, Mo.
Preston Bish, Venice, Ill.
Jas. Benson, 2919 South Seventh St., St Louis, Mo.
Chas. Blanchard, 3220 Easton Ave., St. Louis, Mo.
H. H. Blandelle, 1112 North 22d St., St. Louis, Mo.
Geo. Peters, 2018 Orange St, St. Louis, Mo.
Chas B Farrell, Box 947 Sioux City, Iowa.
R. P. Fairchild, 3061 Penrose St, St Louis, Mo.
Geo. Faulks, 516½ Pine St, St. Louis, Mo.
Wm J. Fry, Jr., 1627 W. Montgomery St., St. Louis, Mo.
John Hartape.
S. N. Hicks, 1922 Sidney St., St Louis, Mo.
Jno. C. Moor, 1628 Benton St, St Louis, Mo.
Jas McBride, 2725 Thomas St., St. Louis, Mo.
Sam'l Hill, Engineer, "City Baton Rouge," St. Louis, Mo
Geo. Brennan, 3600 North 10th St., St. Louis, Mo.
Jno. M. Cobbil, 203 Maiden Lane, Quincy, Ill.
Bernard Duffy, Anchor Line Wharf Boat, St. Louis, Mo.
Jno. Bruce 2000 Sidney St., St Louis, Mo.
Oliver Richey, foot of Victor St., St. Louis, Mo.
Chas Evans, Box 263 Keokuk, Iowa.
B. R. Fuicher, 7 Morgan St, St. Louis, Mo.
G. J. Farrell, 2411 North 15th St., St. Louis, Mo.
Fred Grapevine, West St. Louis P. O., Mo.
Jas. Dallas, Sixth and Philmore St., Carondeler, St. Louis, Mo.
R. M Gardner, 55 Huur Ave., St. Louis, Mo.
Asa B. Hamilton, 1216 North Sixth St., St Louis, Mo.

SAFETY VALVES.

There are many appendages to steam boilers, falsely called safety valves, that are next to useless to infallibly perform the duty for which they were designed.

I have often seen safety valves that would allow the pressure to increase from 15 to 20 per cent., after the valve began to blow, before it opened sufficiently to prevent a further increase of pressure.

There are various causes for this. Insufficient area and lift of valve, corrosion, also friction of the various parts that constitute a safety valve, are some of them. Levers, improperly proportioned, are less reliable and subjected to more friction than those more carefully designed.

Never use a taper pin in hanging a valve lever, but use a nicely turned and hardened steel pin; have a collar turned on one end, and a thread and nut on the other. Have the nut screw up against a shoulder on the pin, so that by screwing up the nut it will not pinch the lever and cause friction. Be sure that the stem slides easily, and is of a material that will not be acted upon by corrosion. The valve and its seat should also be constructed of some non-corrosive material. Keep the valve tight by frequent grinding.

Safety valves of the ball and lever type are most unreliable, and there is no good reason why their use should not be abandoned for those of improved design.

It should be considered bad engineering to attach a safety valve to a boiler with a lever so long, or a weight so heavy, that by slipping the ball to the extreme end of the lever the pressure would increase beyond the safe pressure of the boiler before blowing off. This would, of course, necessitate proportioning the length of lever and weight of ball to correspond with the factor of safety of each boiler of different material, diameter and thickness.

Every boiler maker should see that the area of the safety valve is proportioned to the heating surface, or the amount of water the boiler is capable of evaporating, and that the weight of ball, and length of lever, is proportioned to the safe pressure of each boiler, and not beyond it, before the boiler leaves his hands. Then he will be in no way responsible if the valve is ever overloaded.

Smoke Arch.

Beverly, Mass.

HOW WOOD PAPER IS MADE.

Of all the materials in daily use there is probably less known about paper than any other, although it is constantly about us and being used in a thousand and one ways.

Paper can be made of any fibrous material, but the most commonly used substances are wood, manilla, straw, jute, linen and cotton rags.

None of these materials resemble paper very much, and perhaps none seems less likely to produce a fine grade of it than wood, yet wood is capable of being made into excellent writing or printing material.

To produce a good strong paper it is necessary that the fibre of the raw material be preserved, and to disaggregate it, without destroying it, a somewhat circuitous process is necessary.

At Mapleton, Pa., there is a mill where paper is made from wood, and in this mill there is a machine resembling in appearance a large cheese box about six feet in diameter, standing on its edge. In this cheese-box there revolves at an enormous speed a strong iron disk, armed with a great number of sharp steel knives which cut up the wood into shavings similar to those made by a draw-knife. While we were looking at this machine an attendant picked up a heavy stick of cord-wood, which he placed in an inclined trough at the side of the machine and shoved it into the same. In a twinkling the log had disappeared and a second was sent after it, quickly followed by a third. Although it may seem incredible, that machine reduced those heavy four-foot sticks to shavings at the rate of three a minute!

These shavings are carried off by a conveyor to the "boiling-room," where they are boiled for several hours in caustic soda—"soda lye"—which combines with all the resinous matters in the wood and reduces it to a mere fibrous pulp. This pulp is next run into the "washing machines," which are oval tubs about fifteen feet long and six or eight feet wide, having a longitudinal partition in the middle, extending nearly the entire length of the vat. In one of the compartments thus formed there is a "beater" composed of a number of steel blades with rounded edges, which revolve at a high rate of speed between stationary blades in the bed-plate below. In the other compartment there is a "washer" which consists of an octahedral frame covered with very fine wire gauze and inclosing a sort of water wheel. The washer runs in the opposite direction to the beater, but very slowly, and the result is a constant current of the pulp up one side of the machine and down the other. A stream of water is constantly flowing into the machine and the water wheel in the washer is as constantly scooping it up and emptying it through its hollow shaft. The beater forces all the dirt and foreign matter out of the pulp, and the washer removes the dirty water so that the fibre becomes thoroughly cleansed. It is now removed to another machine similar to the first, where it is bleached by means of "chloride of lime" and muriatic acid. The "washer" is dispensed with during the bleaching. After the bleaching comes another washing to remove the chemicals from the fibres, and the pulp, thoroughly softened and mixed with water, is drawn off into storage tanks, whence it is pumped into the paper machines. At one end of the latter is a box into which the pulp is pumped from the tanks. This box has a fine horizontal slit from which the pulp flows in a steady stream on to an endless wire gauze apron, about six feet wide, which is constantly running away from the box. The rollers over which this apron runs have an "end shake" similar to that of a grain separator. The apron runs over a copper "suction-box" having numerous holes in the top, and from which the air and water are constantly being exhausted. The effect of the suction-box is to remove most of the remaining water from the pulp, which by this time resembles a wet sheet of paper. The damp sheet is now taken up by a felt blanket and carried over steam-heated drums. By this time the paper is strong and dry enough to support itself, so it leaves the felt and passes unaided between the highly polished calender rolls, which smooth it and give it a hard surface. It is now rolled up ready to be removed to the cutting machine, where revolving knives reduce it to sheets, which are piled, sorted, and counted and bundled ready for shipment,

If a fine paper is desired the roll in place of being cut up into sheets is reground in a "rag engine," similar to the washing machines, still further bleached and washed, and sent through another "Fourdrinier machine," whence it issues as pure white finished paper.

The "size" which gives paper its glossy finish is introduced into the pulp while it is in the last washing machine.

At the West Newton paper mills, rolls of paper four miles long are regularly made, and rolls *nine miles long* have been made from re-ground "wood" paper.

L. O. Danse, C. E.

Pittsburgh, Pa.

Nothing succeeds like success. All who have seen our new departure express the warmest and most kindly feeling regarding the improvements.

It rests with American mechanics and engineers to say what kind of a paper shall represent them most favorably. They will support it fast enough, if it is of the right stripe.

THE "BLOW-OFF" AND ITS LOCATION.

One of the most important parts of a steam boiler is the blow-off. It is also one that is subject to more abuse in its construction, location, and use than almost any other fixture pertaining to the boiler. The most peculiar ideas seem to prevail in regard to its construction and position on the boiler. Some put it at the front end, some at the back end, and some put it in the middle of the shell. The majority also, instead of putting it on the bottom of the shell, where it belongs, insert it through the heads of the boiler, anywhere from two to six inches above the bottom of the shell, thus rendering it impossible to entirely empty the boiler when desired, and greatly impairing its efficiency for any purpose.

The only place for a blow-off pipe to enter a horizontal externally-fired boiler is through the bottom of the shell within a foot or so of the back head. The boiler should be set slightly lower at the back end than at the front, say three-fourths of an inch for a boiler 15 feet long. Then it may be entirely emptied by simply opening the blow-off valve, and all syphoning of water out through hand holes is obviated.

This, however, is not the most important reason for locating the blow-off at the back end of the boiler. In a horizontal, externally-fired boiler the application of the heat, and the resulting circulation of the water, is such that the sediment is always deposited at the back end to a much greater extent than in any other part of the boiler. Obviously, then, this is the place for the blow-off. It is true that most boiler-makers now place it there, but there are many who still persist in placing it at the front end.

The proper method of constructing and attaching the blow-off pipe to the ordinary horizontal boiler is as follows: First, the pipe should be 2 inches in diameter. A circular piece of boiler plate about 8 inches in diameter should be riveted on the bottom of the shell, with its center not over 12 inches from the back head. The hole for the pipe had better not be made until after this piece is riveted on, and then it should be drilled. If, however, facilities are not available for doing the job in this way, it may be drilled before it is put on. The hole should then be tapped when it is ready for the pipe. The rivet holes on the inside of the shell should always be countersunk, and the heads of the rivets driven flush with the inner surface of the plate. If this is done there are no projecting rivet heads to assist in the collection of sediment at this point. A blow-off attached in this manner and provided with a straight-away valve, outside the setting will always give perfect satisfaction if properly cared for. In many cases, however, where the water is bad, they are not opened often enough, and the inevitable consequence is that they soon become filled up with scale and sediment. When this occurs it may always be regarded as the best possible proof that it is located in just the right place, and, if properly attended to, will prove most effective in keeping the boiler free from scale and sediment.—*The Locomotive.*

According to the *Railway Age* these figures represent the number of miles of road operated by the several companies: Pennsylvania Railroad, 6,438 miles; Missouri Pacific system, 5,772 miles; Chicago, Milwaukee & St. Paul, 4,500 miles; Chicago, Burlington & Quincy, 4,068 miles; Union Pacific, 3,873 miles; Chicago & Northwestern, 3,500 miles; Wabash, St. Louis & Pacific, 3,425 miles; Grand Trunk, 3,300 miles; Central Pacific, 3,100 miles.

Coming down to a single corporate organization under one title, with one list of officers for the whole system, the Chicago, Milwaukee & St. Paul takes the lead with its 4,500 miles.

The "*Automatic Safety Boiler and Engine Company*," of Sheldon, Conn., has been organized with a capital of $100,000. The boiler is the invention of Prof. W. P. Trowbridge, of Columbia College.

The man who will get up an inverted stuffing-box, that will trap its own condensation, will receive the thanks of millions yet to be, and possibly something more substantial.

We are waiting very patiently to hear that the locomotive which is to be run by hydrogen alone is a success. Much time and money have been spent on this machine, but we do not hear of any results.

The market price of crude rubber has been forced up to $1.25 per lb. Six years ago it was 48c.

THE
Mechanical Engineer.
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NEW OUTFIT.

We hope our friends will permit us to take time by the forelock, in this instance (on account of our date), and wish them a Merry Christmas and a Happy New Year. Also, we modestly point to our new clothes and hope they will please. Everything is new and made especially for this occasion. New head, new type, new subscribers, new advertisers, and with these, lots of the old ones to keep us company for another year.

We do not wish to appear as exalting our horn, for it is written: "*The horn of the ungodly shall be exalted,*" and we do not rank in that class, but we may be pardoned for an expression of satisfaction at the progress made in two years. From an inauspicious commencement in 1880, and a modest subscription list, we have, as soon as our aims were comprehended, risen to a handsome paper, an extended circulation, and cordial recognition from contemporaries. To these last we owe much of our prosperity, and we publicly acknowledge our indebtedness.

To our subscribers, who, with almost one accord, have not only renewed their favors, but brought other friends with them, we can only say that we think THE MECHANICAL ENGINEER will be found of greater interest during the year to come than it has in the past. Certainly this issue gives some evidence of our intent, and future issues will give much more.

Notwithstanding all the changes and enlargement, which in a year's issue is an expensive matter, the price remains the same. We do not know whether it is the "largest paper in the world," or the "biggest in circulation," but we do know that we find a steadily increasing sale for THE MECHANICAL ENGINEER in all quarters. By far the largest part is through the mails. A very small proportion of our circulation is through news-stands. As every publisher of experience knows this last is not a paid circulation, but depends on the chance of the moment, or the latest fancy of readers. One mail subscriber, who pays his money for his paper, is worth four casual buyers to the trade everywhere.

THE MECHANICAL ENGINEER has not merely held its ground, it has very materially extended its boundaries.

Clubs of nine, last year, are twenty-one this year, that is, all the old names renew and twelve others take a hand in, so to speak. Clubs of four are seven and eight, and in some shops in this country THE MECHANICAL ENGINEER circulates fifty copies, where there are only one hundred of all trades.

We submit that these facts are self-evident as to the demand for our paper.

COOL HEADS.

During nearly a third of a century's experience among engineers of all classes, we cannot now recall any individual instance where an engineer was flurried or lost his head at a critical moment. In the time mentioned we have been actors, and spectators, in many cases demanding instant decision for, or against, this or that course; one leading to safety, the other uncertain. As before stated, we cannot recall a single instance where an engineer failed to do his duty through want of presence of mind.

In one case a water tender came rushing up out of a fire-room of a large steamer, headlong into the engine-room, and screamed out that there was not a drop of water in the boilers that he could see. As the vessel had an engine of 3,000 H. P., and was under full headway, with 45 pounds steam on the boilers, this was sufficiently stirring to excite the coolest head, especially as the water tender was known to be one of the best. The engineer in charge turned quickly to an assistant and said: "Mr. Blank, go below, sir, and see what is amiss." Mr. Blank (whom we know pretty well) lost no time, and found that the plug of the cock in the feed-pipe, 4″ diameter, had come out, and the feed-water was going into the bottom of the ship.

He was not slow in putting the plug back into the cock, but the bolt and washer which kept it in place, were nowhere to be found. Mr. Blank screwed his forefinger into the thread on the plug and held it in by sheer main strength against the feed, felt around in the dark with his feet, and luckily stumbled on the nut and washer after awhile. When he came back he was necessarily cool enough, for he was "wet as a drowned rat."

This is a trifling incident, perhaps, but another was much more perilous. Mr. Blank was on watch when a gasket blew out of a hand-hole plate in a steam-chest. The plate was twenty-four inches long, and the piece of gasket which protruded from the joint acted like an organ-reed, and made an awful scream, fit to curdle the blood. In about two minutes, as it seemed, every passenger in the boat, in all stages of undress (it was 2 o'clock in the morning), flattened his nose against the engine-room windows, and swarmed in the gangways, demanding to know what the matter was. The thing had to be stopped at all hazards, and, as usual, Mr. Blank was the man in the gap. A lantern was lowered into the confined space (there was a bulkhead only about four feet from the chest) and instantly extinguished. Mr. Blank armed himself with a lot of pine wedges, about an inch and one-half wide, and descending into the hell of steam, with his mouth shut, jammed the wedges in and stopped the noise.

This sounds all very simple in telling it and reads very matter-of-fact, but the execution was no trifle.

Mr. Blank is only a typical engineer, standing for the fraternity everywhere. Individuals of it perform stirring exploits every day, without any other thought than that it is their duty to.

Any one who has stood by and heard the bells struck by pilots, sometimes, for the engineer's guidance, can see how necessary it is for an engineer to keep a level head. Stop, back, go ahead, stop again, all in one continuous jingle, and just when going into dock, with a heavy ship, is enough to turn any ordinary man grey with anxiety. Except in a few instances, when there is positive conflict of orders, the engines move as the bells strike, and what is a mere jargon of sounds to an unitiated ear is rendered into sense by the engineer.

Situations of absolute peril to property are rendered harmless by the coolness and presence of mind of engineers, who sometimes interpret what the pilot means to do, when he actually gives the wrong bells, thinking he is all right.

MACHINE FINISH OF THE DAY.

The critical observer who compares processes of the present with those of a quarter of a century ago, cannot fail to be struck with the very great advance in the matter of finish that now obtains. Whether this is due to the greater precision of tools, the better education of workmen, or the demands of customers, are questions we cannot decide, but the fact remains, as we have stated.

It is particularly apparent to us, who are personally familiar with all the processes through which the finish is obtained, and also for the reason that, being now apart from such operations, it strikes us with greater force. The engines of the *Excelsior*, illustrated on the first page, afford the text for our remarks, but there are plenty of other instances familiar to us of equal strength. The engines alluded to are as handsomely finished in all parts as if they were to be put on exhibition. Yet she is only a freight steamer. Even the shaft is water polished in the lathe, with a tool, for its whole length, while the valve gear and its adjuncts have perfect surfaces. This is the point—the surface. Without that no finish can be had. We do not allude to a mere scrub of gloss, put on with emery paper, but fair, true planes on flat surfaces, regular curves in fillets, and no apparent connection where one joins the other.

We say again that the finish of metallic surfaces on the tools and engines of to-day is far better than it was on the average thirty years ago. Then it involved great labor and time. It meant dexterity with the file and the chisel, and it is no doubt in a great measure owing to the supplanting of these by planers, shapers and emery wheels, that the fact noticed becomes commercially possible.

MECHANICAL EDITORS.

Mechanical editing is peculiar to itself, in that it demands the solutions of questions promptly. It calls for dissertations adapted to the popular taste on subjects germane, and it is required that the conductors shall be conversant with the details of what is now done, and what has been done in certain specialties.

There is little time to hunt up authorities and none at all to seek for inspiration. Whatsoever is to be done must be executed at once, at the point of the pen. Theory, practice, and the crude speculations of others must be looked after, and a balance struck between the possible and the impossible, and all this without error or gross mistake.

One man writes, but thousands read. Cold type is merciless and holds blunders imperishably, knowing all this the mechanical editor should be extremely careful. He would be more than human if he never erred. To write one essay a week, to polish, eliminate, study authorities, and elaborate sentences is a small matter. It is an entirely different thing to write five or six articles a week, to say nothing of miscellaneous business, and endure the steady grind that is inseparable from the profession.

Sisyphus was a fabulous being of mythology, condemned to roll a heavy stone for ever up a hill. So soon as he reached the top it came thundering down, and all his work had to be done anew. An editor is like unto him. No sooner is one issue published than another claims his attention—has claimed it in fact; he carries on two at once, and his labor is never done. Were it not that it is to him a labor he likes, a congenial task, he would break under the strain.

The demand for editors for mechanical papers is increasing. There are but few in the country, and when one is wanted it is difficult to get one. The demand will increase rather than diminish, and it offers openings to ambitious young men capable of honest, conscientious work.

Mechanical editing, however, is slightly different from editing mechanically!

THE REAL PLAINTIFF.

Our esteemed contemporary, *Mechanics*, observes as follows:

> "There is a general complaint among inventors that railway companies do not want anything. No matter how good an invention may be, no railway man wants to see the invention or the inventor, nor does he even care to talk about it. The inventor may promise to haul a train of cars from New York to Washington, not only without expense, but to make money by selling water from the water tanks to people along the line, so as to make running the trains a double source of economy, yet the railway man consigns the inventor to the fire-box of eternity, and proposes to see him well on his way in that direction. The poor inventor feels that he does not deserve any such treatment, complains, and wonders why it is such hard work to deal with railway men. If he does succeed in making a really valuable invention, why is it that he must put it on trains himself, watch it at every step of the way, and do this all at his own expense? That it is so, every inventor and every railroad man knows perfectly well."

This does seem to bear rather hard, in some aspects, but suppose we look at the other side—the Master Mechanics, how does it appear then? Something like this: The M. M. goes over to inspect an engine under repair, and is met on the way by some enthusiast who proposes to teach him how to make a balanced slide-valve, perhaps. He insists upon an examination, there and then, of his model, which, in many cases, proves to be a repetition of ideas the M. M. has seen tried, and seen fail, time and again. It is of no use to argue with the inventor, to tell him he has nothing new; he came on purpose to convince the M. M. that he had. The only thing to be done is to walk away and leave him.

Before the Master Mechanic gets half way across the shop another man pounces on him from a side door and wants him to look at something else, and this sort of thing goes on, day in and day out. Alternate this with visits from oil salesmen, waste men, general supply men, iron men, machine men, and a dozen others of miscellaneous callings, and our contemporary sees at once, that something must be done in self-defense.

This is sober sense, as every one who has ever had any connection with a railway-repair shop knows. Unless our contemporary has been there, it can have but little idea of the trials Master Mechanics are subjected to.

As a rule railways do not need half so many inventions as some think. The necessity for a great many, exists in the minds of those who think they have a fortune in sight, and want to use the railroads as a means of quarrying it out. Further, when a man has a really useful thing, there are ways enough to get it into use if he knows how; but the inventor should not complain, vicariously, through our esteemed contemporary, that, like most of mankind, he must earn his bread before he can eat it. The Master Mechanic should be the plaintiff.

The Hotchkiss Boiler Cleaner is being introduced rapidly into large iron works, the Reading Iron Works having now thirty of them in use, with twenty more to put on. Twenty were also recently sent out to Cuba.

OUR LECTURE "BUREAU."

Stationary Engineers' Associations, who desire addresses this winter from prominent and capable lecturers in their specialties, can obtain terms and dates by writing us. Prof. J. E. Denton, instructor in Experimental Mechanics and Shop Work, Stevens' Institute of Technology, Mr. Alfred Wolff, of Wolff and Weightman, consulting engineers, N. Y., Mr. William Lee Church of the Westinghouse Machine Co., have signified their willingness to address our friends. These gentlemen, while thoroughly versed in their professions, will bear in mind the fact, that "words of learned length and thundering sound," are out of place at all times, and never more so than to audiences of working engineers. What they have to say will be of direct value every day, and so put forward that men can profit by it immediately. Mr. Church, in particular, has a happy faculty of making the indicator tell its own story.

We shall be glad to answer inquiries as above stated, and will make all necessary arrangements for societies. While our caption is "*Lecture Bureau*," it should not be understood as a mercenary consideration on our part. We make no charges, those attaching belong to the lecturers, whose time is valuable and cannot be given gratuitously.

THE COVER.

The cover of THE MECHANICAL ENGINEER was a great advance over its previous naked and unadorned condition. It preserves the reading matter and keeps it clean; and segregates the advertisements so that they stick out bolder than in any other way. They stare one in the face on the news stands, and are read by hundreds of people who do not take the paper itself. Moreover, if any one wishes to bind them with the paper, at the end of the volume, there is no law to prevent him from doing so. Our advertisers seem to appreciate the prominence of them, for, with two exceptions, at this date, all that expired Jan. 1st have renewed their yearly favors. We are sorry that there is so little variety in this department of our paper, but when an advertiser gets a clinch, so to speak, it would be impolite to ask him to let go.

LATEST FROM THE K——Y M——R.

Once more the perennial Keely Motor rears its horrid front! The "vibrating" engine is now nearly completed, and "Mr. Boekel" asserts his "profound conviction" that it will be entirely successful. It does not appear that anything new has been discovered. Mr. Keely's water is still evolving the same old gas—cold vapor at 20,000 lbs. pressure—and he has spoken to the Pennsylvania Railroad Co. about it, and there the dreariest delusion and mechanical fiction of the Nineteenth Century remains. Oscar Wilde has bought some stock, and other maniacs hold some. In the treasury there remains a balance of $58.84. "Mr. Boekel" pooh poohs at Tyndal, Rankine and others of note, and feels that Mr. Keely has greatly discounted their discoveries.

Every one who has anything to do with this machine appears to be permeated with its gas!

NEW BOOKS RECEIVED.

Practical Steam Engineer's Guide,

In the design, construction and management of American stationary. portable, and steam fire engines, steam pump boilers and injectors, governors, indicators pistons and rings, safety valves and steam gauges, for the use of Engineers, Firemen and Steam Users. by Emory Edwards, author of *A Catechism of the Marine Steam Engine, Modern American Marine Engines, Boilers and Screw Propellers.* Illustrated by one hundred and nineteen engravings. Second edition, revised and corrected.
Henry Carey Baird & Co., 810 Walnut St., Phila,, publishers.

Under this comprehensive title the author has arranged a great deal of useful information regarding the various topics named. His style is clear and not prosy, while his definitions are terse and without ambiguity or double meaning. Automatic engines are illustrated by large engravings and the various peculiarities and good features of each explained at length.

Under the head of boilers, the author gives concise directions, derived from the practice of the best constructors, for their proportions, the management of them as regards feeding, firing, etc., are thoroughly explained and elucidated.

A large space is devoted to the indicator, its action and principles, and any one of ordinary intelligence, who knows the first four rules of arithmetic, can work out the tracings of it as deduced from his own machine. We regard Mr. Edwards's work as a most useful one in all branches, and one that should have a very wide sale.

Pattern-Maker's Assistant.

Embracing lathe work, "bench work," core work and sweep work. Also practical gear construction, the use and preparation of tools, together with a large collection of useful tables. Third edition by Joshua Rose, M. E., author of *Complete Practical Machinist.* with 250 illustrations.
D. Van Nostrand, New York, publishers.

This book gives a very good insight into a trade little known by machinists, and affords them an opportunity of acquiring a general knowledge of the art. It is needless to say that this is a very great advantage and benefit, for machinists who aspire to construct, should have an education in all trades pertaining to them. The author begins with the selection of woods and the treatment of it in various stages, and the various tools in use are commented upon and their fitness described. So far as we are capable of judging, the book is a useful one to all interested in work of that class. It is now in its third edition.

American Foundry Practice,

Treating of loam, dry sand. and green sand moulding, and containing a practical treatise upon the management of cupolas and the melting of iron. by Thomas D. West, practical iron moulder and foundry foreman, fully illustrated.
John Wiley & Sons, New York, publishers.

This is a most valuable work to all who are engaged in similar pursuits. It is most comprehensive in detail, and, without doubt, fully sets forth the practice of the day in its line. It is of the shop—shoppy—and deals with its subjects without padding or allusions to matters wholly foreign to it. Mr. West thoroughly understands the details of his trade, and the snares and pitfalls which beset the inexperienced journeyman, who will find in this work the solution of many vexatious and incomprehensible things. Constructors of steam engines, and student engineers, should avail themselves of the author's experience, the out-come of many years of service. Green sand moulding, as relating to casting fly wheels, pulleys, and large pipes, is fully treated, while loam and dry sand moulding, in its various branches, has a large space devoted to it. Mr. West has done good work in this line, and knows whereof he affirms.

Saws.

The history, development, action, classification, and comparison of saws of all kinds with copious appendices, giving the details of manufacture, filing, setting, gumming, swaging, etc. Care and use of saws, tables of gauges, capacities of saw mills, list of saw patents, etc., and other valuable information. By Robert Grimshaw, author of "Modern Milling," "*Miller Millwright and Mill Furnisher.*" Second and greatly enlarged edition, with supplement. 354 illustrations.
E. Claxton & Co., Philadelphia.

Mr. Grimshaw has apparently exhausted the subject of saws in his latest work on them. If he has not, and there is anything more relating to them, we prefer not to see it, for certainly all that anyone can require to know about this tool, is here set before him. The publishers have mounted the book superbly in heavy tinted paper, and copiously illustrated it in every detail. In appearance it is as handsome as a Christmas gift book.

As to the matter, the author says in his preface that he has tried to be thoroughly impartial in mentioning special productions, and that if some receive more notice than others, it is not the fault of the author, who asserts that information was refused after repeated requests. It is impossible for us to give any detailed account of this voluminous work, and we must refer those desirous of it, to the publishers.

The Jarvis Patent Furnace is coming into general use all over the country. It is readily applied to any furnace, set in brick work, and over two thousand furnaces are now in operation. They are principally boiler furnaces, but include soda-ash furnaces, ore furnaces, puddling and heating furnaces, for glass furnaces, gas retorts, and furnaces for burning wet sugar cane, or begasse.

Three of the principal iron and steel works in New England are introducing this system under their puddling and heating furnaces. There is no kind of waste combustible, containing carbon, either wet or dry, that it will not utilize as fuel.

THE PROFESSOR IN THE MACHINE SHOP.

No. XXIV.

Jacob has fallen a victim to a common malady with some who run small shops. He has an idea that by getting up some small article of universal application and utility we can make our eternal fortunes. He is quite positive on this point, and I have had no little trouble in trying to convince him that he is on dangerous ground.

His ideas and arguments are, that the "*Great American Bottomless Wash-tub Company*" started first in a garret, making toothpicks, and little by little branched out into the well-known company whose tubs leak on every floor, and whose advertisements blacken every page. He says that whereas a few years ago these parties were unknown and unheard of, they now roll in splendor, and are comets in the commercial world. It was done little by little, and not all at once, and whatever they have done we can do if we only go the same way about it, and very much more of similar import.

I am perfectly willing Jacob should hold these views, so far as he is concerned personally, but when it comes to carrying them out I bring forth other arguments, and some conversation ensues, as follows:

"Jacob, are you satisfied to let well enough alone?"

"Yes I am, when I know it is 'well enough.'"

"What's your idea of a bird in the hand?"

"Oh darn your proverbs! let's have common sense in this thing; can you show me any good reason why we should not build small light machines for the market?"

"None whatever; if we have the machines to build. If you are going to supply 'long felt wants,' I beg to object most strenuously."

"Well, give me a reason. I own that I have an idea or two in my head which I should like to see carried out, but I won't go on with it, if you object, or I won't urge it against your views."

"As I understand the matter, Jacob, you have an idea of a new invention, and you want to get a patent on it and manufacture it for the market." !

"That's just the situation exactly."

"Well, I have had a little experience in that line, and I will give it to you, and you can judge whether it is policy on our part to go after a bird in the bush. When I was younger than I am now it seemed to me that if I could only get a patent on a new tool, in general use, that my fortune would be made, and holding these views I was not long in getting a patent on a tool as generally needed as flour in a family. It was good, and simple, and cheap, there was no denying that, and I had a few made and sold to test the popularity of them. They took well, and I suppose if I had had time, and capital enough, I could have got up a trade in them, but being without either, I did nothing further, and that was the end of my 'fortune.' I have been thus explicit, in brief, to avoid a long story on a short subject, but I must add that, before abandoning it, I tried to put it out on a royalty, and I tried to sell the patent. The royalty parties were glad enough to undertake it, but I found that their ideas of royalty meant that they were to have about nine-tenths of the profits. Also that the patent buyers expected to buy on their own terms, and bind me not to make, or engage in the manufacture of similar goods for the rest of my natural life. As none of these conditions seemed to me equitable, or just, I concluded to decline them, and have never been sorry since that I did."

"You admit, then, that a trade can be made in small machines if men go about it in the right way." !

Admit it! of course I do. To deny it would be to say there was no such thing as mercantile transactions. Trade is buying and selling, and if a man can buy cheap and sell dear he is all right, no matter what goods he handles. He can go and barrel up acorns for hog-feed, and get rich rapidly, if he is smart enough to get rid of them at a profit. Here's where you bind, Jacob, making a thing and selling it are two entirely different matters. You argue as thousands of machinists have before you (to their cost), that we have certain unoccupied floor-room, and machines, and that to turn these into money, all that is necessary is to get up some specialty and fill up a warehouse with it. Ain't that so? Don't you look at it in that light?"

"Well somewhat; in the main you are right," said Jake. "I don't see why, when we can manufacture a thing on a margin, we should not go to work and do it. There will be a demand for it."

"Ah! now we get at it. You have made my point for me, Jacob. Did you read an article on '*Starting New Businesses*' in THE MECHANICAL ENGINEER lately?"

"Yes I did."

"Well, that covers all the ground. Whoever wrote it had a level head. You say if we can make goods on a margin there will a demand for them. Not so. There is no demand until you, or whoever makes the goods, creates one. That is expensive work. It means advertising, agents, and no profits for a long time. It means encountering all sorts of opposition from makers of similar goods it comes in contact with. In short, creating a demand is a business by itself, just as much as making the article is. Whoever can do both has a fortunate combination in his person. You don't look at this side of the matter at all. You only see the wash-tub factory sending out goods by the car-load, and you say: 'What man has done man may do,' and you want to go and do likewise. How much profit is there on those tubs?"

"How the deuce do I know. I should say there must be a good big one to support all those work-people, and such a big place, and no end of advertising!"

"Jacob! Jacob! you have something to learn. These are no signs of a profitable business. They are evidences of a large one, and when you see them you want to know exactly how they stand before you do business with them; or so nearly that it is only a fair business risk to trust them. Big operations and big factories do not mean profitable concerns by any means, as stockholders know to their cost, and the men who carry them on and assume the responsibilities of them, are, as a rule, very poorly paid. They do not get more, in a majority of instances, than the same ability would earn them in a private capacity outside, and with about half the care and anxiety.

"Now, if you feel that we ought to go aside from our regular repair work, and building such new machines as are brought to us to make, and start out to introduce your new invention, why I will try to see it as you do, but I tell you frankly on the start, that I take very little stock in your scheme. The more plausible it looks the more risk there is in it. Thin, new ice is as slick and smooth as glass, but it don't bear you up worth a cent, Jake! What is your machine! What are you going to make?"

"It's a self-centering chucking machine for shafts."

"Oh Lord! Oh Lord! Jacob, excuse me, but what's the matter with your head? Why, there are more of such tools on the market than you can shake a stick at. Good ones, too. You can't beat 'em."

"Can't I? Well I can. I can make a machine of that kind that will lay over anything in existence."

"How do you know you can? Have you seen all there is out? Do you know all the machines of that class going? Already on sale, and the manufacture of them established; a regular trade in them! I'll bet you you can't name three, and if there is one, there are certainly half-a-dozen. Mighty good tools, they are, too. One of 'em will do as much work as a dozen men can do, and of a far better character. Jake, my good friend, don't get vexed at my plain speech, you know I would not willingly hurt your feelings for anything on earth, but I think you have got the wrong pitch on this notion, and we had better abandon it. I like energy, and ambition, and drive, as well as the next man, and I have done my share of it in my time, and still do a little at it, but I am unmistakably down on starting a new line of business and neglecting the old."

"I ain't going to neglect the old; I know where our bread and butter is," said Jake.

"Well, you say so, but you will find out differently. You will find that you are pursuing it and letting the other take care of itself, and that by degrees customers become dissatisfied. They are skittish, these latter. One of 'em comes in and wants a job done in a hurry; he finds you or me pottering over this new centering-machine and he goes over to Slagtown with his work, saying that we have got into a new line of trade and don't pay any attention to business. Besides, when you come to look at all the detail and outlay necessary to start in this line of trade it is appalling."

"I don't mean to go hammer and tongs at it. I told you at the outset that we would take it up by degrees, and go slow until we found out it was a success."

"You can't do any such thing. Going slow means slow business. You have got to get wet to swim the river; its no use shivering on the bank and wetting your feet only; that never fetches you on the other side. You can't go slow introducing new machinery. You have to make a stock on the start, to show around in various cities, and you must wait until they are sold before you can get any returns. Business cannot be done by sending out a few here and there, and expecting manufacturers are going to swamp us with orders by return mail. That's a bad rock in the channel, expecting a great return from a mighty small investment. Nothing venture; nothing have. Little output; little business."

"Moulton, you are solid every time," said Jake, chewing a toothpick. "Your head is level; though anyone who did'nt hear you talk out might say you were slow."

"Mr. Hess you flatter me. Thank you, sir."

MECHANICAL DRAWING—NO. IV.

BY EDWIN H. MARBLE.

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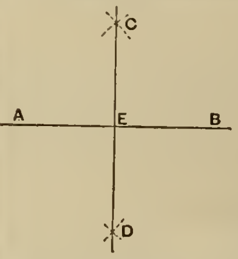
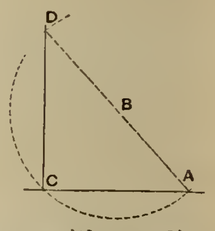
PROBLEMS AND THEIR APPLICATION.

(1) To bisect a line as A B—





From points A B as centers, with a radius greater than $\frac{1}{2}$ the line, describe arcs intersecting in C and D, connect C D and the line will bisect A B in E.

As the line C D is perpendicular to A B, we also have a method of drawing perpendicular through the center of a line.

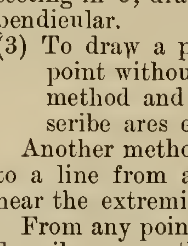
(2) To draw a perpendicular to a line from a point within it E. Fig. I.

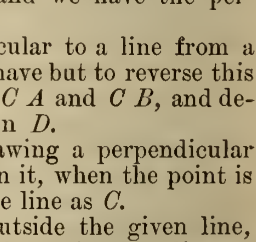
Set off on the line from E equal parts E A and E B, from these points describe arcs intersecting in C, draw C E and we have the perpendicular.

(3) To draw a perpendicular to a line from a point without C we have but to reverse this method and cut off C A and C B, and describe arcs cutting in D.

Another method of drawing a perpendicular to a line from a point in it, when the point is near the extremity of the line as C.

From any point as B outside the given line, describe an arc through C, cutting the line at A, and produce beyond C. From A, draw through B, line A B D, a line from D to C is the perpendicular required.





(4) To bisect a given angle, as B A C—

From the apex of the angle with any radius cut off A E and A D of the sides. From D and E with any sufficient radius, describe two arcs cutting in F, draw F A and you bisect the angle.

(5) To divide a line *A B* proportionally to a given divided line, *H K*, or into equal parts—

At any distance from *A B* draw *H K* parallel to it, and through *H B* and *A K* draw lines meeting in point *C*. The points of division, 1 2 3, connect with *C*. The *A B* is cut by 4 5 6 into parts proportional to the parts called for. If the divisions 1 2 3 are equal, the line *A B* is divided equal.

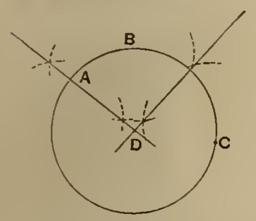
Using the reverse of this method—

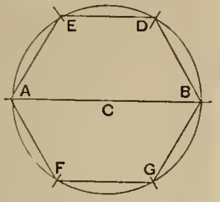
Set off from *K* on *K B* the number of equal parts, and from the last division draw through *B* the line *H B*, also *K A*, and proceed as before.

(6) To find the center of any given circle or arc of a circle—

Take any three points *A B C* and bisect *A B* and *B C* by perpendiculars. The place of intersection *D*, is the center of the circle.

Reversely—To draw a circle through three points not in a straight line, connect any two and bisect the connecting line by a perpendicular, repeat with any other two, and the intersection of perpendiculars is the center of the circle.

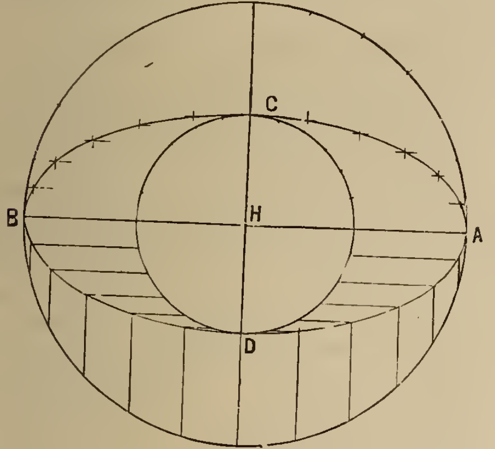




(7) To construct a hexagon, its longest diagonal, *A B* being given—

Bisect this diagonal in *C*, and with *C A* for radius, describe a circle. Set off from *B* and *A*, with same radius *D E*, and *F G*. Connect those points.

Since the part *B D* is one-sixth of the circle, or 60°, your 60° triangle will give you these points *A G D B E F* from the center of the circle *C*.



(8) To construct an ellipse, the major and minor axes being given *A B C D*—

Draw the long diam. *A B* and bisect with perpendicular at *H*, which perpendicular make equal to *C D*, equaling above and below *H*.

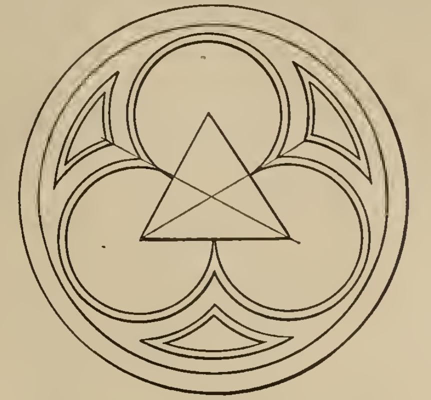
From *H* as center describe two circles with radius *H C* and *H B*. Divide each circle into the same number of equal parts, as 1 1′ 2 2′ 3 3′.

From the points in the circle of the long diameter draw lines within, perpendicular to the long diameter, and from the points in the circle of the short diameter draw lines perpendicular to the short diameter. The points of intersection of these corresponding lines will be points in the curve of the ellipse.

Many other problems might be given which would be of value to the student, but lest some may think it a series of articles on geometry we will take up our time with further principles, simply showing our practical illustration of the principles already studied. We will draw a design for a Gothic Trefoil Window.

A horizontal line 3″ long is first drawn, and with radius equal to its length, and the extremities for centers, short arcs are described above the line intersecting; joining this intersection with the extremities, and we have an equilateral triangle. By bisecting the angles, or bisecting the sides by a perpendicular we have the center.

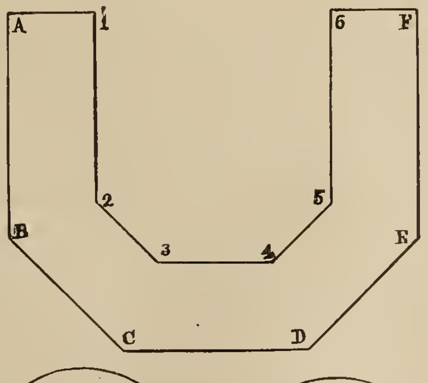
The radius of the circles forming the trefoil is one-half the side of the triangle, and the apex of the angles the center. The outer circle is struck from the center of the triangle as a center. The proportions of bands and beading is left to the judgment of the draughtsman.

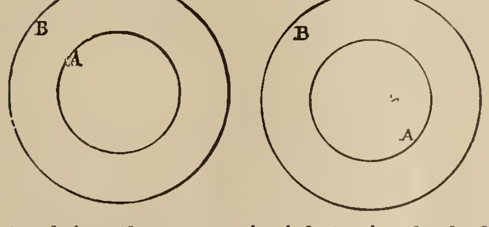


The proper introduction of shade-lines on a drawing renders what might look like a confused arrangement of lines, an intelligent one, and this proper introduction we will now endeavor to present in as clear a manner as possible.

All light is supposed to come from the upper left hand corner of the board, and in parallel rays at an angle of 45 degrees. The rays, if not intercepted, will leave a bright line upon a surface, while those portions of the surface, or solid, which do not receive the direct rays are in the shade. It is usual to consider that all corners, or intersections of surfaces, are rounded to a greater or less degree, and, therefore, do not present sharp, clearly defined edges, or angles. These corners are light, or shaded, in the proportion to the amount of light that is received upon them, though it is customary to consider all of them in the same degree darkened for the sake of uniformity.

To illustrate this principle, reference is made to the accompanying engraving, through which we will draw imaginary lines, representing rays, downward to the right at an angle of 45 degrees. These rays falling directly upon the parts *A-B* and 6-*F* of the outer form, and 6-5, 5-4, and 4-3 of the inner portion; they will be given in light lines, while the portions from *C* to *F*, and 1 to 3 are not touched by direct rays and will consequently be darkened. Two lines are still to be considered *B-C* and 2-3. These, it will be seen, are parallel to the ray, and though strictly represented as slightly darkened, are in practice considered as light lines.





Applying the same principle to circular bodies we have here represented a ring, square in section; also a circular base with a smaller circular projection. In the first case it is evident that the inner circle must be shaded on the side *A*, since that side is in the line of intercepted rays; for the same reason the side *A* of the second figure will be shaded. The outer circle in both will be bright on the side *B*. The meeting of the light and shade is on a line at an angle of 45 degrees through the center; such line being at right angles to the rays. By this simple method one can easily determine the shape of any solid, and its projections or depressions.

Having outlined the principle, we will now give a rapid method of determining the lines that should receive shade. With the *T*-square in position against the left edge of the board, place the 45 degree triangle against its upper edge with the long leg representing the ray of light. Commencing at the upper angle and following down this ray, any line cut by it directly will be bright, while all lines which lie behind, or which would not receive this ray direct, must be shaded. With a little practice one can readily note the lines without recourse to this plan.

In applying these shade lines, there are some points which it would be well to notice particularly when a body is sectioned (of which particular notice will be taken soon), the boundaries of this section are treated the same as any flat, or plane surface. When a line represents a joint, or union of two bodies, this line is left light, though it may, in other views, be darkened. In representing cylinders or other circular bodies, the ends are shaded, but the sides or lines representing curve boundaries are not shaded, for the sake of distinctness of outline, and also from the difficulty of properly representing the curvature.

It will be found in referring to some German and French drawings that two different plans of shading are sometimes used. First.—As I have already given, all rays coming from the upper left corner. Second.—In plans, and sometimes end elevations, the shade lines appear on lines which are shaded in the original position of the article. This last method is but little used in this country, since it tends to confuse rather than render distinct, many drawings. In the second method it is supposed that one takes position opposite each side, or face, of the article to present the view, while in the first, or American method, the article is supposed to be turned so as to present the side it is desired to show, while one occupies the same position. This, though admitted to be somewhat incorrect of itself, is sanctioned from the fact of its great simplicity.

As it is the aim of all mechanical drawings to render plain and distinct all parts represented, some over correct parties may object to practices sanctioned by common usage. In answer to this protest it may be said, that these drawings represent the object as it should be made, and also how to make it, without reference to the *picture* part of the work.

[TO BE CONTINUED.]

PATTERN MAKING.

BY A PATTERN MAKER.

No. V.

I have invariably observed, that where a grindstone has been put up, especially for the pattern makers, it is smaller, and finer in the grain than that erected for the machinists. If we ponder on this arrangement for a little while we shall find that this is the wrong way about, or at any rate it will, I expect, be admitted that if the machinist needs a coarse, rapidly-cutting stone, the pattern maker has need for such also.

In the ordinary course of things, that is putting accidents by which tools are broken out of the question, the machinist gives his tools a few touches on the grindstone and they are in condition for work again. But the pattern maker, since last grinding his chisel or plane, has been dubbing it on an oilstone until it has assumed the outline of fig. 24, or if a chisel used in turning, it may be as in fig. 25. The dotted line indicates the amount of hard steel that must be ground away, to bring the tool into proper order; and this on a chisel $1\frac{1}{2}$ inches wide, or a plane $2\frac{1}{4}$ inches. A machinist might like to finish his tools on a fine stone, as frequently they receive no other finish than that the grindstone gives them. Not so with the pattern maker. All his tools must receive an oil-stone finish, therefore he does not require a grindstone fine in the grain. But even when a pattern maker, has access to a grindstone, of the most powerful kind, it is still a tiresome job getting away with so much steel, if he simply bears as much of his weight as he can upon the tool as it lies upon the stone. Therefore, I recommend the following method of grinding chisels, and such other tools as it can be applied to.

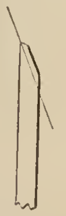


Fig.24

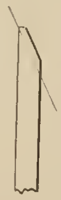


Fig.25

Having the tool-rest about half an an inch distant from the grindstone, hold the chisel as in fig. 26. In this position the stone will not have sufficient power to draw the tool in, though it would not be prudent, nor indeed is it necessary, to allow any part of the hand of the operator to come between the steel and the stone. A great leverage is hereby gained for taking off rapidly the most of the material, by pulling at the tool-handle, the rest forming a fulcrum. The chisel must be frequently changed from right to left, to secure evenness in the grinding, and when the process is nearly complete, finish by grinding in the usual way.

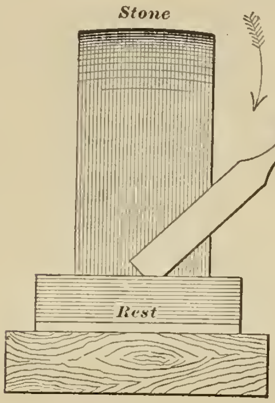


Fig.26

Material.—In making patterns, many kinds of wood are used, pine, cherry, mahogany, Spanish cedar, walnut, beech, teak, and probably many others. Various circumstances govern the selection. Accessibility first, for a man will not use what he can't get! The item of cost also steps in. A mahogany pattern might be preferred to one of pine, but the price of that material is much greater (with us), and more labor, perhaps, would be required to work it into shape. Another great consideration, governing the selection of the kind of lumber, is the amount of duty required from the pattern. It frequently happens that a man will enter a shop and say:—

"I wish you would make me a pattern, so that I can get a casting like this; I don't care what it is made of, or how it is put together, provided I can get one casting; after that I shall never require it again."

For a customer of this kind, our duty is to knock together something cheap, and we can take any kind of wood we please, green or dry, for the pattern will be molded and done with before it has time to alter its shape. I have taken pitch-pine to fill such orders as these. On the other hand, if the man brings a globe-valve and requires patterns for it, telling us he expects to go on making thousands of such valves, the matter of cost would fall into the back-ground, and we should endeavor, to put some of our fine work upon the best of material. Hard wood, in this case, would be selected, as it will stand more wear than pine; the sharpness of the angles will also be longer retained.

Young fellows are always over anxious to use mahogany, I suppose because that wood, when varnished, shows up a good job better than any other; "a fault that leans to virtue's side."

In the ship-yards of England, when a hard-wood pattern is required, teak is often pressed into service. There is always plenty of it in such places and a very excellent wood it is, of a fine and even grain, hard as mahogany, closer than walnut, and of a greasy nature which allows of its being more easily planed than either; it is commonly supposed to be imperishable. Probably in this too much is claimed for it; however, a piece of rotten teak is certainly not a common sight.

After all, hard woods are only used for exceptional work. The *pine* is the tree of the pattern-maker, not *any* pine tree however. He leaves that of Georgia and of Oregon to the carpenter for his heavy frame-work. The stair-builder, or the joiner, may even find uses for these strong and tough woods. He (the pattern-maker) looks to it that his lumber be soft, light in weight, clear and straight in the grain. A gnarled and knotted stick is an abomination to the pattern-maker, but a straight plank is his delight. His views are met, his wishes fulfilled, in the best selected pine of Michigan. How beautiful the freshly resawed planks of this wood appear, in color a very light pink, with a knot seldom seen! Its appearance foretells its quality; the shavings come long and silky from the trueing plane leaving a surface glossy as satin. Across the grain it is not refractory, and end-ways it may be cut like cheese. So excellent is the quality of this lumber that pattern-makers demand, and receive it, in all parts of the world, from London (England) to San Francisco.

Michigan, or as we term it, Eastern pine, is seldom used on the Pacific Slope, sugar pine being cheaper, on account of the cost of freight, is what is commonly made use of, in conjunction with what is here known as red-wood, yet to be alluded to. Sugar pine, though for our purpose not equal to Eastern pine, is still a valuable kind of lumber. As its name may indicate, it is of a gummy nature, not easy to plane. Plane irons, the mouths of planes and planing machinery, if not frequently cleaned, become loaded, and stuck up with gum. Beads of gum may be seen on the surface of a pattern upon which the sun has been shining. Veins of liquid-gum are often struck in the middle of pieces got out to form a pattern. This stuff is horribly sticky even after a pattern has been varnished, some hidden vein in its interior is liable, on a slight exposure to warmth, to exude and reek in a manner entirely obnoxious to the molder, who in self-defence washes the pattern with coal oil, thereby destroying the varnish. This pine is also more liable to warp and shrinks to a greater extent in drying than the Eastern.

From this state of things, we, in these Pacific States, have a recourse, which, when sugar pine is not very suitable, still enables us, in most cases, to get along without employing Eastern pine. This is in red-wood, it is of a salmon color, and is extensively employed in carpentering, building, pattern-making and other wood-working trades. It planes well, but is rather brittle to pare; but what causes it to be much esteemed by the pattern maker, is the fact that when made up it will keep its shape better than pine. In view of this, much may be overlooked. If well selected, there is not much to say against it; it is brittle, easily split, in driving nails, and does not carve or pare well; but, as far as my experience goes, it is never so well selected but that we are troubled with its unequal quality. Some boards are much heavier than others, veins or fibres, hard as hornbeam run through it, and so un-uniform is its character that even on the same board one side may be soft, straight, clear and free from knots, while the other is coarse, hard and veiny.

As I have said, many kinds of wood are used for patterns, practically, however, there are but two kinds, hard and soft wood. The question is, when shall we use the one or the other? Pine, or soft wood, is used for large and heavy patterns and for small ones, provided there are no cross-grained parts, which, from their thickness, or from being unbraced, are unable to stand the process of moulding. Stock patterns expected to be in use for a number of years are made of hard wood. The teeth of the best gear-wheel patterns are made of hard wood, to retain the sharpness of their outlines. For very small work hard wood is always to be preferred, because in bringing such work to size and shape, very light cutting has to be performed, and the hand is guided in a measure by the resistance felt in using a tool.

The great trouble, with all patterns of wood, is the movement of the material; expanding in the damp sand of the foundry, contracting in the dry atmosphere of the store. Hard wood is sometimes used as being subject to this action to a lesser degree than soft wood. Lengthwise of the grain, the movement here mentioned is scarcely perceptible, it is confined to the direction which lies across the grain of a board. This is worse for us than if it were the same in both directions. As it is, through unequal shrinkage, rounds became oval, and squares became oblong. If two pieces of board are glued together, with the grain of the one crossing that of the other, they may be depended on to come apart again, as soon as the hygrometric condition to which they are exposed is to any considerable degree altered.

Again, in any block of wood, there are two ways cross-grain, a movement takes place in both directions but not equally. Let fig. 27 represent a section of a tree from which the block *A*, *B*, *C*, *D*, is to be cut. That block in drying will shrink more in the direction *A*, *B*, crossing the concentric circles, than in the direction *C*, *D*.

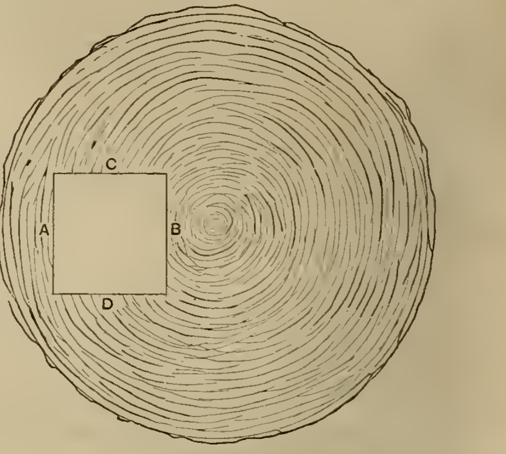


Fig.27

It is to be understood, that these remarks apply to wood thoroughly seasoned, for none other is supposed to be used in pattern-making. Wood is ever ready to be thrown into a state of movement. The removal of the surface by planing will start anew the shrinkage. If a board, newly planed, is left lying flat upon the bench over night, or even while the workman goes to dinner, he will find it, upon his return, concave on the upper side, for the reason that the currents of air played over that side but were prevented, by the bench, from coming in contact with the other; the upper side of the board, as it parted with a certain amount of moisture, became narrower than the under side, and in that manner the curvation was induced. None but a careless workman, therefore, ever leaves his lumber in such a position but places his freshly planed pieces upon edge, or rears them up on end, so both sides may shrink alike and his work remain straight.

The reader, I presume, has gathered from the above remarks that there are three movements in lumber; a slight movement in the direction of the length, generally disregarded, a greater across the grain in the direction *A B* (fig. 27) and greatest of all in the direction *C D*. Furthermore, in consequence of the inequality in the two movements last named, the nearer a board is cut to the heart of a tree the less liable it is to keep straight. Very old lumber, approaching decay, is supposed to be almost, if not entirely, free from the inconvenient action under consideration. In some shops certain old pieces are treasured up only to be used for critical work. I have not fully verified this opinion, though I have always acted upon it and where the opportunity offers shall continue to do so.

To have a thorough understanding of the nature of lumber and to act upon that understanding, is to save time and material, to avoid annoyance to the workman and to give satisfaction in the casting if the pattern is in other respects properly made. Hence it follows that lumber intended for patterns must be well seasoned. When re-sawed or planed, it must be piled so that the atmosphere is free to act on both sides of each board. A sufficient number of strips of wood must be placed between each board, to prevent sagging, and the boards should not be piled in a triangle. When brought into the shop they should be placed in racks until required. In making the patterns, the same principle is, as far as possible, carried out, viz., allowing the air to act on all sides. Lastly, in storing away patterns for future use, they are to be so placed and supported, that they will not sag or twist and will dry evenly, unexposed to inequalities of temperature, the sun, the wind, and the rain.

Verni Noir.

[TO BE CONTINUED.]

The Boston *Commercial Bulletin* states that there is a scarcity of young men specially fitted to assume positions of responsibility in the practical application of electricity to the wants of the public. The thought is suggested that electrical engineering presents a wide field, and that the demand for able young men in that line will be a great and a growing one.

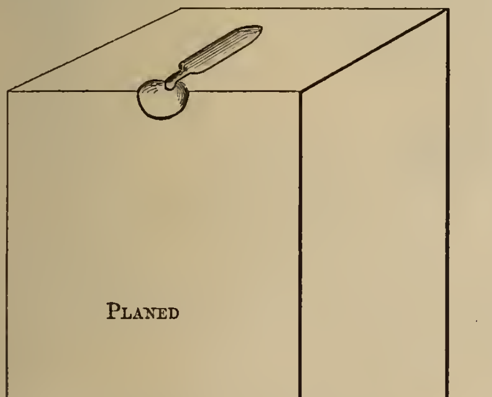
DIES AND DIE-SINKING—NO. II.

BY A DIE SINKER.

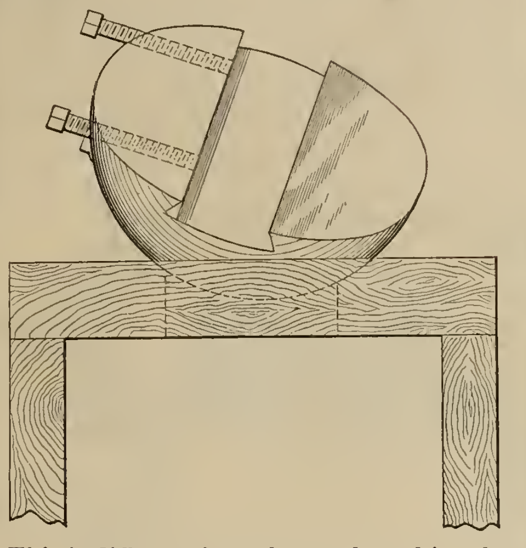
In the last article, No. 12, Vol. IV., I said we were ready to sink our die, but after consideration I find that there are still some more points which it is desirable the reader should understand before we begin. The first is in regard to economy in using the steel we require for our die-blocks. The others relate to appliances for facilitating the work. To make our die-blocks we take a bar of steel four inches square and cut off about nine inches for the bottom die and four inches for the top die (or, in this instance, punch), plane up the ends perfectly parallel to each other and also plane one side its whole length. Now make a dovetail on one end of each of them to fasten them in the drop, being careful to keep the planed side for the front; (see engraving.) Our bottom die is nine inches long, set up on end in the drop. The reason we make it so is, that when the die, or impression of the shuttle is worn out, we can anneal and plane it off, and use the die until it gets down to about four inches; then it can be used for a top die, or something else. This reminds me that the top die, for no matter what purpose, should never stand higher than four inches.

We have now got our blocks; the first thing to do is to file the face on which we are to work, when filed put on some blue marking. I fancy I hear some machinists say, "what is blue marking?" For their benefit I will say it is simply a piece of bluestone dipped in water and rubbed on the smooth, clean, filed face of the die. It deposits a thin coating of copper on the steel which affords an excellent ground for scribing on. The scriber cutting down into the steel shows a bright mark, clear and distinct through the copper.

I will here give a receipt for making this blue marking in a better way. Take about three ounces of bluestone, pound it fine and put in a common beer bottle, fill up with water, add two or three drops of vitriol, and let stand for a day. Apply it with a piece of clean waste. This makes a heavy copper deposit which cannot be rubbed off, but the metal must be clean and free from grease. The reason this is used is because the center-punch is inadmissible on die work. To return to our die; draw a center line across the face of it at right angles to the planed side. Place template No. 3, (see page 142, No. 11., Vol. IV.,) on the die, with the center line on the template corresponding to the center line on the die, with the heel of the shuttle toward the planed side. Let the edge of the template be even with the planed side. Now scribe the outline of the shuttle (which is in the center of the template) on the die with a sharp scriber. We are now ready for cutting the die. A block similar to that used by a letter-cutter is necessary, but it should be a great deal heavier, as an ordinary vice is not handy.



The die-sinker should have a round hole about ten inches diameter cut in a handy place on his bench. In this hole should be his cutting block. This is a casting about 120 lbs. weight. It is a hemisphere, with a recess planed out of the flat side to put the die in, and two screws to fasten it with. Thus, this is a great assistance, as we can place the die in any position we wish, and through its inertia the blows of the hammer and chisel take more effect. There should also be a good assortment of chisels of every shape that your job may suggest. At the least you should have half a dozen flat chisels, made of $\frac{3}{8}$ hexagon steel, drawn out thin. The same number of capes of different sizes, from $\frac{3}{16}$ down to $\frac{1}{32}$, also "round-noses," and a variety of others, such as side cutting, diamond-points, etc. These should be all drawn out thin and tempered with the straw color reaching up half an inch from the point.



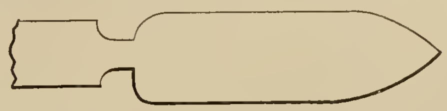
This is different from the usual machine shop practice, but it is necessary in cutting steel to keep a good edge, and as we use a lighter hammer, and take thin cuts, the chisels at this temper stand well. It is a good rule to take light cuts and many of them. By this means you will make better progress than otherwise.

Now we want a few scrapers of different sizes and shapes, some rifflers and gravers, and we also want a comfortable seat, and something to rest the feet on. The demands of the body being supplied, it is easier to put one's whole mind on the job. Put the die in the cutting block, screw it up tight, seat yourself comfortably, and take a keen flat chisel; hold it upright and mark around the inside of the scribed outline with it, and any other that is found necessary. This is done with a few light taps of the hammer. Then take a round-nose chisel and chip from the heel towards the point, holding at the place where it narrows off near the point. Some die-sinkers drill holes here. Others, who have a die-sinking machine, mill it out. I have tried all ways, and found that we can only take the rough out by either way, and that it had to be chipped after all. As the roughing part takes only a short time, it may as well be done that way, as it takes less time than to get your machine ready, and do it in, for one die. Set your depth-gauge the proper distance and rough out almost deep enough. Form the block so that the point of the shuttle is towards you and cut out the piece that remains there, chipping from the point towards what we may call the shoulder of the shuttle. Clean it out as nicely as possible with the chisel.

We are now ready for the force, use a little red lead on it at first, but as we get further on, we omit it. Place it in the die fair and square. Holding it with your left hand, you strike one heavy blow with a hammer about twice the weight of that used by machinists. Now take out the force and carefully relieve, with the chisel, the hard spots that the force has shown. Repeat this, alternately driving the force and relieving with the chisel, until the force becomes nicely bedded into the die, making sure that you make no false strokes with the chisel, or marks that cannot be entirely removed by the time the die is finished. If you do it will be necessary to plane off and sink it over again. Keep trying the template No. 2, in it to be sure that you are sinking it at right angles to the face. Now lay aside the chisels and finish with the gravers and scrapers; driving in the force as a guide to show the hard places, continuing until there is not one spot that the force does not touch. If you have the right depth the die is finished, if not, if it is too shallow, you must go deeper. If, by bad judgment, it is too deep, you must plane it off. In setting the depth-gauge, allowance must be made for the fin, or burr that will be on the shuttle when it is forged. A good way to finish up the die smooth is to put a little saliva on the gravers and scrapers, as you use them. This, together with the perfect, smooth finished force, gives the die a beautiful surface-finish. This it must have, otherwise the hot steel forged in it sticks in the die and draws the temper. The man who runs the drop-hammer also has unnecessary trouble, and as he generally works by contract, may lead to profane language. Worse than all, as previously mentioned, if there are any marks or under-cuts on the sides of the impression, the metal dovetails itself in and it will cost more to get the forging out of the die than to make it; it will be out of shape and useless.

But assuring that we make a good job, without any of these defects, we will proceed to verify it. To do this, melt some lead and pour it into the die until it is full, having a clay border around it to keep the lead from running all over the face of the die. Then take a piece of iron large enough to cover the size of the shuttle, set it on the lead, and strike two or three heavy blows to force the lead down into the die. Then take out the lead, and we have an exact counterpart of the die, or shuttle. Try templates Nos. 1 and 4 on it. If it fits them exactly, all right. If not, we make what alterations are necessary, and call it finished.

It will be observed that the impression is right in the center of the die block, and as we forge our shuttle directly off the bar, as shown in this figure, it will be obvious that there is something else to be done before the die is hardened, or the bar would be flattened, and rendered useless for the distance between the heel of the shuttle and edge of the block. This is about one inch. To avoid this, we mill a piece out of the block up to within $\frac{3}{8}$ of the heel, as shown in the first figure. We chamfer off the $\frac{3}{8}$ that remains, until on the face of the block there is apparently only $\frac{3}{16}$ between the heel and the recess. Across this we cut a gap about $\frac{1}{4}$ wide and $\frac{1}{8}$ deep to keep the shuttle from breaking entirely off the bar.



The die is now ready for hardening, but as the top die, or punch, has to be made, as also the blocking or breaking-down dies, I will reserve this for a separate article.

[TO BE CONTINUED.]

ADVANTAGES OF HIGH-SPEED ENGINES.

Prof. Channing Whitaker, of the Massachusetts Institute of Technology, recently lectured before the Stationary Engineers' Society of Rhode Island, and, in the course of his address, gave some details of high-speed engine economy. He said:—

"The cylinder capacity of an engine that runs at this increased speed needs to be only one-tenth part as great in order to produce the same power. It is obvious, then, that if the quick-speed and the slow-speed engines are equally well designed and built, the quick-speed engine will cost the least; and that the builders of quick-speed engines have a large margin of profit, due to this difference of size and cost to divide between themselves and their customers. The Porter-Allen engine is not the only engine of this class. The Buckeye engine, built at Salem, Ohio, and at Hartford, Conn., was not long ago its best known and most formidable competitor. Very recently, after an elaborate series of expensive experiments, the Lawrence or Armington and Sims engine has shot rapidly into the front rank of the quick-speed competition. All through the West quick-speed engines are now common, and it is no longer a strange sight to see a circular saw placed directly upon the crank-shaft of an engine, and making 250 turns per minute, or to see the plate iron saws, which, in rolling mill, trim iron and steel bars to length, directly connected to a quick-speed engine that turns from 300 to 500 times per minute. Even in our large manufactories a similar change is taking place, held in check by conservatism on the part of mill managers and by lack of experience on the part of the designers and runners of quick-speed engines. The purchasers of unusually rapid engines will doubtless have some unsatisfactory experiences until designers become entirely familiar with the peculiar conditions which attend high speed. But such purchasers will advance both the science and the art of steam engineering. As the quick speed engine becomes known and improved, it will be found more frequently attached directly to the shafting of manufactories, and this method of connection will gain favor until it has become the common one

"The Herreshoff Manufacturing Company, of Bristol, R. I., manufacture a small, quickly rotating marine engine. It is reported to have made, in Lorillard's steam yacht, 1175 revolutions per minute, and to have made at a slower speed, in the steam yacht Leila, a horse power with but 16.4 pounds of water per hour."

And he says further:

"In 1775 Smeaton invented an improved engine. It was capable of producing 76 horse power, and had a piston with a diameter of 72 inches and a stroke of 108 inches. It is a singular fact that the growth of the steam engine has reduced its size so far, that a modern high-speed engine, which would produce the same power as this enormous engine of Smeaton's did, would have a cylinder only 9 inches in diameter and 16 inches stroke. The volume of its cylinder would be only 1-216 part of that of the cylinder of Smeaton's Chase-Water engine. After a few years of successful work this engine was altered by Watt to his improved system. James Watt invented the surface condenser, the steam jacket, the double-acting engine and numerous other valuable devices for preventing those wastes of heat that occurred in Newcomen's engine.

"Probably no man ever introduced more, or more important, improvements in a single machine, than Watt did in the steam engine; but these improvements could not have been brought into practical use had he not associated himself with men of capital, who had unbounded confidence in his ability, and who had means enough to carry out these improvements in the very best manner. His first financial partner, Dr. Roebuck, became impoverished before the public fully realized the value of Watt's inventions, and had not his late partner, Matthew Bolton, been engaged in a peculiarly lucrative business, and had he not had an extended acquaintance among the wealthy and influential people of Great Britain, even Bolton might have failed in the undertaking. Probably no very valuable improvement has ever been made which has not involved the sinkage of a large amount of capital."

◆

INTERESTING INFORMATION ABOUT SAWS.

On few points connected with wood conversion is there more difference of opinion than the question of speeds. Commencing first with circular saws for ripping, for sawing soft and medium woods, a speed of 9,000 feet traverse per minute at the points of the teeth may be taken as a standard speed ; if hard wood has to be sawn this should be reduced to about 7,500 feet per minute, and with very hard wood 6,000 feet per minute will be found sufficient. The shape, number, pitch and set of the saw teeth being modified to suit the nature of the wood.

In one experiment I put a circular saw, 30 inch diameter and 12 gauge, on a spindle and gradually increased the speed to between 12,000 feet and 13,000 feet per minute, when it became wavy and pliant and ran out of truth. It therefore follows that, not only is the extra speed entirely unnecessary, but it is positively detrimental, as more power is consumed, more heat engendered in the bearings, spindle and saw plate ; extra lubrication is therefore required, and the belts deteriorate more rapidly. I should, however, prefer to err on the side of high speeds instead of low, as this necessitates perfect workmanship and finish not always found in these days of so-called "cheap" machinery.

The speed of circular saws for cross-cutting can be increased with advantage 1,000 feet beyond those used for ripping say to 10,000 feet per minute. The difference in the cutting action of the two kinds of saw teeth will readily account for the necessity of this increase in speed. In the case of a ripping saw the action is chiefly a splitting one, the saw teeth acting like a series of small wedges, driven into and separating the longitudinal fibres of the wood, while with cross-cutting saws the fibre of the wood has to be severed across the grain, is comparatively unyielding, and the teeth of the saw meet with much more resistance. It is found necessary to make the teeth considerably more upright and more acute or lancet-shaped in their form than for cutting with the grain. Although the subject is one of great interest, time and space forbids extended remarks, and I pass to band saws.

Owing to improvements in the manufacture of the blades and the machines themselves, the speeds of which it is safe to run band saws has increased considerably of late years. On machines in which the saw wheels are of small diameter, say below 36 inches, and where the arc of contact of the saw on the wheels is necessarily more acute, the speed of the saw blade should not much exceed 4,500 feet per minute. With saw wheels above 36 inch diameter this speed may be safely increased up to 6,000 feet per minute ; this is, however, on the supposition that the saw blades are of good quality, and that the top saw-wheel is mounted elastically, and that the machine generally is well designed and made. The proper construction and use of saws involves many important scientific points that are unfortunately much neglected, resulting in an enormous waste of material and power.

M. Powis Bale in Mechanical World.

◆

THE AMERICAN LOCOMOTIVE IN A TRANSITORY CONDITION,

Howard Fry, Supt. M. P., of the N. Y. West Shore and Buffalo R. R. writes to the *Railroad Gazette* as follows:—

"American engines have rarely been specially designed for the road they run on, and the economical performance of an engine is not the point most considered when an order is placed. The designing of engines has fallen almost entirely into the hands of the builders, and the firm that can the most quickly execute an order is the one which generally gets it.. The interchangeability of parts, the application of a most admirable template system, so that large quantities of similar parts can be cheaply produced and easily assembled together — these have been the natural results of the American system of ordering locomotives. The fewest possible alterations have been made from year to year—only just enough to meet the views of such railroad men as had suggestions to make. This system has contributed many admirable features to the American locomotive, and was a necessity at a time when rapid advance was being made with new lines, that could not wait the slow process of developing engines just suited to their special requirements, for new types of locomotives are not suddenly designed. Even on old roads with accumulated experience and ample drawing office force, it takes many months to design any serious modifications of existing types, and then the new locomotive, after running a few months generally needs modifications.

What would have been the result if for the last twenty years there had been at the head of the locomotive departments in America such men as have made American machine tools and American stationary engines the marvels of perfection they now are! Nothing is more striking than to contrast the great change that have been effected in machine tools during the last 15 years with the absolute similarity between the locomotives built to-day and those built 12 years ago for similar duties. The American lathes and planers, like the English locomotives, have changed in almost every detail during the past 15 years, while at any of our best works the ordinary passenger engine, say 17 × 24 in. cylinder. built to-day would be almost interchangeable with one built in 1870.

It is, however, very certain that a change is taking place in America, and that the importance of reducing the consumption of fuel and decreasing the cost of repairs is being recognized. A few first-rate locomotives have been turned out during the past two years on several different railroads. There is a great inquiry for good draftsmen who have experience in locomotive work, and on all sides there are signs of increasing interest in this important subject."

◆

ELECTRIC LIGHT CHEAPER THAN GAS.

Experiments to determine the relative cost of electric lighting as compared with that of gas, have been conducted in Germany, France, and England also, during the past year or two. The results have not been uniform, and it cannot be said that the actual relative cost of the two systems is known.

The reason for this appears to be that no system of electric lighting has been sufficiently long in use to be tested under widely varying conditions. There is an element of actual cost seldom considered. The electric light (incand cent) and the gas jet are essentially differen The relative cost of manufacturing silk and cotton goods is easily ascertainable, but the relative desirability of one or the other, according to circumstances, has an important bearing on the proportionate cheapness of the one or th other. For some purposes, perhaps, illuminating gas at a reasonable price would be cheape than the electric light, even though the latter actually cost a little more. But the incandescent filament has several positive advantages over the gas jet. It gives off no deleterious products of combustion, to affect the health, walls or ornaments. It is perfectly steady, and, when perfected, will be so easily adjustable. With these considerations, a price in excess of that charged for gas, would in reality make the new light the cheaper, because the better. The German experiments alluded to above, were with one series of Schukert lamps and with three of Siemen's differential lamps, and the tests were uniformly in favor of the light used as against gas.

OUR CLUB LIST.

To new subscribers who wish to take THE MECHANICAL ENGINEER in connection with other papers, we are enabled to offer the following publications; the publishers of which also make reductions from their regular rates.

The rates named cover both publications for one year :

THE MECHANICAL ENGINEER and *Scientific American*, together one year	$4.20
Railroad Gazette, together one year	5 30
American Miller, " "	2 25
North-Western Miller, " "	3.00
Railway Review, " "	3.90
Builder and Woodworker	2.25

◆

MARKET REPORTS.

By request of many manufacturers in various parts of the country, we renew our publication of market reports of metals and engineers' goods, which was dropped some months ago, it being found a great convenience.

These quotations are made by the houses represented, who alone are responsible for the statements. While every effort will be made to insure strict accuracy, we disclaim any liability that may arise from changes without notice or typographic errors.

John W. Quincy & Co. quote, Dec. 20th, Commercial Pig Iron :

Number 1x	$26@$26½	
Number 2x	$23@$24	
English Foundry	$22 @	
Scotch Number 1	$23½@$26	
Lake Copper	18¼@18½	cts.
Arizona Copper	17¾@	"
Baltimore	17½@17¾	"
Tin	21 @23	"
Spelter	5¼@ 5¾	"
Antimony	11 @13	"
Babbitt Metal	8 @25	"

American Tube Works quote :

BRASS TUBES (solid drawn).

Per pound, $\frac{3}{8}$, 50c.; $\frac{9}{16}$, 45c.; $\frac{11}{16}$, 40c.; $\frac{13}{16}$, 40.; $1\frac{1}{1}$, 35c.; $1\frac{5}{16}$, 30c. Same price to $3\frac{1}{2}$ diam. Copper tubes for above sizes respectively, 63c., 58c., 53c. 48c., 43c , 38c., for $1\frac{5}{8}$, and same price up to $3\frac{1}{2}''$ diam. Special price for large orders.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, etc., engraved in a superior manner. Finished castings at reasonable prices. JOHN BECKER, 28 Oliver Street, Boston, Mass.

PATTERN LETTERS FOR MOULDERS, Brand Letters, etc. Vanderburg, Wells & Co., corner Fulton and Dutch Streets. New York. Send for price-list and catalogue.

"HOW TO KEEP BOILERS CLEAN," and other valuable information for Engineers and Steam Users. Book of sixty-four pages published by James F. Hotchkiss, 84 John Street, New York. mailed free to any address.

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THE MECHANICAL ENGINEER

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THE MECHANICAL ENGINEER.

New Series. Vol. V.—No. 2.
Enlarged, 1883.

New York, January 20, 1883.

Single Copies, 8 Cents.
$2.00 per Annum.

A NEW ENGLISH SLIDE VALVE.

A new slide valve, just brought out in England, has some peculiarities, which are shown in these engravings, re-engraved by us from sketches in the *London Engineer*. Its chief peculiarity is that, in addition to its movement to and fro in a right line, it has semi-rotation around its own axis; the object being to keep the faces always tight. This would seem to be accomplished at great expense of detail and mechanical "fal-lal," of no great value, and decidedly mischievous if dirty oil or grease ("engine gurry" so called) gets inside the details. These are as follows:—

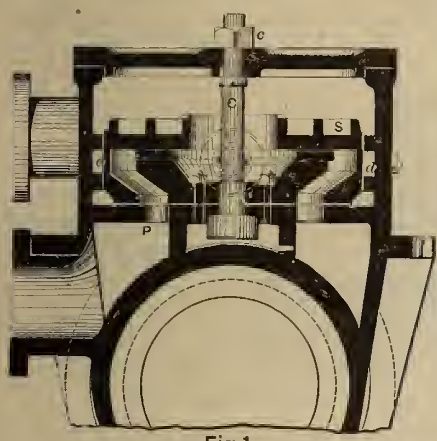


Fig. 1.

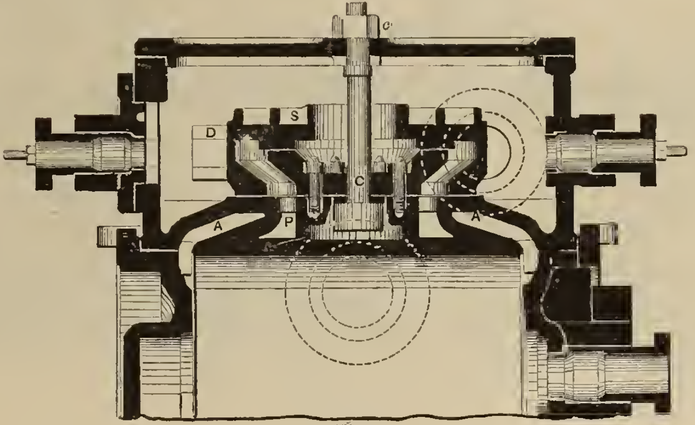


Fig. 2.

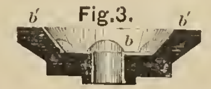


Fig. 3.

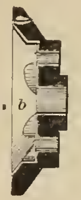


Fig. 4.

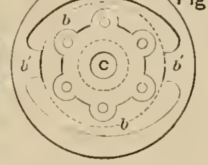
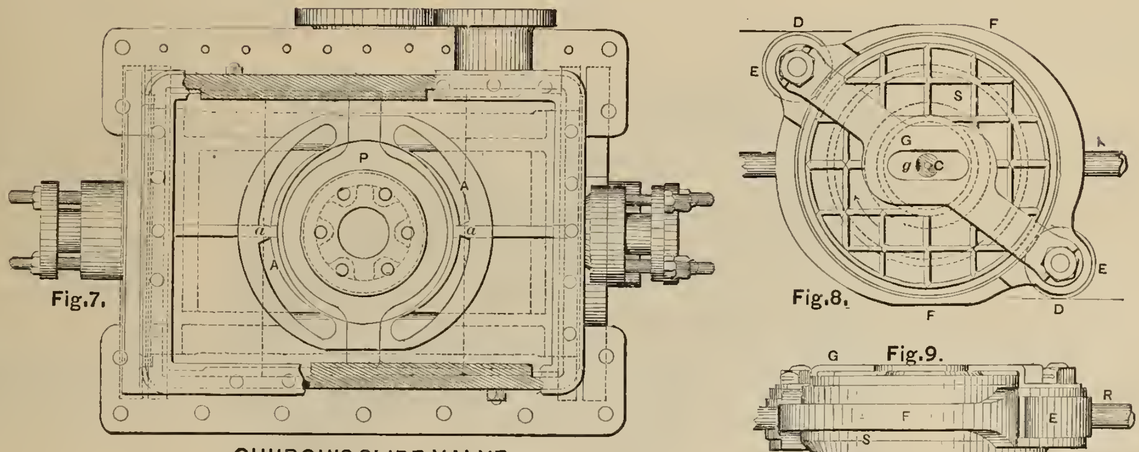


Fig. 5.



CHURCH'S SLIDE VALVE.

The slide, *S*, Figs. 2, 3, 4 and 5, is circular, being a shallow cylinder with a face at its lower edge, and a hole through its back cover. The face of the valve works over the valve face, bringing each of the ports, *A*, alternately in communication with the steam chest, and with the interior cavity of the valve, so that steam enters the port during one part of the movement, and exhaust steam, during another part of the movement, issues from the port into the interior cavity of the valve, and passes thence by the internal ports, *P*, to the discharge. The ports, *A*, are peculiarly shaped, having a somewhat crescent form, their inner and outer edges being circular arcs, and struck with radii so suited to the inner and outer radii of the valve face, that, as the face reaches the edge of the port, a very small movement of the slide covers or uncovers, as the case may be, a large extent of the port. The cylinder facing, in which the ports are formed has a raised surface, thus no ridge can be formed at either extreme of the stroke of the slide. As the ports have a considerable width, and as the slide is of circular form, not having the continuous lateral support given to the sides of a rectangular slide, ribs, *a a*, are provided in the ports to prevent the edge of the slide from dipping into the port so as to catch against its edge. Reciprocating movement is given to the slide by the rod, *R*, working through a stuffing-box in the front of the slide case in the usual way; but in order to provide for the turning movement of the slide, the rod is made to form a buckle or ring, *F*, which surrounds and embraces the circular body of the slide, leaving the slide free to turn within the buckle. In order to ensure the turning of the valve this arrangement is adopted: On the buckle of the rod are mounted two rollers, *EE*, whose peripheries touch the circular exterior of the slide, and also touch two straight faces, *DD*, formed at the sides of the steam chest. The rollers, *EE*, being mounted at points considerably inclined to the line of travel of the rod, *R*, and there being a little looseness of fit within the buckle, *F*, the first effort of the slide rod in each direction of its motion is to wedge one or other of the rollers, *E*, in between the periphery of the slide and the surface, *D*. The slide rod then continuing its motion, the wedged-in roller, *E*, rolls along the surface, *D*, and by its friction against the circular surface of the slide causes it to turn partly round within the buckle, *F*, as it travels along with it. When the slide rod, *R*, makes its return stroke the other of the two rollers, *E*, becomes in its turn wedged in, and gives a further turn to the valve in the same direction as before. Thus the movement of the valve over the valve face is a composite one, consisting of its to and fro movement, combined with a partial rotation around its axis. Every part of the slide face is thus brought to bear on every part of the valve face, and the wear is so equalized that the surfaces which begin work with the tool marks prominent, become, after a few days of working, polished like mirrors.

MARINE ENGINEERS' ASSOCIATIONS, FOR 1883.

The annual elections for officers are now being held in the various associations throughout the United States. We have advices from No. 3 of Detroit, as follows:—

W. P., James H. Reid.
W. V.-P., Charles E. Soleau.
W. T., John H. Cronenwith.
W. R. S., James H. Kendall.
W. C. S., W. F. Cullen.
W F. S., Frank Kenyon.
W. Chap., C. L. Barron.
W. Conductor, R. C. Ludlow.
W. D., John Bloom.
Delegate to Nat'l Convention, W, F. Cullen.

From No. 6 St. Louis:—

W. P., George Soulk.
W. V.-P., W. W. Cory.
W. R. and C. S., James H. Harris.
W. F. D., James Spargo.
W. T., William Hamilton.
W. Chap., James L. Tate.
W. Cond., A. B. Jewell.
W. D. K., C. B. Jackson.
Delegate to Nat'l Convention, Geo. Foulke.

No. 4 Chicago elects:—

W. P., Andrew Ritter.
V.-P., Joseph Quinn.
W. T., John Brown.
F. S., D. W. Wise.
R. S., J. J. O'Connor.
C. S., William Ponsonby.
W. C., Daniel Riee.
W. D., Charles Van Every.
Trustees, James Donelly, F. W. Whitehouse, Geo. Furness.
Delegates, Andrew Ritter, Jas. Donelly.

Sec. A. M. Davy of the *National Association Stationary Engineers*, writes from Detroit:

"A vote of thanks was extended to THE MECHANICAL ENGINEER for the able manner in which it has assisted the *National Association*. I issue charters to-day to Chicago, Detroit, Providence, and Grand Lodge of Massachusetts, and expect applications from St. Paul, Minn., and Rochester, N. Y., this week."

From this brief mention our readers will see that the Association is full of energy, as it must be, with able men to direct it.

CHICAGO BROTHERHOOD OF STATIONARY ENGINEERS.

This enterprising and thriving branch of the *National Association of Stationary Engineers* is now 250 strong, and is without doubt the largest local organization of its kind in the country. Its thrift and large following is undoubtedly due, in a great measure, to the energy and enterprise of its representatives, among whom none are more prominent than William Ponsonby, Esq., and Jas. G. Beckerleg, Esq. Chicago is a large place, and naturally affords material for a strong association; but those who have ever had anything to do with organizing societies know that it is uphill work and by no means "does itself," so to speak. The Chicago Association would be glad to open correspondence with others in the United States. Address William Ponsonby, 361 Hubbard St., Chicago Ills.

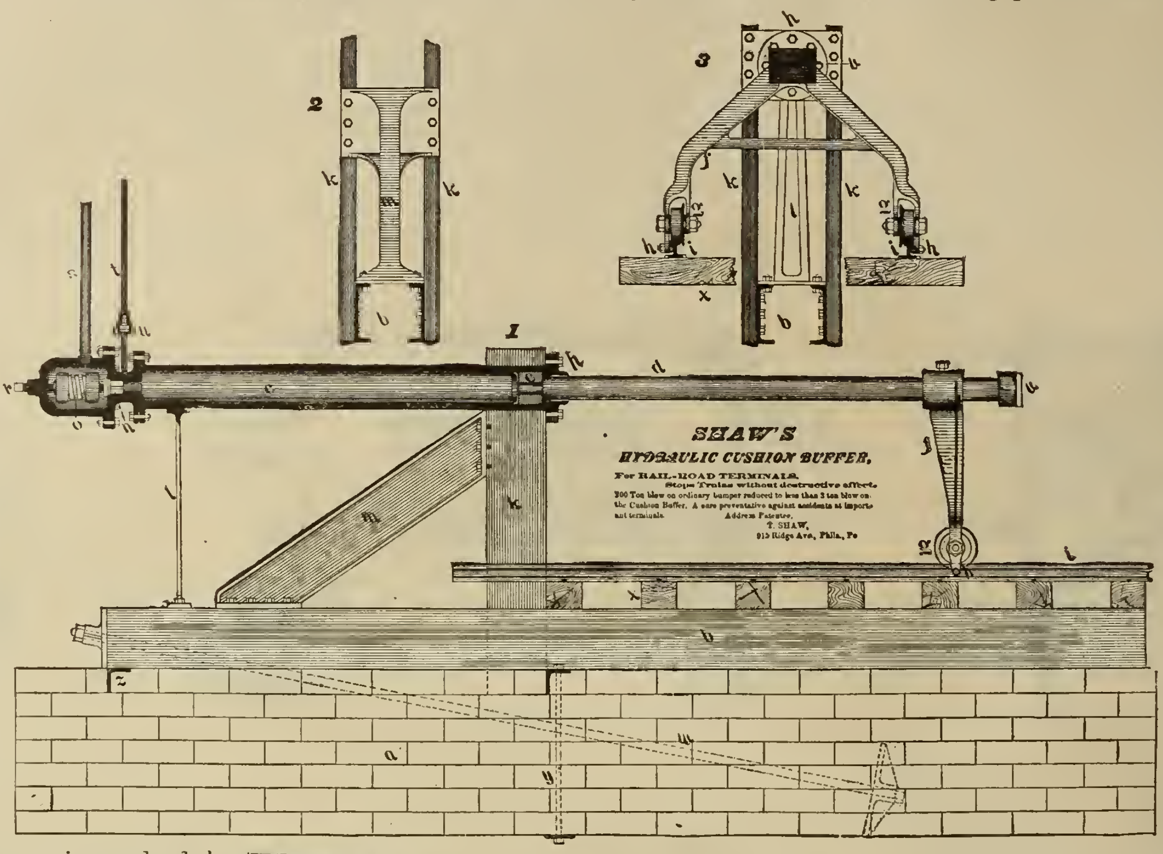
Names of officers for 1883 are as follows:—

Chief Engineer, M. J. Tierney; Vice-Chief, Joseph Hull; Treas., Lawrenee Hardgrove; Fin. Sec., William Mortimer; Rec. Sec., James T. Edwards; Cor. Sec., William Ponsonby; Conductor, George Place; Door Keeper, William Nuttal; Trustee, David Ponsonby.

The engine of the new iron steamer for the Fall River line is nearly ready for steam. Engineers can form some idea of the size of it from the fact that the strap on the crank end of the connecting rod weighs two tons!

SHAW'S FRICTION BUFFER.

Many disastrous accidents occur at railway termini from the carelessness of attendants, or the failure of brakes to act when called upon. To prevent these is the office of the invention here illustrated. It is most efficient for the purpose, and is an absolute safeguard against damage to property or loss of life. In construction it is very simple, in action it is very positive, and while capable of bringing up the heaviest train within certain assigned limits, no shock or jar occurs to passengers or freight. For elevated railways it is an indispensable adjunct, and should be at every important terminus.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SHAW'S
HYDRAULIC CUSHION BUFFER,
For RAIL-ROAD TERMINALS.
Stops Trains without destructive effect.
300 Ton blow on ordinary bumper reduced to less than 3 ton blow on the Cushion Buffer. A sure preventative against accidents at important terminals.
Address Patentee,
T. SHAW,
915 Ridge Ave., Phila., Pa
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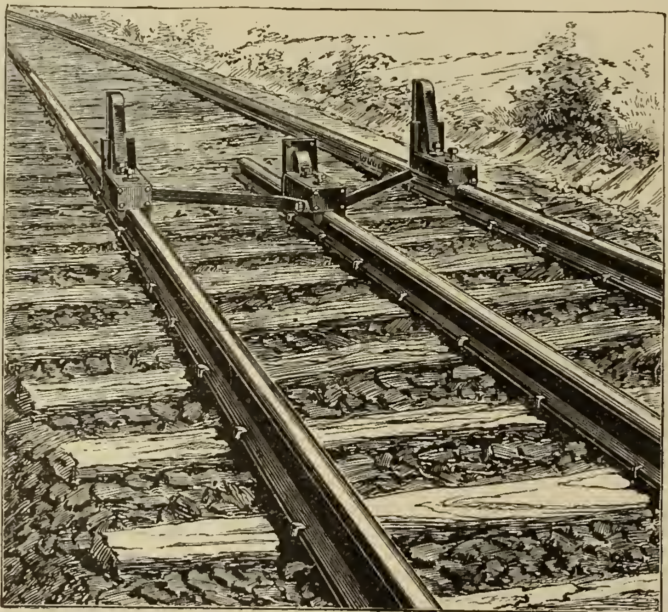
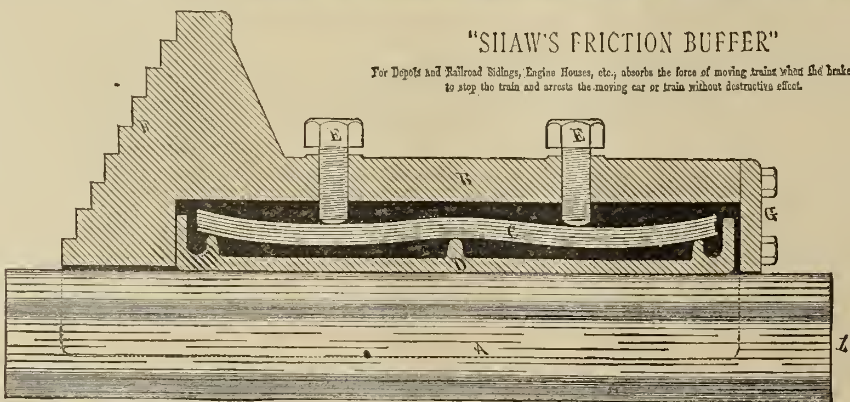
As its title signifies, this buffer acts by friction, and, in detail, consists of a cast iron shoe, two feet long, fitting snugly around the head of the rail, as shown in the illustration, and provided with a friction plate twenty inches long, that rests upon the head of the rail. On top of the friction plate are two semi-elliptic springs, upon which presses an ordinary screw, forcing the springs down upon the friction plate with more or less friction, according to any predetermined pressure put upon the screw. The maximum load is set for three tons friction upon the rails, ordinarily one ton is sufficient, in which event, one ton pressure, derived from motion of the train causes the buffer to slide upon the rails for a distance of 2 to 10 feet, according to speed and weight of train. The one ton frictional resistance, for ten feet, will overcome the momentum of a train that otherwise would strike a blow upon the ordinary bumper of over one hundred and twenty tons, which force is competent to break the bumper, the platforms, etc., and to cause in less than one minute of time several hundred dollars damage. This accident is impossible with the friction buffer.

The middle buffer has a front projection, shown, to receive the nose of the pilot of engine. The pressure here is so moderate that it in nowise tests the strength of the pilot; in fact a 2-inch square wooden rod, 4 feet long, will take the entire strain put upon the buffer. The middle rail employs one length, or less, of rail, and is firmly spiked in place with notches in the rail, to prevent sliding of the rail. The two outer buffers have elevated projections, 18 inches high, the front portion of which is capped with wood, to receive the bolts and nuts on the brake rods, etc. The car wheels or the brakes touch the outer buffers, and all three buffers slide together by reason of the cross brace-rods, clamping all firmly together. These buffers should be placed on new rails, to insure uniformity in the friction action on the rail.




"SHAW'S FRICTION BUFFER"
For Depots and Railroad Sidings, Engine Houses, etc., absorbs the force of moving trains when the brakes fail to stop the train and arrests the moving car or train without destructive effect.
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THOMAS SHAW, M. E., PATENTEE,
No. 915 Ridge Avenue, Philadelphia, Pa., U. S. A.

"Few engineers," says the inventor, "will credit the enormous force exerted when arresting suddenly a moving train of 100 tons weight striking an ordinary buffer, which stops the train in the limits of about one inch after touching it. Presuming the train to be moving at the rate of 8 feet per second, which is a moderate speed in depots, the resulting force equals 9,600 tons. Presuming that the bumper and the platform of the cars are competent to withstand this load (they are not), the platforms and bumper are crushed, while the cars move onward until this force in the moving train is overcome in ripping timbers, and smashing every obstruction in the way, a kind of accident which has been witnessed more or less by every railroad employee of any experience."

Another system for attaining the same end is shown in the large engraving wherein hydraulic resistance is employed to arrest a train, instead of friction.

The CUSHION BUFFER consists of an iron frame, *b*, secured on brick or stone foundation, *a*, and held from any sliding action by bolts properly secured. The vertical posts, *k*, are braced securely by heavy cast-iron brace, *m*, bolted in place, all of which gives firm support to hydraulic cylinder, *e*. At *p* the cylinder is provided with piston, *c*, and ram, *d*, of heavy wrought iron, on the outer end of which is a metal head, *v*, of any shape adapted to ordinary cars, and a cross-head *f* (shown in transverse section, Fig. 3,) supports weight, and guides the plunger rod, when at its furthermost limit; the lower end of the crosshead being provided with the flange wheels, *g*, to guide it upon the track. A smaller wheel *h*, catches beneath flange of rail to prevent any lifting of the crosshead. The cylinder, *c*, is filled with oil, water or glycerine, and is provided with an outlet, *n*, covered by valve, *n*, kept in place by spring, *o*, controlled by screw, *r*. Said valve is set at any predetermined pressure to be sustained in cylinder, *c*, which, for example, may be three tons. In which case a moving train coming against the ram head, *v*, will exert a pressure of three tons on area of piston head within the cylinder. This pressure will open the spring valve, *n*, permitting the fluid to escape under that pressure into the chamber, *o*, and from thence to the outlet pipe, *s*, to any elevated tank of sufficient capacity to hold the fluid ejected from the cylinder, *c*.

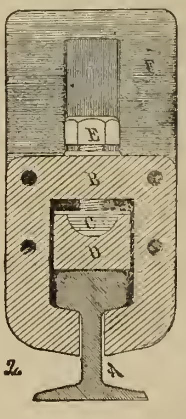
The fluid escaping in the manner indicated, offering a constant resistance to the plunger, *d*, gradually absorbs the force of the moving train without any damaging effect, that would otherwise ensue when the train comes against the common bumper in the ordinary way.

Mr. W. Lorenz, C. E., of the Philadelphia and Reading R. R., attests the value of the friction buffer in a letter to the inventor, and states that he has tried many experiments with it satisfactorily.

Mr. Thomas Shaw, the well-known mechanical engineer and inventor, is the designer, and will furnish prices by addressing him at 915 Ridge avenue, Philadelphia.

A GEM OF PUREST RAY SERENE.

THE MECHANICAL ENGINEER.—There are very few papers on our exchange list in which we place more reliance than THE MECHANICAL ENGINEER. Although it makes no great stir in the world by trumpet-blowing or bell-ringing, it has an influence far beyond that of many journals that put on more pretentious airs. The great feature of this paper is, that the editors keep down to everyday matters, and never fly sky-high over the heads of their readers, and the reason of this is, that the writers have themselves handled the hammer, the chisel and the file; they are practical men, and write for practical men.—*Builder and Wood Worker.*

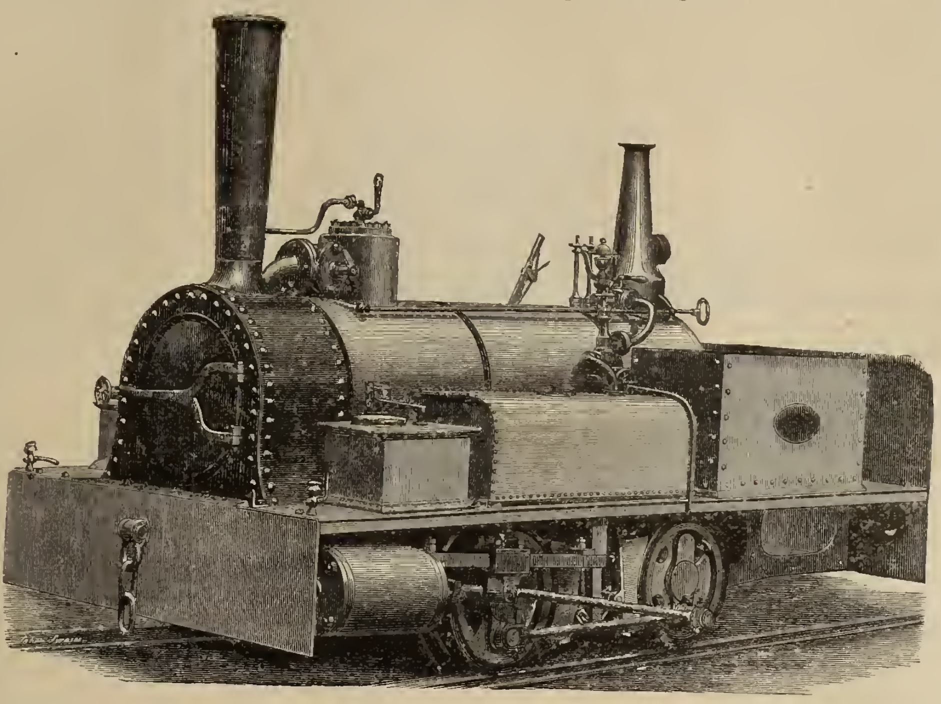


* * *

A correspondent in the English *Contract Journal* asks: "How it is our paper makers are compelled to go to America for the best chilled rolls for glazing calenders?" and says, "Neither our English nor Scotch Engineers can, or do, produce any as good as the Americans."

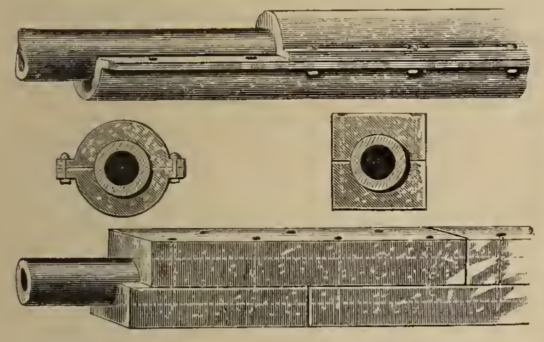
ENGLISH TANK LOCOMOTIVE.

This engraving represents a small locomotive used in England for charging coke ovens. It runs on a track directly over them and does the work of six men with great ease, one man being able to charge 15 ovens only per day, as against 90 by this engine, with a great saving in wages. In dimensions it is 9 feet over all, 5 feet in width, and weighs 3 tons. The wheel gauge is 3 feet 6 inches, and the diameter of them 20 inches. The cylinders are 4½ inches diameter by 9 inches stroke. It is a compact little affair, and similar engines could be used, modified to suit American ideas, in this country.



AN EXTRAORDINARY MATERIAL.

A new material in the arts, has just been put on the market, which, for useful qualities in the trade, has no superior. It is called *Terra Cotta Lumber*, which is somewhat confusing, by the way, to those who have never seen it. In color it varies from a light buff to a fiery salmon; in appearance it is similar to a slice of bread, that is its cellular structure is similar; in weight it is about the same as cinder of the same bulk; in characteristics, however, it is totally unlike any other substance known. It is exceedingly refractory to fire, and resists more intense heat than fire-brick, while in addition it is quite tractable to edge tools; it admits of driving nails in it and can be handled by artificers precisely as wood is. It can be used in the place of it for buildings, or it can be put up for bridge walls of boilers and smelting furnaces. The Babcock & Wilcox Co. are using it for lining the doors of their boiler furnaces. This really wonderful material is entirely neutral as regards fire and water, neither having any destructive effect upon it.



What is more remarkable is the fact, that the material from which terra cotta lumber is made, is a waste substance, two of them, in fact—the top layer of fire clay beds and saw dust. The top layer clay has always been found useless for ordinary fire-brick, and is thrown on one side.

Sawdust is a genuine waste product. By the union of these two, when fired, is produced the material under notice. The engravings appended show some of the uses to which it can be put. The slabs or brick can be moulded to any shape and formed to fit particular positions. If repairs are needed at any time, holes can be bored in it or pieces sawed out as if the substance were wood.

The Company are over-run with orders for it and we make this notice to keep our readers informed of the latest discoveries useful to them.

◆

A non-conductor of electricity has yet to be found, for all substances hitherto discovered are conductors of the force under certain known conditions; but those which offer a great resistance to it, serves the purpose of non-conductors in practice, although they may be all classed as good or bad conductors. The best conductor at present known is silver, the worst conductor is solid paraffin.—*Mechanical World.*

◆

An extraordinary mechanical curiosity will be illustrated in the next issue of this paper.

GREAT GUNS.

A memorable year in the history of artillery science has ended with some conclusive experiments at Spezia. The new steel and compound armor plates are shown to be able to withstand any known projectile, even the 2,000-pound Whitworth steel shot from the new 100-ton gun. Artillerists abandon the idea of perforating the armor of the future, and will now turn their attention to the construction of larger guns and the use of enormous projectiles, so as to gain the greatest possible total energy of blow. Hereafter the effort will not be to perforate a ship's armor, but to crush in her whole side by the impact of a projectile weighing two or three tons, and having a striking velocity of 1,500 feet per second, and a total energy of about 100,000 foot tons. With such ordnance it becomes not so much a question of the vessel's exterior armor as of her structural strength. The 100-ton breech-loader used is 39 feet long, 17 inches bore, takes 700 pounds of powder at a charge, carries a shot weighing a ton, and can be loaded, aimed, and discharged by the hand of a lady in less than one minute, so simple is the machinery by which it is operated. It was powerless, however, against the new steel and compound armor.—*New York Sun.*

REMEMBER THESE THINGS.

A note dated on Sunday is void; one obtained by fraud, or from an intoxicated person is void. If a note is lost, or stolen, it does not release the maker of it; he must pay. A minor's note is not valid. Notes bear interest only when so stated on the face of them. Ignorance of law is no excuse. It is fraud to conceal fraud. Signatures with lead pencil are valid. A receipt for money is not conclusive proof that a debt has been paid. Acts of one partner bind all the others.

◆

MAKING ESTIMATES FOR CONTRACTS.

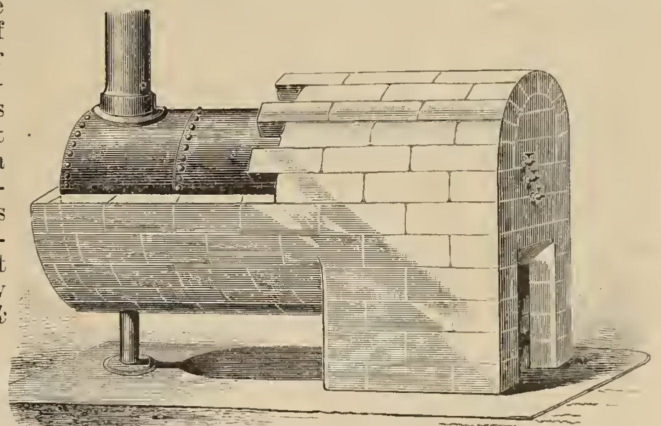
"In dealing with forgings, which are usually of uneven form, the method is adopted of reducing them to bar or plate iron; and here a little practice is sometimes required to see at once the readiest way of taking out the weight. Another way of working out the weight of awkward shaped forgings, is that usually adopted for castings, whether iron, brass, or other metal, that is: bring them to cubic inches and multiply by the weight per inch, which for wrought iron is 0·28, cast-iron 0·26, and steel 0·283 lbs.

On the other hand the casting may be taken out as wrought bar iron, multiplying the resultant weight by 0·95 for weights in cast-iron, 1·02 for steel, 1·16 for copper, or 1·09 for brass. When calculating the weight of irregular sections of iron, such as girders, channel rails, tyres, etc., it will sometimes be found convenient to have drawn out on a piece of tracing paper a 6 inch or other convenient sized square, divided into square inches by heavy lines, and into smaller squares of $\frac{1}{100}$th part of an inch by thin lines, that is, divide the sides of a 6 inch square into six parts each way by heavy lines, sub-dividing each into ten parts, so that the whole paper is divided into small squares of $\frac{1}{100}$th part of an inch; and if this be placed over the full-sized section of the rail, or other required section, and the number of squares contained in its area counted, then dividing by 100 will give the number of square inches, and this, multiplied by 3·33, will give the weight per foot. For instance, suppose the area of a particular section to contain 635 divisions, then the weight per foot will be 6·35 × 3·33 = 21·14 lbs.

The weight of bolts or rivets must be taken from a table of weights, but for such small items as nails, washers, etc., it is generally the quickest way, if no table is available, to weigh, say ten of the particular kind required on a scale, and calculate the weight of the total number from this, because scarcely any two samples of nails weigh the same.

If for a large contract, the safest plan is to obtain quotations from the manufacturers for all plates, channels, and other heavy items, so as to avoid any after risk in the fluctuation of the market price, by binding them to keep their quotations open for a certain length of time.

In estimating the labor on a contract, considerable judgment and practice is necessary to arrive at a near result, and this portion of the estimate is in many engineering establishments given in by the foremen of the various departments; but if the work is similar to any that has been already executed, the amount for labor may be advantageously based on it, by making an allowance for any alterations or differences.
—*The Mechanical World.*



◆

According to a local paper, in the coal regions, a new size of anthracite is now being put on the market at some collieries. It is called "corn" size, and, as its name intimates, is next above buckwheat. It is thus prepared: "Culm that was formerly dumped on the bank as worthless after the buckwheat coal had been screened is run into a screen with meshes about $\frac{1}{8}$ of an inch square. This screen revolves rapidly, and a stream of water is forced into it, which washes the dust into troughs and allows the coal to drop into a chute. It is then dumped and remains in stock until sold. It brings from $1.25 to $1.50 per ton.

◆

The Browne & Sharpe M'f'g Company, of Providence, R. I., have put on the market a a metallic, triangular scale for draughtsmen, which is superior to the boxwood scale commonly used, inasmuch as it neither chips on the edges, or alters in length. They will send an illustrated circular of it.

◆

Indices for Vols. III. and IV. now ready, price one dollar.

Marine Engineers' Association No. 3, of Detroit, favors us with a handsomely printed card of invitation to their annual ball, which occurs on January 10th. It is needless to say that it would give us pleasure to attend, but unfortunately, at this season, we have to think of business before pleasure.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

A HINT TO CORRESPONDENTS.

Editors Mechanical Engineer.

I think the correspondent's department most instructive, and for one, wish that subscribers would write oftener. There is scarcely an Engineer but has had some experience, peculiarly his own, which would be full of information for your readers if written up. Something, perhaps, with reference to a boiler explosion, or the bursting of a fly wheel, defective draught and its remedy, a change from a throttling engine to an automatic, and the results, etc., etc.

I venture to make a few suggestions which the older heads know well enough, possibly they may give younger ones some new ideas.

First, when an engine has made one half of a stroke the crank pin has not made one fourth of a revolution. In other words, when the cross head is midway of its stroke, the crank pin has not reached a point half way from one center to the other. As the length of the connecting rod is the distance from the center of the main shaft to the center of the cross-head pin, at mid-stroke, it will be readily seen that if the crank end of the connecting rod be dropped, when in this position, that it will fall short of reaching the exact center of the main shaft

Again, when a cylinder head is in place and the bolts properly set up, there is no more strain upon them (the bolts) when the engine is working than when standing without steam. Should any one question this proposition, I should be pleased to see it discussed.

Ravenna, O. W. M. Chapman.

[The correspondence of our friends is, as Mr. Chapman says, one of the most interesting features of the paper, and we shall be glad to hear from new friends everywhere. Our circle has widened greatly this year. —Eds.]

THE SLIDE VALVE.

Editors Mechanical Engineer.

I want to get a good work on the slide valve. I know of several, but which to select puzzles me. I was tempted to get *"Link and Valve Motion"* by Wm. Auchincloss, but I fancy it is a book more suitable for an engine builder than a stationary engine driver. Then there is a book by Hugo Bilgram on this subject, another by C. W. MacCord, one by Burgh, and still another by J. Rose, and I might add another by Dr. Gustav Zeuner, (all advertised in Spon's Catalogue,) I am no hand at geometry (wish I was) so I do not want to buy expensive books far beyond my comprehension. Can you oblige a reader by naming the most practical book on the slide valve? I wish to study its action, and began to make a model, but am bewildered at every step.

Ignoramus.

[The works our correspondent names are standard on the subject, with one exception, that one being chiefly a re-hash of all the others. We know of no work on the slide valve, or any other detail, which will give a person knowledge of the subject without study. He will naturally, perhaps, feel bewildered at first, until he has mastered the details. There is nothing so intricate about the subject that it cannot be comprehended by application.—Eds.]

TRACING PAPER.

Editors Mechanical Engineer:

Of what is tracing paper made, and how can it be prepared? I am a long way from stationers' stores and would like to know how to prepare it myself.

Tennessee. Scale Protractor.

[Tracing paper can be made by saturating any strong thin paper with castor oil, cut with absolute alcohol. The alcohol quickly evaporates and leaves the body of the sheet translucent, without grease. Our correspondent can get tracing paper by mail by writing to dealers advertising in The Mechanical Engineer.—Eds]

BUCKLING OF BRASSES.

Editors Mechanical Engineer:

The bearings of a large shaft of an engine I am running have troubled me by heating. Thinking it might be caused by too close fitting of them, I took them out and filed them so the bearing was only a little over one-third of the surface; this was to give the oil a chance to get in all around. It did not remedy the heating, which continued as before. I again took the brasses out, and found that they bore all round, in spite of previous fitting. This makes me think that the brasses spring under the weight of the shaft and cling around it like clamps.

There is no way to remedy the matter, that I know of, without getting new pillow blocks. I would feel obliged to you if you could suggest a remedy. The heating gives a great deal of trouble.

New York. Siphon Gauge.

[Our correspondent's trouble is not an unusual one, and undoubtedly proceeds from the cause mentioned. He omits to give the size of his shaft or thickness of brass. If he will put in a cast iron box on the bottom, we think he will have no more heating. Cast iron is one of the best metals for bearings.—Eds.]

AUTOMATIC TIME-KEEPER WANTED!

Editors Mechanical Engineer:

In your issue of Dec. 23, 1882, of The Mechanical Engineer I notice an article and illustration on *"An Automatic Time-keeper."* Desiring something of the kind, I would like, if you can do so, to have the address of the manufacturer, or where they can be had.

Your truly,

Cleveland, O. Chas. N. Kuntz.

[This is an English invention and not on sale in this country. There is a hint in it for an enterprising inventor.—Eds.]

FROM ONE WHO KNOWS WHAT HE IS TALKING ABOUT.

Editors Mechanical Engineer:

I receive and read your paper as thoroughly and with as much interest almost as the paper I am connected with. The fact that it is practical and direct, with no unhealthy theories or hobbies to weary its readers, makes it most acceptable to me. It is eminently a paper for practical men, and I find in my travels that it is a constant and welcome visitor to railroad shops.

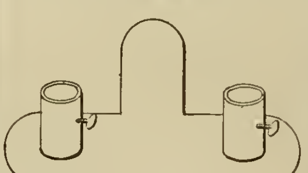
Delaware, O. Frank C. Smith.

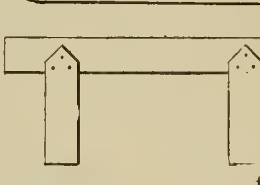
A HUB TURNER'S REST AND CHISEL.

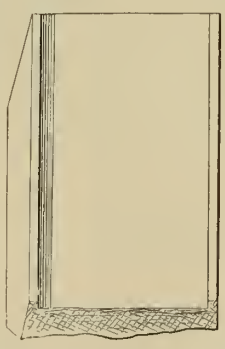
Editors Mechanical Engineer:

Among your readers I fancy there are lots of pattern makers, and others who work at wood turning lathes for their bread and butter, so perhaps a description of the following convenient tools will interest them. Perhaps these fixings are old—Solomon said, "There is nothing new under the sun"—but I see few shops where they are in use.

All turners know the annoyance of a spring rest. As generally made they only have one socket; then they have to be supported at the ends by short pieces of stick, or the rest will vibrate.







I use a rest as shown in fig. 1. It is of cast iron, all in one piece, with a slot on the bottom for the bolt, to key the rest down to the lathe bed, and it is provided with the ordinary screws for keeping the rest at the proper height. The rest itself is also shown. I have a piece of steel riveted to the top edge, as cast iron wears so unevenly, and it is important to have a nice true surface for the tool to slide on, or it will surely dig into the work, especially when the paring chisel is used. For holding the rest to the lathe bed the eccentric cam is a good thing, better than the wedge so commonly used. Any turner can turn one out of a piece of 1½″ hard plank, it only needs a short handle; then get a piece of scantling as long as the width of lathe bed and cut a slot the thickness of the eccentric.

The chisel shown has no equal. I am a hub turner, and use it for cutting down the ends of hub blocks and forming the bands. It is no fun cutting about two inches off a rough block 14 or 16 inches in diameter with a gouge and ordinary chisel. This tool is also handy in cutting shoulders, etc. The lips should not be so hard that they cannot be filed, as that is the only way of sharpening them. The chisel is made from a piece of steel 1⅝ in. wide, ½ in. thick, and should be about a foot long in the blade. It is planed out about ⅛ in. deep, leaving a rib on each side 1–16 in. thick. It should have a good, stout, long handle.

Be careful when first using it, as it acts ugly if it is not properly handled.

Walter Burdekin.

THANKS IN GROSS.

To those who have written kind words respecting the change in The Mechanical Engineer we return sincere thanks, and assurances that their expressions are not lost. We do not receive them as matters of course, but as greetings from personal friends.

"FOOT-BOARD'S" EXPERIENCE.

Editors, Mechanical Engineer:

Noticing a paragraph on the front page of No, I., Vol. V., giving instructions for firing locomotives. I would like to relate my experience. I served my time at firing soft coal, and one day on the Baltimore and Ohio Railroad I was firing an engine that had a fire box eleven feet long, with a crown sheet, only about five feet from the grate. She was filled up pretty near to the crown sheet, and the traveling Engineer happening to come along and look in, saw this. He yelled out: "Young man! suppose you were to run off the track, or get run off, how in —— would you ever get that fire out of her?"

I told the worthy gentleman I was not firing that engine to go off the track, or to get run off, but to make steam, and that was the way to make it.

As to black smoke coming out of the stack, showing that an engine is not working (steaming?) at her best: all I can say is, we never had so much steam on as when we had black smoke out of the stack. When she was smoking she was steaming. I have read in your paper and heard others say, this is an evidence of bad firing and waste of fuel, and that it is contrary to the theory of combustion. All I know about theory is to get as much steam as is called for, and when we are on a grade and she smokes heavy, she is "bilin!" I would like to have some locomotive fireman corroborate this or disprove it.

Ohio. Foot-board.

BUTT WELDS AND LAP WELDS.

Editors, Mechanical Engineer:

In No. XIII., Vol. IV., of your valuable journal, "B. T." objects to the method of scarfing shown in my article on lap welded tubes, and shows what he considers the correct form of scarf.

A moment's thought will convince any one that the scarfing shown in his sketch can only form a butt weld and not a lap weld. As to testing before or after threading, it is best to test before threading, as the testing develops all defects, and if the pipe is faulty the expense of threading is saved.

Pittsburgh. L. C. Danse, C. E.

TESTIMONY OF GREAT VALUE TO US.

Editors, Mechanical Engineer:

A paper of as much value as The Mechanical Engineer is well worth its price, and if it were doubled I certainly would never be without it, so long as it maintains its present standard of excellence. The only change I could wish for would be to have its size doubled, and issued weekly.

There is not a first-class mechanical paper published in this country but that I have some time been a subscriber to, and I have taken the —— —— for 8 years, but I am free to say that your paper far excels them all in valuable matter, in a comprehensive style suited to those for whom it is intended.

In an experience of 21 years as an engineer I have fully realized that just such a journal as yours, is one of the things most urgently needed by the average engineer, and would be fully appreciated by almost all of them; though I have met some to whom it would be of no use. They "know it all" now! You will always find an interesting museum in and around the engine rooms of such men. I think I can relate at least one circumstance that will parallel most every-day experience, and I intend soon to muster up ambition and send it to you. But I will reserve the rest of my flattery for some other time, lest you become puffed up, etc.

Kingston, Ill. L. P. Harvey.

[Our correspondent lays us under great obligation by his communication, for, as he represents a class, he tells us just what we are very glad to know, and that is that our efforts to please are appreciated. He and others will see, as time goes on, that we are not unmindful of the attentions shown us.—Eds.]

SOME LOCOMOTIVE NOTES.

It a recent trip over the Pittsburgh Division of the B. & O., the writer noticed three of the engines particularly. The first was engine 735, American pattern. In this engine the entire back of the boiler was lagged and jacketed with Russia iron, giving it a very neat appearance. I never could see why the part of the boiler in the cab should not be jacketed like the barrel outside, and think such a jacket highly desirable.

Engine 738, is a ten-wheeler, with smoke-box extension and straight stack. Since the extension has been applied she is rated the best freight engine on the road. It is gratifying to see this device being introduced on freight engines as well as on passenger.

No. 760 is a saddle-tank, Mogul, used as a shifter in the Connellsville yard. She is very neat and graceful, and rated the best yard engine on the division. A highly commendable feature is the Engineer's seat. This is a regular pivoted chair, having a back, and upholstered in the green oil cloth used on box seats. Being pivoted it does not in the least interfere with the engineman's movements, and adds greatly to his comfort by supporting his back. It is to be hoped that some such arrangement may be extensively introduced.

Before closing, it may be well to mention a fact regarding reverse levers. The writer recently heard a discussion as to why certain engines are harder to handle than others. Perhaps the least thought of cause of hard handling—although a frequent one—is a crooked lever, or reach rod, or both. Engines with straight levers and reach rods invariably handle easier than those with crooked ones.

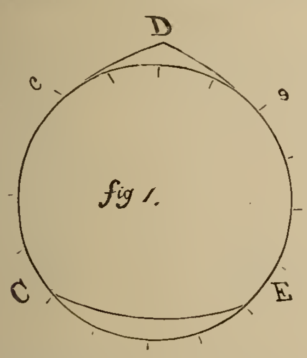
L. O. Danse, C. E.

["Handling easy" and "handling hard," are, it seems to us, independent of the shape of the reach rod. At one point, that is when the strain of the eccentrics hauling on the valve is off, the engine can be handled without difficulty, but with the eccentrics in full throw, a man, undertaking to reverse an engine, will be pitched through the front window. The only effect that a crooked reach rod might have, that we can see, is its spring.—Eds.]

THE PITTSBURGH CAMS.

TO LAY OFF THESE CAMS.

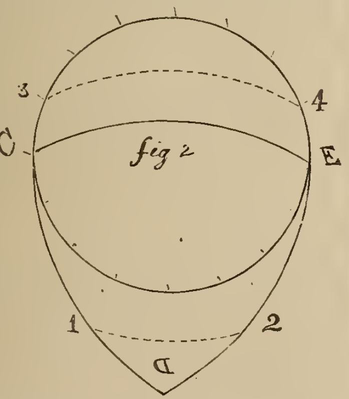
With a radius, dependent upon (determined by) the stroke of the valve, describe a circle as shown, which divide into any convenient number of equal parts.



For a half-stroke cam, fig. 1, count off one half of the divisions of the lower half, and from the points thus determined, with a radius equal to the diameter of the circle, describe the arcs terminating at *D*, and from this point as a center, with the same radius, the arc, *C E*; the inclosed figure will be the cam required.

While the cam is traveling from *C* to *c*, that being an arc of a true circle, no motion can be given to the valve, but while it travels from *C* to *e* the valve is opened and shut. Now, as the piston moves from one end of the cylinder to the other, for each semi revolution of the cam, and as the distance from *C* to *c*, is the same as from *c* to *e*, the valve necessarily remains closed during one half of the stroke.

In a quarter stroke cam, the distance from *C* to *E* is one fourth of the division of the lower half. In a three-quarter stroke cam, three-fourths, etc.



In the full stroke cam, as no part of the outline is concentric with the shaft, the valve must be in motion all the time the cam is in motion. Instead of making the point, *D*, (fig 2), sharp, it can be turned off as at 1, 2, and to retain the same dimensions on the cam, an equal amount must be added, to the arc, *C E*, as shown 3, 4.

This will not alter the point of cutting off, but it reduces the travel of the valve and has the effect of keeping the valve stationary when wide open, while the cam travels through the arc, 1, 2.

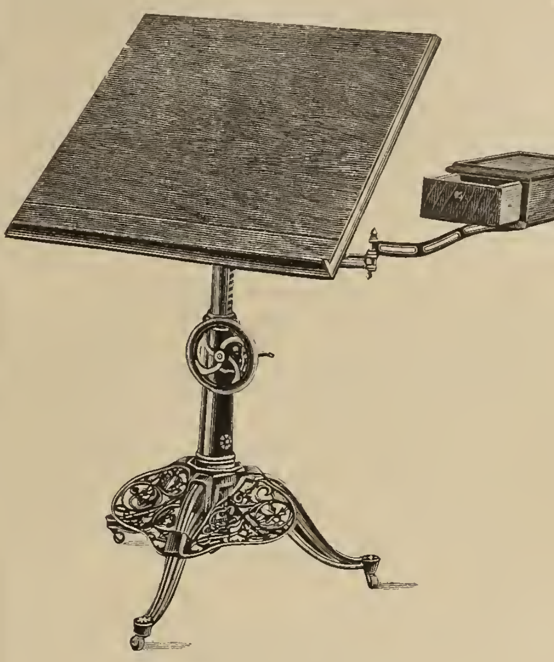
William M. Henderson, M. E.
Philadelphia.

The Putnam Tool Company are about occupying their new premises, which they have been building the past year. Some final touches remain to be added, but "the whistle will blow Jan. 1st." says Mr. S. W. Putnam.

If every one who gets a sample copy will send a sample of the kind of $2 bills he is most familiar with, he will be treated with distinguished consideration.

Preserve this copy if you subscribe, as we cannot guarantee to duplicate it.

Some steel plates were recently rolled in Cleveland, by the Otis Iron and Steel Co., which were fifty feet six inches long, fifty-one inches wide, and three-eighths of an inch thick.

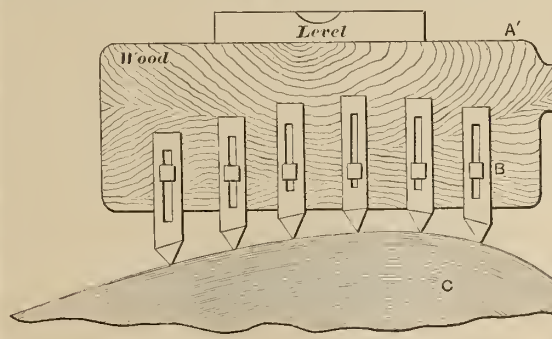


DRAWING TABLES.

A very convenient table for draughting is that here shown. It is capable of adjustment in the angle of the board, and can be raised or lowered to suit any height, by the rack and pinion in the column. The cabinet at the side is also very useful to hold the various instruments needed. It is made by Keuffel & Esser, 127 Fulton St., N. Y., who will furnish catalogue of drawing materials on application.

AN ADJUSTABLE TEMPLATE.

What may prove a handy tool in some cases, is here illustrated. It is intended for taking contours of castings where it is inconvenient to work with tools to make regular templates. It is easily understood by the engraving wherein *A′* shows a board fitted with slotted battens *B*. These latter can be raised or lowered to touch any hill or hollow; by chalking them and using a pair of dividers in a manner understood by any mechanic; lines can be drawn on them from the surface of the casting and a template quickly made in the shop where tools are handy. The level on top is to secure a right line to work from.



A friend, who saw the proof of this engraving before publication, thinks that he has also seen a similar instrument in shops, but cannot say where. It is not expensive, and may save time.

Mr. Andrew E. Arnold, a well-known machinist of Newark, recently informed us that to his knowledge, a tool made from Mushets steel turned the face of a fly wheel 25′ diameter by 7½′ face without requiring to be reground. The cut was ¼ of an inch deep, metal removed, and the feed was $\frac{1}{16}$ to the inch. This is extraordinary duty.

A few back numbers containing the commencements of the serial articles now running can be had by early application.

PATCHING A STEAM CYLINDER WITH WOOD.

The steamship *Sandringham* was on a voyage, in October, from London to Galatz. When going full speed, making about 59 revolutions, the engines suddenly brought up. The chief engineer, Mr. Watson, hurried into the engine room, and taking a lamp, examined all over without finding any cause for the accident. He next lifted the valve casing, but everything was found to be in order. The low-pressure cylinder cover was then taken off, and on the starboard side of the cylinder a hole was discovered about 3 ft. square, the pieces of metal belonging to which were found lying on top of the piston. The weather being squally, with a high beam sea, no time was to be lost, and the happy idea seems to have presented itself to the mind of the chief engineer to make a wooden patch, which he proceeded to do by getting a piece 2 in. thick by 6 in. wide, which he put between the jacket and the cylinder face, bedding it close at both ends, and holding it by means of countersunk screws through the cylinder face. Six such pieces were put in and secured in this way, and then some hard wood was used to make the recess, still remaining, flush with the working face of the cylinder, the hard wood last spoken of being screwed to the 6 in. pieces first mentioned.

Only seven hours were taken up in making this ingenious repair, and the cover being again put on, the engines were tried with about 45 lb. of steam, and allowed to work at half speed until the steamer was brought safely into harbor. The engines were at Syra, thoroughly repaired, and great interest appears to have been excited by Mr. Watson's wooden patch.—*London Engineer.*

DEFECTS OF MODERN PARLOR STOVES.

The improved stove is recommended as "a thing of beauty" as well as utility. It is designed in part for "a parlor ornament." It is constructed largely of mica, which is one of the poorest conductors and radiators of heat known. It is employed to excellent advantage in the construction of refrigerators and fire-proof safes and vaults, but to very poor purpose in the construction of heating apparatus. A hundred pounds of coal might be burned in a stove constructed entirely of mica without radiating heat enough to comfortably warm a small bed-room. A considerable portion of the outer surface of these stoves which is not mica is nickel, copper, or silver, rendered very smooth, and highly polished. If one should seek by careful study, observation and experiment to find materials that would radiate the smallest amount of heat, he would finally select the substances named and would finish them in the manner they appear in modern parlor stoves. The remaining parts of the stove which require strength are made of iron, it is true, which is, when rough, a very good radiator. In the stove, however, it is highly polished or covered with plumbago, which is rubbed till it is as smooth as plate glass. In this condition it is a very poor radiator of heat. The stovepipe is made of very smooth iron plate glazed, or highly polished. If it were specially designed for carrying the products of combustion up the chimney without their parting with any of their heat, it could scarcely be made in a manner that would suit the purpose better. In fact the entire heating apparatus, from the carpet to the ceiling, is constructed of about the poorest materials possible, if the object be to afford a large amount of warmth at the cost of a comparatively small amount of fuel. Only one change can be suggested that would render it less effective, and that would be having the entire surface of the metal coated with burnished silver, nickel, or tin.—*Chicago Times.*

Messrs. F. C. & A. E. Rowland, New Haven, Conn., have their new shop nearly completed. It is well arranged and has facilities for doing the best machine work. The Messrs. Rowland have had long experience as engineers and machinists.

THE

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FORTNIGHTLY.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

THE COMPOUND ENGINE.

The various efforts made by some writers to simplify the subject of using steam expansively, in compound engines, are not remarkably successful, for the simple reason that the matter is an abstruse one, by no means simple, in any aspect. It requires a wide range of experience and engineering information, to construct a compound engine which shall perform satisfactorily and be harmonious in all parts. When we say harmonious we mean, that the power of one engine shall be, to all intents and purposes, the same as the other, that the times of the valve motions shall be correct, and not liable to derangement in action, and that the relation of the valve motion of one cylinder shall not be interfered with by the other. Let us look at some of the conditions required, in a compound engine.

When steam is let into the high pressure cylinder of the ordinary engine it follows a certain portion of the stroke and is then cut off, to expand the remainder of it. The average of all the pressures at various portions of the stroke gives, of course, the mean (total) pressure on the high pressure piston. This together with its diameter, and speed in feet per minute, fixes the power exerted in that cylinder. Now suppose that the exhaust of the high pressure cylinder escapes into a receiver, it at once falls in pressure, because it fills more space; it is degraded so to speak. This degraded pressure is all that we have to act on the low pressure piston, and its dimensions (diameter) must therefore be such that the power exerted in it is equal, no more and no less, to that of the high pressure. This is one of the nice points we alluded to previously.

The dimensions of the low pressure cylinder turn wholly upon the mean of the degraded pressure in the receiver, acting through the stroke,—that is to say, the pressure in the receiver and the dimensions of the low pressure piston do not indicate the power exerted by it. It is the mean of this degraded pressure, acting through the whole stroke of the low pressure piston which fixes it. This may be anything, according to the manner in which the engine is constructed. It becomes exceedingly variable when there is no cut off upon the low pressure cylinder. In such a case the low pressure piston is wholly dependent upon the terminal in the high pressure cylinder, which, in its turn, may be anything, according to the steam on the boilers and point of cut off. Now in addition to this there is the vacuum to derange matters. Suppose the engine is calculated to work under twenty-six inches of vacuum, and, from defects in construction, we are able to get only eighteen to twenty inches! In such a case the back pressure forms a large element of loss and a factor against us,

It is with no idea of introducing any new theories of construction, that we have made these remarks, but rather to protest against the position assumed by some, that the compound engine is a very trifling affair, easily designed, and its proportions fixed. We think this remains to be proven.

The compound engine is not simple, if our readers will permit us to use the expression. Indicator cards betray a very wide range in the power exerted by each cylinder, and very great losses from want of proportion. Those who find that a single engine working through the same range of expansion with equal areas, is just as economical, have some foundation for their belief, and their assertions, when low pressure cylinders are so enormous, that the steam by the ratio of diameters and point of cut off, is expanded sixteen times; and when the pressure above the atmosphere in the low pressure cylinder is a mere "tit" on the card, scarcely visible.

We say the compound engine is complex not simple. We do not say it on account of its mechanical arrangements or devices, or its combinations of any form, but we say it by reason of the varying and diverse action of the steam in its cylinders and by the varying power obtained from it through want of proper proportions. We say so because the proportions of the receiver even, affect the action, and because through expanding steam in two cylinders and heating the walls of these, elements of loss are set up, which are almost impossible of detection and prevention.

RELATING TO STEEL.

Notwithstanding the circulars of manufacturers, which assure us that steel is entirely uniform, and that it is subject to certain known laws (which expression they modify by adding "not so well-known as they should be"), the fact remains that steel is as variable as domestic bread, and is good, bad or indifferent, according to the care displayed in its manufacture.

This leads us to remark that we quite coincide with the expression above quoted, where it says that the laws are not so well known as they should be. They certainly are not. When a manufacturer of machinist's taps, for example, finds that a steel, which he has used for some time with satisfaction, suddenly acts in a most unexpected and injurious manner under the same careful attention formerly given it, he is apt to feel that he would like to know more. If he asks the steel-maker himself, he will often be told that his (the machinists) men were careless, and that over-annealing or under-annealing, or centering too deep, too quick heating, or too quick cooling—some one or all of these things, have been improperly done, and there the matter ends, if we except adjustment of damages for loss incurred, which, let us say, steel makers are always willing to consider fairly.

It strikes us as premature to say that the laws governing the action of steel, or its curious behavior under the same mechanical conditions of manipulation, are well known or can be always accounted for. Certainly foreign steel makers do not hold these views, or foreign professional men generally, for they find the widest range of behavior, wholly unaccountable from the carbonization of the stock from which it is made. Past issues of this paper are full of reports of the discussions of scientific men, wherein they confess themselves puzzled by certain phenomena. Doubtless many of the variations in quality occur from causes that cannot be prevented, say for example in the stock itself, the quality of the carbonizing material and also the crucibles. The best brands of iron have faults which are not always located, or rather found out until too late, and the same is true of the other materials and agents used.

Our experience teaches us that the best brands of steel require constant watching through every stage of treatment, to detect inequalities and faults, and that no name or make, however celebrated, is entirely faultless, or beyond suspicion. We believe this experience to be common with all steel workers who handle it in quantity.

A LOST ART.

Judging from daily examples, making steam tight joints on pipes is a lost art in this city. In no other way can we account for the constant trouble from this cause The American Steam Company is having. Scarcely a day passes but that joints blow out and leaks of greater or lesser magnitude are discovered. Quite recently the whole street, in a section over a pipe, went into the air, from bursting of an elbow. This sort of entertainment, with variations, has been much too frequent this fall.

There is no occasion for it, as all engineers know; but if steam pipes are put down on the bottom of a trench, with nothing to support them except that, have no slip joints, and are adjusted in place by the average laborer, nothing else than the occurrences noted can be expected. Apparently cheapness of first cost in construction is a paramount consideration, and permanence the least; but by the time all the suits for damages are settled, the pipes torn up and relaid properly, as they should be, it will be found that it would have been cheaper to do the work ship-shape at first.

Perhaps less high-class engineering and more practical knowledge would have given better results and cost the Company less money!

RESPECTING BOILER EXPLOSIONS.

From the time the first steam boilers were put in use to the present day, casualties have occurred to them with greater or less damage to property and loss of life. When little was known of steam as a force, these disasters were attributed to all sorts of mysterious influences; boiler explosions were supposed to be inevitable and were submitted to as part of the risks involved in the business use of them. Theories on the most absurd and improbable bases were promulgated, and the more "obfuscated" and stupid they were, the easier they were swallowed.

This is a sample of the stuff we alluded to previously. It is cut from an architectural paper:

> "Every one knows that water, after long boiling, loses its capacity for quiet and steady ebullition, and assumes a violent and intermittent mode of evaporation, the temperature of the water often rising quietly to a point far above the nominal boiling point and then suddenly falling, with the instantaneous liberation of a considerable volume of steam. This condition, which has not been very satisfactorily explained, undoubtedly exists at the time of many boiler explosions, and it is desirable to find some means of avoiding it. This end may be accomplished, it is found, by restoring to the water the dissolved gas which is eliminated by boiling, and the particles of which seem to form nuclei around which steam bubbles can form rapidly and quietly. In one form of apparatus air is injected forcibly into the water of the boiler, and serves to maintain a quiet and uniform evaporation, and a chemical substitute for the mechanical addition of permanent gas is said to have been successfully applied by the simple process of placing pieces of zinc in the boiler. This, coming in contact with the iron shell, forms a voltaic pair, the

current of which decomposes the water about it, producing free oxygen and hydrogen, which serve, like air, to determine the rapid and steady boiling of the unchanged portion of the water."

This is, perhaps, a little the worst effort, in its special line, ever made, but there are others that come close to it. "Dissolved gas," indeed!

A few unbelievers dissented from the view that explosions of boilers were not preventable. They combated the idea that they were in any sense mysterious, and they pointed out that a steam boiler was a structure of iron, built to contain a certain force; that if it was strong enough for its work, and made by persons who had a clear idea of their responsibilities, it was as safe against explosion as any other magazine. These matter of fact persons made experiments which destroyed theories put forward, and showed to any one desiring conviction, that they were inevitable. So-called mysterious cases of explosion were investigated, and when sufficient of the original structure remained to form an opinion upon, defective condition and gross carelessness on the part of attendants was detected. These views thus put forward are held to-day by a larger class than ever before, and men of experience, familiar with steam boilers by everyday association with their construction, concede the points above made. There are still, however, a large class who, averse to investigation and wedded to hobbies, insist upon hidden causes (occult forces), as the sources of boiler explosions, and the mischief they do is very great. They inspire the timid with fears that are groundless, and lead unthinking persons to feel that attention to the boilers in their care is thrown away, for at any time, and without warning, a series of impossible events may occur and blow them up.

It is to appease such persons that we have written this article. We can say that a long experience among steam boilers, and personal investigation of many explosions and disasters, has not shown us one single case that could be called mysterious, or could be accounted for by any of the arguments of theorists. On the other hand, safety valves stuck fast, sheets corroded, braces carried away, bagged sheets, defective riveting, too few socket bolts and braces, and a host of similar things have been shown active in disasters.

If these views were simply held by an individual they would have no more weight than those of others, but they are not solitary or exceptional. The wide experience of *The Hartford Boiler and Insurance Co.*, of Hartford, coincides with it and its monthly reports are full of material instances where boiler disasters, of one sort or another, have been caused by the twin foes of safety—avarice and carelessness. The first, on the part of steam users' "penny wise and pound foolish," and the last also, through the same cause—that is, the carelessness occurred because the steam user hired a careless man at a low price, rather than a capable one at a fair price.

In conclusion, men in charge of boilers may rest assured of one thing, that, given a boiler strong enough for its duty, and proper attention to it, no disaster will ever happen. The proprietor who takes his chances, however, with boilers that are old, unserviceable, in many cases condemned, and expects to escape misfortune, is simply accessory before the fact. He gambles in a game where the odds against him are so great that no professional *roué* would assume them.

THE ROYAL ROAD.

It is frequently asserted that there is no royal road to learning or to riches, but there is one broad highway that leads to both, and that is through work. Intelligent labor accomplishes all things. "*Labor vincit omnia*," saith the proverb. "Labor conquers all," literally, and any one in the bonds of poverty or walking in mental darkness has only to take this motto to heart to attain any station or height. Work is the universal panacea for bodily or mental ailment of any kind. It is a cheap physician, a sovereign cure. It never fails. A man with a definite object in view, with work for his ally, will certainly attain it.

Faculty is much, natural ability in any one walk, is a strong staff, but even without adventitious aids the man who depends upon persistent effort to attain his object will not fail of it. Those who are discouraged and fancy their road is long and fatiguing, that it vanishes in the air, leading to nowhere, should plod along, keeping always their object in view. There is sunshine at the end.

A CURIOUS HOUSE.

An iron "palace" is being built in Pennsylvania, and following are some of the details of it:

"The floor of the hall, vestibule and library will be laid with polished cast iron tiles, in which different qualities of iron will be used to produce the same variety of color as in ordinary tile flooring,"

We are curious to know how this is to be done; red, yellow and blue iron is a novelty to us.

"Hollow iron walls and partitions will be used instead of chimneys, for conveying heat to different parts of the house and for ventilation. The hot smoke and gases from the furnaces, passing through the sides of the rooms in this way, will, it is claimed, be almost sufficient to keep the house comfortable in the coldest weather, so that the heating can be done with about one-half the fuel required in ordinary houses."

Very pretty in theory, but quite impracticable in reality.

"In the parlor will be a mantel of polished steel, handsomely ornamented. In the library will be a massive mantel, so constructed that it will look as if it were made of pig iron fused together. A curiosity in this room will be a cabinet for the exhibition of specimens of iron. This will be constructed entirely of strongly magnetized iron, so that all the specimens will adhere to the back of it, held in place solely by magnetic attraction."

The style seems to be quite I(r)onic throughout!

CONVEYING STEAM LONG DISTANCES.

Mr. W. T. Silver, of Salt Lake City, recently put in some machinery and boilers in the Emma Mine; the steam pipe is 1,800 feet long, and he says there is only a difference of one pound in pressure at the end furthest from the boiler. He writes to a contemporary asking if this is unusual, and is informed that it is, and that he "must have made a mistake."

Our view is that he has not, and that the mistake is on the other side. In the Gould and Curry mine Mr. R. G. Carlyle, the Engineer in charge, made some experiments in 1865, which are on record, and afford data in this case. The pipe was underground, and ran in all sorts of directions 1,341 feet. It was properly protected and trapped, and the loss of pressure at the end remotest from the boiler was undiscoverable by any gauge, siphon, or any other.

There is not necessarily a loss by conveying steam long distances. It depends wholly upon radiation, trapping off condensation, the size of the pipes, the number of turns, and the internal surfaces through which the steam flows.

The Engineer in question, Mr. Carlyle, declared that he would not hesitate to carry steam one mile if he could properly protect the pipes.

Our contemporary also says in another part of its paper that it consigns a good many questions to the waste basket every week; that would be a good place for some of its "answers," or guesses.

SPEED OF RAILWAY TRAINS.

Mr. A. L. Rotch, in a recent address to the Massachusetts Institute of Technology, gave the time of the fastest trains in this country as follows:—

Philadelphia Express, New York to Philadelphia, *Pennsylvania R.R.*, 88·4 miles in 112 minutes, equal to 47·8 miles per hour, including three stops; six cars, one of them a Pullman.

Philadelphia Express on *Bound Brook and Reading R.R.*, 89·4 miles in 117 minutes, including five stops; equal to 45·8 miles per hour. The greater part of the distance, 85·1 miles, was run 107 minutes, with three stops; equal to 47·7 miles per hour.

The fastest train on the *New York Central and Hudson River R.R.* is the Chicago and Lake Shore Special, which makes the run to Albany, 140 miles, without a stop, at the rate of 49·5 miles per hour.

It has been said that it is impossible for an engine with a 5½ ft. driver to make a mile in a minute. Mr. Le Van gives the greatest piston speed as about 1,200 ft. per minute, which would give about 59 miles per hour with such a wheel. On the Pennsylvania, the fast train engines had two pair of drivers 68 in. in diameter, and had to make 300 revolutions to make a mile a minute. Coupled drivers are said to be dangerous at high speeds, from the liability of the parallel rods to break, and such accidents have recently happened.

THE PROFESSOR IN THE MACHINE SHOP.

No. XXV.

"There," said Professor Rhombus bursting into the office one cold morning last week, "I would like you to read that, Mr. Moulton." As he spoke he laid a copy of "*The Tech*" on the desk before me, opened at the last page. "Read what a *confrere* of mine has to say about technical schools, and technical education. But," said the professor, checking himself, "possibly you don't care for such things, and think that to read matter of that class is a waste of time."

"Professor," said I, "I can tell better whether I like the article or not after I have read it. When I have, I will give an opinion with pleasure. As to its being a waste of time to read such things, I do not think so. When a sensible man has any thing to say and is in earnest about it, it must be poor stuff that one can't get an idea or two out of. I never could see why practical men should not have a diversity of information, as well as other people who are not practical. If a man reads nothing except what appertains to lathes and planers, or pistons and cylinders, he gets into narrow ways of thinking, and his mind is not half so retentive of technical matter as it would be if he eased off a little, and tried some other line of reading. If I am correct, the mind needs change of diet as well as the body."

"Yes, sir, singularly well put, Mr. Moulton; but I don't take much to your term, 'practical men.' What do you mean to convey by such a distinction? That men who work with tools are practical, and all who do not are impractical; wasting time in futile efforts?"

"Professor, I am sorry you asked me that question, for it raises a discussion that is not very profitable, that I can see. If you will permit me I will say you have answered your own question. A practical man is one who works out his problem by the aid of tools and materials, the theorist—I don't call him impractical—works his out by the aid of rules and figures. So far as definitions go this is as good as any other, but I don't see how such things can be defined. There are plenty of men who have never learned trades who are as good engineers, or constructors, as ever stepped, but in saying that, I am aware I make no point. Isolated instances are exceptions, and not the rule. Somehow, there seems to be a sort of irrepressible conflict between the two schools of workers. It is a matter of regret, for they are mutually dependent, one on the other."

"Just run your eye over that article," said Professor Rhombus, "if you are not too busy, and tell me what you think of it."

I took up the paper and grasped the substance of it very soon. It was chiefly an argument in favor of technical education (technical schools, more particularly), and asserted that no man was the worse for them—that is the pith of the article the professor wished me to read. "I endorse it, first and last, said I, if it is any compliment. I don't know that the writer will so consider it, coming from a practical man."

"I answer for him that I am sure he will," said the Professor.

"Professor Rhombus, does it not strike you as a little humiliating, in a certain sense, that we should have to argue, or advance arguments to support the cause of education at this late day? It seems so to me. One side says a certain line of schooling is of no value, and another says it is! That's about the English of it. I thought that question was set at rest."

"I thought so too," said the Professor, "but it seems to be popping up all the while."

"Well. I will tell you one way to settle it, so far as this shop is concerned, and that is this: We have now some thirty men in the place, of all trades and all ages, and I will give you a chance to hear what they think of the matter. Their opinions are not cut and dried, or formed to please you or any one else. I will call them in, one by one, and you can ask them what you please."

"I will not ask them a single question. I would rather have you catechise them. They would be more at ease and unembarrassed. I will sit back here, out of the way and out of sight, and take down what they say."

"Let's have Jacob in here," said I. "The men are more used to talking to him than to me, even, and will speak right out flat-footed."

I called in Jacob and explained what the scheme was, and he readily assented. He went to the door and roared in a voice that was heard way above the din of the shop, for Cephas Miles.

Cephas came in and Jacob said to him point blank: "Cephas! how would you like to go over to the Institute and take a course of lessons this winter?"

"Lessons in what?" said Cephas.

"In mathematics, for instance," said Jake; "in common philosophy, and the sciences that pertain to this business."

"Mr. Hess!" said Cephas, flushing all over, and wiping his hands with a piece of waste, nervously. "You don't mean it! I can't afford it. Oh, if I could! Are you going to send me over there this winter? If you will, I will make it up by overtime, or any other way you like, except by money down; that, I have'nt."

"Jake looked a little nonplussed at this; it was'nt the sort of answer he looked for, and it rather seemed as though he had put his foot in it. The Professor helped him out though, by saying in a whisper, "Yes, yes; send him over; it will not cost him anything. I will see to it."

So Jake took the cue and went on, saying: "Well, I don't know, Cephas: would you be any better off if you knew more?"

"Any d—f—, I mean," said Cephas, hastily, "Any one could ask such a qustion as that. Of course I would be better off. I never saw a man yet who knew too much, except one who don't know anything at all; he naturally thinks knowledge of no account. You take any one of the boys out there in the shop, Mr. Hess, and ask them if they would like to go to the Institute this winter, and I will bet he will answer yes. You see they can't think of it, Mr. Hess, for many reasons. One is, they can't afford to pay for tuition, for they are all poor and depend on their wages for their living. Another is, they think the rich men's sons over them would look down on them. Another is, that some of 'em really only know the first four rules of arithmetic, and they fear this ain't enough capital to start with. They all want to learn bad enough, and if you could put them in the way of it—you two bosses—you would do the biggest thing you ever did." "That's so," said Jake, earnestly.

"Well, Cephas," said Jake, "I have an idea in my head, and if I can carry it out it will be a good thing for all of us. You go and call Lamb in here; but mind you, don't let on a word to him about what I have said to you."

"No, sir," said Cephas, going out.

Before Lamb came in Jake turned to the Professor and said: "Your hands will be full this winter if you take in all the boys in the shop as a class for instruction."

"Let them come," said the Professor, "I am not afraid of a little extra work when it is appreciated. It is no trouble to teach men who want to learn; the hard work lies in trying to teach those who do not want to learn."

Lamb came in. He is the new boy with the looking-glass we took on last fall, and being a little fresh in his address and carriage generally, I was curious to hear what view he would take of the question.

"Lamb!" said Jake, "how much schooling have you ever had?"

"No mor'n the law allows," said Lamb.

"How much does it allow in your section?" said Jacob.

"Well, every able-bodied man and boy, where I came from, is reckoned to be able to read, write, and cipher up to fractions. When you git 'em on them, they'd sooner hive bees with naked hands, any day than tackle 'em."

"You cut some bolts in the lathe, the other day?" said Jake.

"Yes; what's the matter with 'em?" said the boy, thinking this was the cause of his being called into the office.

"There is nothing the matter with them," said Jacob, "but who put the gears on the lathe for you?"

"I did, myself."

"How did you know which to put on?"

"By the index," said Lamb.

"Then if I take the index off the lathe, or ask you to cut a thread that is not on the index, you are gone up?"

"I am, that's a fact," said Lamb.

"But you would soon come down again," said Jake, "If you knew the why and wherefore of it! If you knew the principle underlying cutting threads in a lathe, you could come at any thread, couldn't you?"

"Yes sir," said Lamb, more respectfully.

"Now," said Jacob, "you have been in this business some months, and you begin to get an idea of what it is. A boy of your ability is able to see that to be a master workman you must understand principles, not rules, and to make machines satisfactorily and cheaply, the better you understand the mechanical powers, the easier your work is, and the more you accomplish. is'nt that so?"

"I tumble; you bet," said Lamb, sententiously.

"That's all," said Jacob. "I wanted to get your ideas on these points; go to your work."

When Lamb had left, the Professor said it was unnecessary to call any more men; it would only be a repetition of the same views. He was satisfied from what he had seen.

"You should have some of the old hands in and ask them what they think about the matter," said I.

"Don't want 'em," said Jake, "they know it as well as the boys, that education of any kind is a good thing, because it enlists all the faculties. An old man knows it better than a young man, for the reason that he can look back and see all the tracks he made going all round some mechanical puzzle, when if he had known the ABC principles of it he could have gone cross lots direct. I think it is the honest conviction of every mechanic that if he had had the opportunities now afforded to the rising generation, he would be a long way ahead of his present record."

MECHANICAL DRAWING—NO. V.

BY EDWIN H. MARBLE.

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When we place a common brick before us in such a position that the eye is opposite and above one of the corners, there are three faces presented to our sight, the top, side, and end. All the faces are in appearance slightly perspective, or rather, the sides have a tendency to meet at some distant point. Since it is our aim in Mechanical Drawing to represent all bodies as appearing on flat or plane surfaces, this perspective will not be admitted, so we must resort to another method of representation.

Should we place one side of this same brick directly before us, and at a distance away, so that the lines of sight are parallel, and between our eye and the brick place a plate of glass, at right angles to this line of sight, we have means to show the body as produced upon a flat surface, in such a position, and size, as will be found to be correct. We will now draw upon the glass the image that is received and we have a *projected* view, or *projection* of the brick. Repeating this operation with reference to the other two faces shown in the first position taken, and we have obtained three views of as many different faces of our solid. These three views are necessary to properly show the complete brick. To obtain the three dimensions which we have found necessary to properly define a solid, we must have a representation of each, shown in connection with one of the others.

We will first look upon the object, viewing the side that presents the greatest breadth, or that which shows the greatest number of important parts. Thus viewed, the drawing made, we will call the front or side elevation, and since the drawing must be made upon a plate of glass, which is placed vertical in regard to the ground, we can always associate the words elevation and vertical. Should we examine the object from above, and produce a drawing of the same, we have a plane, and it must be constructed upon a glass horizontal. and the same reasoning will associate the words plane and horizontal.

These plates of glass we designate as the planes of projection, since the picture is projected upon them, as representing a plane surface.

The proper position of these views upon paper is a matter that has produced much discussion and argument among draughtsmen, though the arrangement in general use is as shown in Fig. 1. The plan at the bottom, with the front elevation perpendicularly above, and should a third view, as an elevation of the end, or side, be required, it is placed either to the right, or to the left, as the case may demand.

Should we place any object before us and examine it closely, we must observe two or three points which will be of great use to us in future work. Any line which is presented in a position other than at right angles, or directly across our line of sight, will be seen much shorter than it is, while the only position that does show it in its proper dimensions is that from which we have digressed.

If we place a glass between our eye and the object, as explained in the early part of this article, and draw the different boundaries of the object, its peculiarities will be the more readily seen.

From the definition of a line this will be evident; should we determine the projections of any two points in the line, we can give its direction, and should those two points be the extremities, we can also find its projected length.

The projection of curves is sometimes much more difficult, since every change in the position of the curve will produce a much more varied projection than in the case of a line. To properly project curves, points in the same must be projected, so as to produce a series of projections, which will locate the curve without doubt. The more complex the curve, or the flatter its angle, with one or more of the planes, the more points being needed.

The words *plan* and *elevation* as here used and applied, will not be considered by some as correct, since it is often found that the plan of a house is a view of its front entrance, and of a church a finely colored picture, showing much decorative art, while the same party will show the advantages of the interior by a plan of the seats. Thus showing that it is merely an easy and quick title to place upon a drawing, rather than referring to the particular view one is desirous of representing.

Other than the views already noticed recourse is had to sections. These are views of parts of an object, produced by apparently cutting the object in planes, so as reveal parts otherwise hidden, and which it is desired to show for the complete construction, when used in connection with one or more projected views they are of the utmost importance. These sections should be located in the views by lines representing the cutting planes, and the direction from which it is seen. They should also be cross-lined, or hatched by equidistant angular lines, parallel, as in the illustration of the same brick as first shown, but representing it as hollow or chambered.

One of the simplest and most familiar articles from which we can obtain an example of projection is a hexagonal pencil. By looking directly down upon the end we have the *plan*. If we hold the pencil vertical, and so that one side is toward us, we see three sides, and the pencil, in its full width of the hexagon. The side toward us is alone given in its true size. The other two being foreshortened; the sides being oblique to the line of sight. We will revolve the pencil, still holding it vertically before us, so that one corner is nearest our eye, and we can see but two sides, both of which are shortened. Examining the pencil in these three views, with the last two positions noted carefully, and we find the following characteristics: When the pencil is in the second position we obtain the width of the hexagon from corner to corner, that is, the measurement of the diagonal through the center; also, we find the side nearest us in its true measurement. In other words, these measurements must be made square across the line of sight. In the third case the hexagon is only shown across two parallel sides, and we see the diagonal connecting two angles not adjacent.

Let us now make a large drawing of a limited portion of this *hexagonal prism,* for such we have before us. In the lower right corner of your paper draw a *plan* of the hexagon, with one side parallel to the bottom of the board, using either the method already given or by means of the 30° and 60° triangle alone; making the diameter of the circumscribed circle 3″.

Since in all cases it is best to have a center line, from which we may make measurements, and one that we can use to determine the position of other parts, we will draw through the center of the hexagon a vertical line, also a diagonal, *A B,* through *C,* Fig 3. We will now set off by two parallel lines, above our *plan,* the length of our prism, which we will assume to be 4″. These two lines represent the side view or elevation of the top and bottom boundaries of our prism, and also contain the projections of the points, *A D E F,* which points are the boundaries of the sides of the hexagon, as viewed upon the end, or perpendicular to our plane. These projections as here shown in elevation, are from the principle of projection, directly over or under the same joints as seen in the plan, and we may determine the position of the same by means of imaginary perpendiculars drawn with square and triangle, or by geometrical methods, as shown in dotted lines, *A′ A′ E′ B′ M N P Q.* The center line as shown in plan should be located as shown by, *C′ O′.* Connecting these points by successive perpendiculars and we have the Side Elevation of the prism, as view with the side, *D E,* at right angles to the line of sight.

From these two figures already drawn we can construct the third or Side Elevation as seen from *W,* as indicated in the plan. The heighth of the prism is already indicated by the length of lines, *B′ Q,* etc., and this we can transfer to our third position by means of a T-square. Examining our plan we see that the point, *B,* occupies the center of the figure, with *E* on the left and *Q* on the right, but the distance these are from the center is not shown by lines, *B E,* or, *B Q.* Since both these lines are oblique to our line of sight, the center of which is indicated in this, our third position, by the line *B″ Y,* and must necessarily be foreshortened in the drawing.

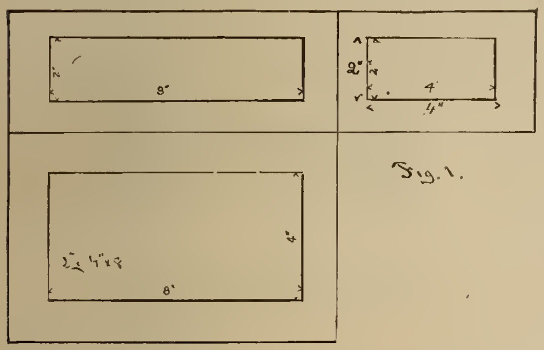


Fig. 1.

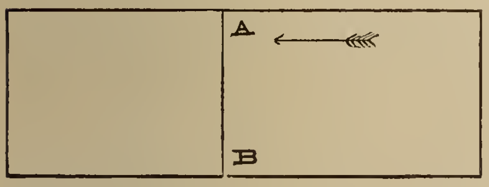


Fig. 2.

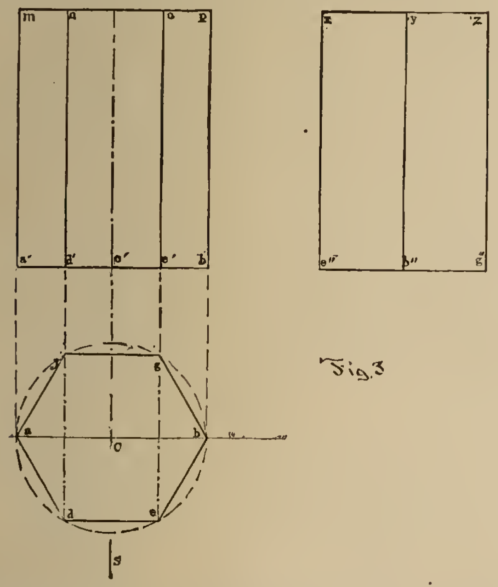


Fig 3

As we have already observed, all measurements must be made between lines perpendicular to the planes upon which we wish to draw our view, or in other words, square across our line of sight, so we must find means to determine these measurements. By referring to our plan we notice the line, *H K,* as perpendicular to our line, *W A B,* and by this line we can obtain the measurements required. In our drawing of the prism as here shown, Fig. 3, we have but to set off from *B″ Y,* the distance from, *C,* to the line, *F G,* or or *D E,* and erect our perpendiculars as before. It will be noticed that as the points, *F D,* are directly behind the points, *E G,* as seen from *W,* the points last located also give the distance from *A′,* of the first.

The method and explanation of the application of the principle of projection as here applied to a hexagonal prism, is also as readily applied to any object. To better understand the same, we will, however, give two or three other applications, showing the details of the constructions.

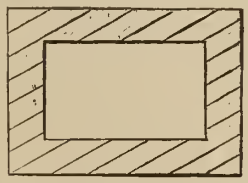
[TO BE CONTINUED.]

PATTERN MAKING.

BY A PATTERN MAKER.

No. VI.

MECHANICAL DRAWING.



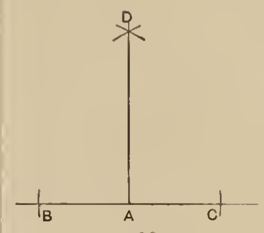
Books are teachers, differing only from those of the human kind, in that if you should ask them a question you will receive no reply. Therefore, to learn well and thoroughly any science or subject, many writers must be consulted, as one may omit, or insufficiently explain, what another may place in the clearest light. I believe a majority of the readers of THE MECHANICAL ENGINEER will welcome the appearance of the articles on Mechanical Drawing with at least as keen a satisfaction as I do myself, who pretend to some acquaintance with the subject.

I have been led to make these remarks for the reason that it is of the highest importance that a pattern maker should possess a knowledge of Mechanical Drawing. In fact all men engaged in "applied mechanics and the allied arts," need a knowledge of it. That is to say, they should have sufficient acquaintance with its principles to enable them to interpret a drawing, if not the ability to compile it. Be this as it may, the pattern-maker *must* possess at least that amount of knowledge. A machinist may be shown a set of castings, shafts and wheels; he may fit the wheels on to the shafts, the shafts into the frames, and do a great deal towards the construction of a machine without knowing of the existence of a drawing; a blacksmith, if he says he knows nothing of a drawing, will have models (or blacksmith's patterns) made for him, but if a pattern maker says he cannot work from a drawing—why, there's got to be a change made, that's all ! *

PRACTICAL GEOMETRY.—On this head I subjoin a few problems, most of them being required nearly every day. For more extended information the reader is referred to a special treatise on the subject, or to any of the mechanical pocket-books.

I.—From a given point in a straight line, or arc of a circle, to erect a perpendicular. (28, 29, 30, 31.)

Let *A* be the point in the given line. With *A* as center and any convenient distance, taken in a pair of compasses, mark off the points, *B* and *C.* With *B* and *C* as centers, and any distance greater than half *B C,* describe arcs intersecting in *D.* Join *D A,* and the line, *D A,* will be perpendicular to the line *B C.*



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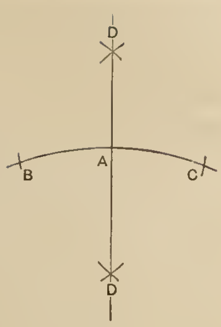

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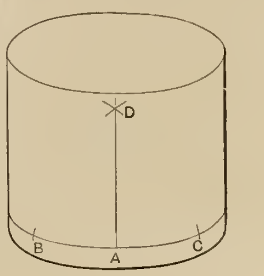

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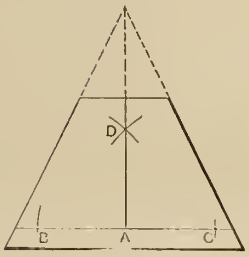

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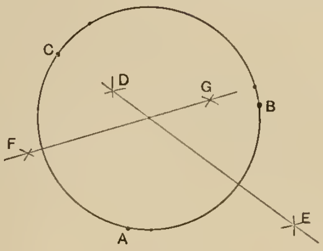

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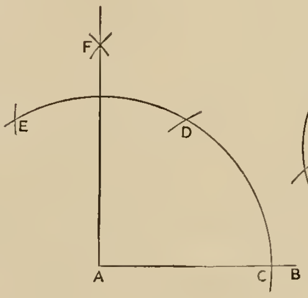

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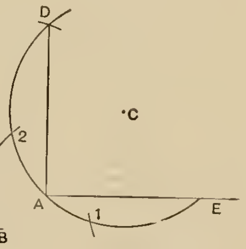

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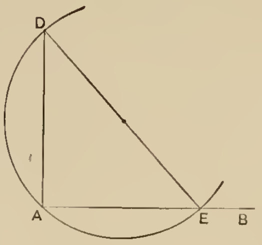

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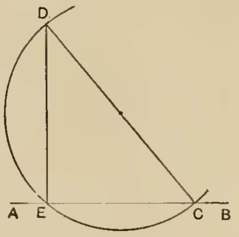

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In (28) and (29) the operation is shown as carried out on a plain piece of board. In (30), the line, *A B,* is supposed to have been scribed on the short cylinder, while it was turning in the lathe. In (31) the same, is as performed on a frustrum of a cone; if the cone were perfect, the line can be drawn direct from the apex to the given point, *A.* By this method, the direction of the teeth on bevel-wheels is determined.

II.—Through any three given points to describe a circle. (32) Let *A B* and *C* be the three points. With *A* and *B* as centers and any distance greater than half *A B,* mark off arcs intersecting in *D* and *E.* With *B* and *C* as centers, and any distance greater than half *B C,* describe arcs intersecting in *F* and *G.* Through *D* and *E* draw a straight line, also through *F* and *G;* where these lines cut one another will be the center of the circle. By the use of this, is avoided what is known as "fishing for the center."

III.—To draw a straight line perpendicular to a given straight line, at the extremity of it.

(33) Let *A B* be the given straight line. With center, *A,* and any distance, *A C,* describe the arc, *C D E.* With *E* and *D* as centers, and any distance greater than half *E D,* describe arcs intersecting in *F.* Join *F A.*

Another Method.—(34) As before, let *A B* be the given line. Take any point, *C,* above or below *A B.* With *C* as center, and distance, *C A,* describe arc, *E A D.* From *E,* without shift-

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[* *It is proper that we should say here that, in view of similar diagrams in No. I., Vol. 5, the author of "Pattern Making" had this article written long before the article on Mechanical Drawing appeared.*—EDS,] ing the compasses, mark off three spaces, arriving at D, the third point. Join $D A$.

Another Method. (35) Proceed as in second method, but instead of marking off the three spaces, join $C E$ and continue the line until it cuts the arc, $E A D$, in D. Join $D A$.

This problem comes in exceedingly handy at times, as in squaring large boards, or in making large drawings on the floor, restricted in space by the walls. Each method has its peculiarity; the first is the most correct, but we might not have space to get in the point, E, (33); in which case we would use the second method; but if we could neither lay down the point E (33), or the point, I, (34), we should then have recourse to the the third, and least correct, method (35).

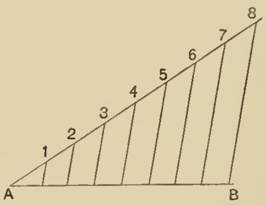
IV.—To let fall a perpendicular to a given straight line from a given point.

(36.) Let $A B$ be the given straight line, D the given point. From D draw any straight line, $D C$, to the line, $A B$. Bisect $D C$ in O. With O as center and distance, $O D$, describe an arc cutting $A B$ in E. Join $D E$.

V.—To divide a straight line into any number of equal parts.

(37.) Let $A B$ be the given line it is required to divide into, say, 9 equal parts.

From A draw a straight line making any angle with $A B$. From A, with any convenient distance in the compasses, mark off 9 spaces. Join 9 B. Set a bevel to the angle, $A B$ 9, and with it draw lines down from the points of division 1 to 8 upon the line, $A B$.



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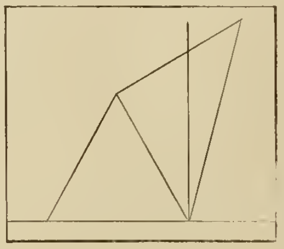

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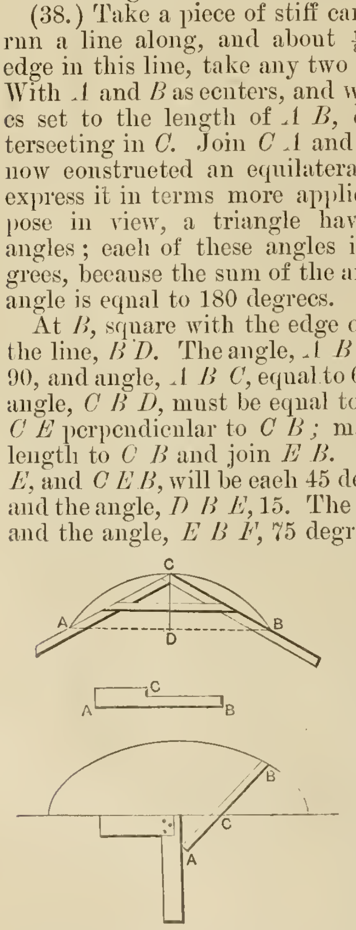
VI.—To construct a figure, containing various useful angles, for the purpose of setting a bevel to those angles.

(38.) Take a piece of stiff card, or thin brass, run a line along, and about $\frac{1}{8}$ inch from the edge in this line, take any two points, A and B. With A and B as centers, and with the compasses set to the length of $A B$, describe arcs intersecting in C. Join $C A$ and $C B$. We have now constructed an equilateral triangle, or to express it in terms more applicable to the purpose in view, a triangle having three equal angles; each of these angles is equal to 60 degrees, because the sum of the angles of every triangle is equal to 180 degrees.

At B, square with the edge of the piece, draw the line, $B D$. The angle, $A B D$, being equal to 90, and angle, $A B C$, equal to 60, the remaining angle, $C B D$, must be equal to 30. At C draw $C E$ perpendicular to $C B$; make $C E$ equal in length to $C B$ and join $E B$. The angles, $C B E$, and $C E B$, will be each 45 degrees, or a miter, and the angle, $D B E$, 15. The angle, $A B E$, 105 and the angle, $E B F$, 75 degrees.

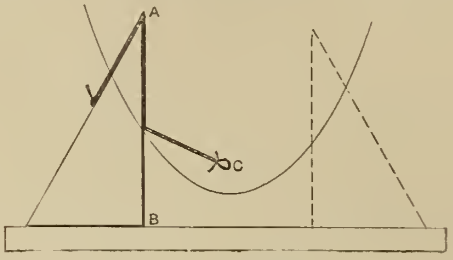


VII.—To describe an arc of a circle, of large radius, the centre being inaccessible; the span of the arc and its rise (chord and versed sine) being given.

Let $A B$ be the span of the arc and $C D$ its rise (39). Take two pieces of narrow board and having planed one edge of each straight, fasten them temporarily together, so that the outer edges may lie to the points, $A C$ and B. The half of each piece should be cut away at C, so as to form a level joint. At some distance from the angle, nail a strut across, to give rigidity. Drive a nail partly into the board at the points, A and B; then by holding a pencil at C and moving the frame from A to B, as it bears against the nails, the arc required will be traced.

VIII.—To describe a semi-ellipse the major (transverse) and minor (conjugated) axes being given.

Cut a piece of lath, $A B$, to the required length of the major axis, (40). Out of it cut a recess, $B C$, of the length of the minor axis. Against the planed edge of a piece of board, let some person hold a square, (41). Place the piece of lath, recess down, upon the board and let it lie against the square, then by holding a pencil at B and making the point, A, pass along the square, while the point, C, travels along the edge of the board, a quarter of a true ellipse will be traced. Reverse the square and in the same manner trace the other quarter.



IX.—To describe a parabola.

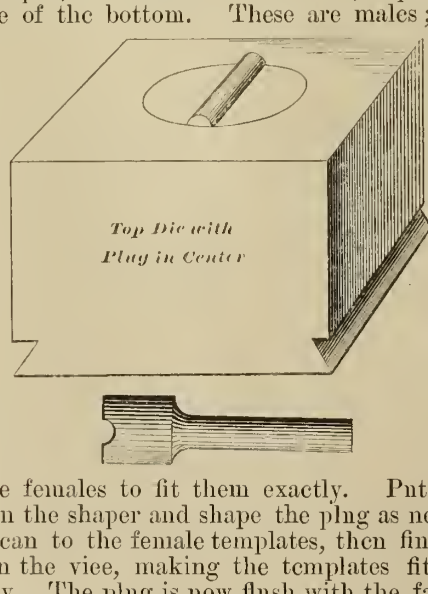
Tack a straight piece of lath upon a piece of planed board, (42). Take a set square, such as used by draughtsmen, but thicker, and place it against the lath, as shown in the figure. A loop must now be made, at each end of a piece of string, put a pin through the loop at one end and stick into the board at B; stretch the string along the set-square, passing around the point, A, pin the other loop where it may come, along the slanting edge of the square. Extract the pin, at B and place in some point, C, then by keeping a pencil against the edge, $A B$, of the square, and against the string, tight enough to stretch it as before, at the same time sliding the square along the lath, a parabola may be drawn upon the board. Any point, in a true parabolic curve, is equidistant from the point, C, and the edge of the lath. The set square must be reversed to form the opposite side of the curve.

[TO BE CONTINUED.]

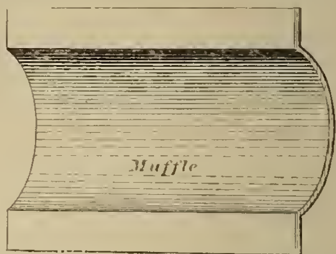
DIES AND DIE-SINKING—NO. III.

BY A DIE SINKER.

We will now begin the top die, (which you will remember we planed up in our last number,) the first thing to do is to find the center on the face and drill a $\frac{5}{8}$th hole right through it, then counter-bore this hole, one inch deep and of sufficient diameter to completely cover the recess in the shuttle. Now turn a steel plug a tight fit for the counter bored hole. Make it one inch long, plus the depth of the recess in the shuttle. Drive it home with a heavy hammer, and be sure it bottoms. File it off, put on some marking and lay out a center line on it at right angles to the planed side of the die. Now make two templates of the recess; one for the length and depth, the other for the width, depth and shape of the bottom. These are males; now make females to fit them exactly. Put your die in the shaper and shape the plug as near as you can to the female templates, then finish it up in the vice, making the templates fit perfectly. The plug is now flush with the face of the die, all but the piece that represents the recess, (which should be at right angles to the planed side.) On one side of this piece, right on the line which shows the circumference of the plug, drill a $\frac{1}{4}$ inch hole, which shall be half in the die and half in the plug. Get a piece of $\frac{5}{8}$ round steel, and by means of the hole that is drilled through the die, drive the plug out and harden it. This should be done in a charcoal fire, by heating slowly to a cherry red and cooling off in clear water, now polish it up bright and draw the temper to a straw color. The die is also to be hardened, but we are not quite ready yet, for we have still the blocking, or breaking down dies to make. These are similar to the finishing dies we have just made, in that you have to go through the same routine, of making templates and faces. Good judgment is required to make them so that there will just be enough metal to finish in the other die with, but they do not need such refinement in finishing, as they are made shallower and broader than the finishing die, and being of a wedge shape, do not stick in forging. The dies are ready for hardening now, and I should apologize to the reader for dragging him through such weary details, but they are necessary to thoroughly understand the subject. I purposely made the finishing die first, to simplify the description of the roughing or blocking die.



Now, for hardening the dies, there are four of them, two bottom and two top dies. They are large and will need a big fire, so we will dispense with the charcoal this time. Use small coal and a muffle. Perhaps some of our readers do not know what a muffle is, it is simply a piece of sheet iron bent to the form shown in this sketch, placed on the fire, filled with small coal inside, and covered with the same to a depth of four or five inches outside, well wetted, the blast put on until all the coal inside is at a red heat, and the sulphur entirely dissipated. This converts it into a little furnace, for the coal on the outside of the sheet-iron is also red, and by continually wetting the outer layers of coal it throws all the heat into the inside of the muffle, and affords a nice clean place for heating. As it is open at the front, you can put in your die, and take it out again without disturbing it, and leave it ready for the next die. This is an excellent plan for heating steel, for it ensures an equal heat all over. In this case we only want to harden the face of the die, so we only put it in far enough for that purpose.



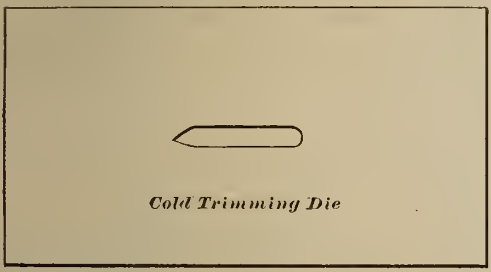
While the die is getting hot I will describe the place for cooling it. This should be an iron tank, or trough, with a supply, and an overflow-pipe. The supply-pipe should have its nozzle pointing directly upwards, and situated about two inches below the water line. Around it should be an iron frame to support the die, face downwards. A good thing for this purpose is what might be called a square box without a bottom, having its sides widest at the top. This will hold almost any size of die and gives room for the free action of the water on the face.

The die is now hot, so we take it carefully out of the muffle and place it over the nozzle, face down. The trough should be full to the water line, then turn on the water, and of course it is directed right on to the face of the die. The die is only two inches deep in the water, so it will take some time to cool, and while it is doing so, put another die in the muffle to heat, let the die stay in the water until it is cooled down so that you can almost bear your hand on it, then take it out and let it cool in the open air. This is all the drawing it gets, as we want it very hard. It will get soft soon enough working. Repeat the process with the other dies until they are all done, then clear out the counter bored holes and put in the plugs, but before you drive them home, put a piece of $\frac{1}{4}$ inch round steel in the holes you drilled at the circumference, and drive the plug home with a drift made for the purpose, (see sketch under the die). The $\frac{1}{4}$ inch steel acts as a guide to its former place and keeps it from shifting when it gets there.

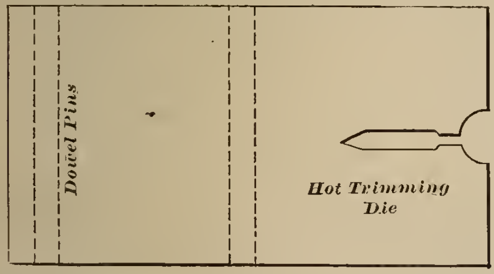
We are now nearly ready for drop forging, but before we can do so, it is necessary to have hot trimming dies. I must here explain that in forging, the shuttle gets three blows, one in the blocking, then one in the finishing die, but right here is the difficulty: the surplus stock spreads out between the two dies into a broad unshapely fin, or burr. This must be removed and is done in the hot trimming dies; it then is re-heated and receives another blow in the finishing die. It still has a little fin around it, but this is taken off, in cold trimming dies. The forger having nothing to do with this, cuts it off the bar with a little shear attached to the drop.

To make things clear, I should say that the forger has two drop hammers and one punching press (for trimming) all employed in making the shuttle. His furnace is right behind him, about midway between the two hammers, and as he has five or six bars heating at once, he has a lively time of it. A first-rate man can forge two thousand a day, if he has good dies.

But let us return to the trimming tools. We will make the cold trimming die first. These are used in a press. Get a piece of steel $\frac{3}{4}$ inch thick, about 4 inches long and $2\frac{1}{2}$ inches wide; plane it up and dovetail on the sides, so that you can hold it in a bolster to fit in a press. It will be of no use to give "hard and fast" rules how to make either the punch or die to fit the press. This must be left to judgment. It will also depend on the make of press used. I will confine myself to the cutting part of the die.


Cold Trimming Die

When the steel is planed, and filed smooth, put on some marking and draw centre lines along its length and breadth. Then get template No. 3, that you made for your face, and place it central on the die and scribe the outline. Then drill holes through the die inside of the outline, and chip and file it out to the line, making it widest at the bottom, or at an angle of 2 degrees from the face. Now harden and draw to a straw color and then get the steel ready for the punch. This should have a stem of some sort to hold it in the press by. Plane up the part intended for the face, put on some marking and place the die on it face to face. Then take a scriber and mark around the inside of the die. This gives you the exact outline, and you can go ahead and remove the surplus metal any way you choose, but make a good easy fit. The hot trimming dies are made much the same way, except that they are made of two pieces of steel, which are planed together, to be of the same dimensions as the cold trimming die, when they are placed side by side as shown in this sketch; two dowel pins are put through them, near one end to hold them together. The die is also cut nearer one end than in the cold trimmers, and it also has to be left open ended, as shown, so that it can trim the shuttle without breaking it off the bar. The face should also be reduced $\frac{1}{8}''$ in thickness, up to within $\frac{1}{4}''$ of the outline of the die, this allows it to be readily sharpened by grinding, as they wear away very quickly. It seems strange, but the hot trimmers wear out about ten times as fast as the cold trimmers, for this reason we made it in two pieces so that it could be closed, by grinding or otherwise, when badly worn. The punch for this should have an extension on the end to press on the bar, as well as the shuttle.



Hot Trimming Die

There is still one more die connected with the shuttle, but some makers do not use it. That is a die for cold pressing them after they are trimmed. It is made in exactly the same way as we sunk the first, or finishing die, we use just the same force and templates, the only difference is that it is made to fit a press instead of a drop hammer; the plug of course is the same.

Our job of making a shuttle is now done; perhaps it has been a tedious one to the reader, but nothing is gained without trouble, and we began at the beginning. The next time we would have only to sink the finishing die and make a plug; all the others still being in good order, and the templates and forces kept as standards to work by.

In the next article I will not weary the reader with these details, but will refer to them, when necessary, for illustration, so it will be well to pay particular attention now, but I will confine myself simply to sinking dies and will give samples of many. Some must be made wholly with hand tools and some partly by hand and partly by machine, and others can be done entirely by machine.

[TO BE CONTINUED.]

THEORY.

Now, in arriving at your conclusion or speculation, you have, consciously or unconsciously, assumed certain things to be true, of which you have no proof. Thus you assume, for instance, that I walked; that I walked at my usual rate of speed; that I started from the station; and that I naturally took the shortest way here. Upon the truth of these assumptions, singly and collectively, your speculation depends. Each of these assumptions we call an "hypothesis"—something assumed. We say "if" this or this be true, then it follows, etc. Your speculation then is based upon one or more hypotheses for which you have no proof, but only a probability more or less strong.

But now suppose that you do know these things which before you assumed, viz.: that I did walk; that I walked at my usual rate of speed; and that I started from the station. Then your conclusion as to the route I took is a "theory," because it accounts for all the known facts without any hypothesis at all intervening. It may or may not be true and is therefore by no means certain or demonstrated. Thus I may have come by some other route of equal length, and that would account equally well for all the facts. We have then, several "theories," all equally good, but each of them is a "theory" and not a "speculation," because it is a strictly logical conclusion from the known facts; which accounts for all those facts; and makes use of no assumptions or hypotheses to connect the facts. From the facts we go back to the theory, by a logical chain which has no flaw.

But suppose finally, that it is winter and there is snow on the ground, and that you have thus traced my footsteps all the way from the station to this house. Then your theory as to the route I took is said to be "demonstrated." From the known facts you go straight back by unbroken logical steps, to the conclusion, without any other theory being possible. The theory is demonstrated when all other possible theories are excluded; and in this way we arrive in science at what we call "demonstrated fact." This is the kind of proof which science claims, and it certainly seems convincing enough.

Generalizing then, we see in the light of our example, that a theory must be the strictly logical outcome of all the known facts. It shows the relations which exist between those facts and their mutual dependence. It may not be the only logical deduction, in which case we naturally adopt that which has the strongest probability; but we adopt it only provisionally, because it is serviceable and helpful in further investigation. We do not consider it as proved. But in any case, it must be a strictly logical deduction from the facts, or it does not deserve the name of "theory."

When a theory can be thus reasoned back to from the facts, however, without any other theory being possible, then the theory becomes demonstrated fact.

When, in reasoning back from the facts, we come to a gap in our logic, which the facts so far as known cannot bridge over, we may sometimes leap the chasm by means of some assumption. The theory which then results is only as true as this assumption, which still remains to be proved before conviction can result. Such an assumption we call an "hypothesis," and the resulting fabric of conclusions is known as a "speculation." Speculation then becomes theory, when hypothesis becomes fact; and theory becomes demonstration, when we become convinced that no other theory is possible.

If anything is considered certain in this world, the truths of pure geometry may lay claim to that distinction. Here at least we seem to reach absolute truth. Even Almighty power, it is claimed, could not make the three angles of a plane triangle add up greater or less than 180 degrees. But it is not so. Whether man does or does not ever attain to absolute truth, one thing is certain, he cannot know, and he can never logically claim, that he does. Even the truths of geometry rest upon axioms, and these axioms are only "self-evident," as we say—that is, we have to believe them,—because all our experience is in accord. But since experience is limited, to suppose them absolutely true is to assume by faith that which we cannot demonstrate. The proof is not rigid. An hypothesis intervenes—and geometry, with all its conclusions, is but speculation!—*Science and Faith*, Prof. A. J. DUBOIS.

JUDGING BY THE FRACTURE.

Whenever a line of shafting breaks, a boiler explodes, or a rod or a link snaps, an examination of the fractured surface of the iron is made. The inferences drawn from the examination are sometimes very unfair to the maker, at other times to the consumer; although the examiner himself would do no injustice to either. These unjust conclusions may frequently be ascribed to the prevalence of crude notions concerning the appearance which the fracture should present. Many suppose that if it is not fibrous, but crystalline, then the metal was unfit for use, and they charge the foreman or engineer with having subjected it to injurious and unnecessary strains which rendered it worthless at the time of the accident; or they charge the maker with having furnished metal of so poor a quality that it was unable to stand customary wear and tear. These charges are grave; they injuriously affect professional character, and they should be made with extreme caution, for the condition under which iron may assume and maintain a fibrous or a crystalline structure are yet matters of profound scientific inquiry. For a long time they have engaged the attention of the best engineers, who, recognizing the difficulties involved in the question, have been slow to form and to utter positive convictions.

The appearances of fractures being due to the positions assumed by the molecules of iron at the places, when the metal is fluid, any change in their position may be accounted for. Thus, when pouring molten metal into a mould, that which chills rapidly will, when broken, exhibit a different fracture from the rest. It will be crystalline and lustrous, indicating hardness and brittleness; while parts of the same casting which cooled slowly will exhibit a dull, granular fracture, and be found comparatively soft and tough. Here the fluidity of the mass readily permitted its molecules so to arrange themselves under the varied conditions of temperature, as to impart to it the different qualities.

When the iron of which good shafting, boiler plate, rods or links are made leaves the fashioning, it is of uniform quality. It remains solid while in use, and any molecular changes must be attended with difficulty, and be produced only by powerful external agencies. The opinion that the severe cold of our winters changes fibrous iron into crystalline, although generally entertained outside the profession, is received by engineers with many grains of allowance, and some of the best of them reject it altogether. Indeed, they have great reason to doubt whether iron, as it comes from the rolls or the hammer in the form of bar, plate, or rod, has a fibrous structure. Take the rod to the draw-bench, and draw it into wire in the usual way. You impart to it a fibrous structure; and so do all machines for testing tensile strain. The test pieces when drawn asunder exhibit fibrous structure, and this is assumed to show that they possessed such structure before they were subjected to the strain; but it proves nothing of the kind. As in wire-drawing the tendency of the operation is to cause the molecules to take the form of fibre; but had another method of rupture been employed the same pieces would have appeared crystalline, and by the popular standard been adjudged inferior. Nick them round, as is frequently done in the rolling-mill, and, laying them flat between two supports. subject them to the force a falling weight. They will break squarely off, and not a trace of fibre can be detected in the fracture. Had the same bars been tested in another familiar way—by making a nick on one side only, and then with a hammer bending them until they broke, the fracture would have been fibrous, the bending so far a wire-drawing process, as to arrange the molecules in fine lines. Whether the fracture be fibrous or not depends upon how the rupture came about, and to condemn iron because its fracture is crystalline, without taking into account the method of rupture, is most reprehensible.

STEAM.

In *steam engine practice* we are not now advancing rapidly. The introduction of the "drop-cut-off" in 1841, by Sickles; of the now standard type of automatic valve gear in 1849, by Corliss; of the high-speed engine, twelve years later, by Allen and Porter; of the combined advantages of jacketing, superheating and reheating, and the definite acceptance of the compound engine in later years, still constitute the complete history of modern steam engineering. But we are, nevertheless, continually gaining a knowledge of the best methods of handling higher steam; of attaining higher piston speed; of securing greater immunity from cylinder condensation and leakage, and of providing against other causes of waste. We are just beginning to perceive what principles must govern us in the endeavor to secure maximum commercial efficiency, and how economy in that direction is affected by the behavior of steam in the cylinder, and by the mutual relations of all the various expenditures that accompany the use of steam power.

The younger Perkins are still leading in the practice of carrying high steam, and make 400 pounds per square inch—27 atmospheres is a usual figure while they are experimentally repeating the work of the elder Perkins, and of Dr. Albans of forty years ago, working steam at 1,000 pounds or nearly 70 atmospheres.

Unfortunately, the gain to be anticipated by the use of these enormously increased pressures does not seem likely to be very great, unless some decidedly less wasteful kind of engine can be devised in which to work them. The "*Anthracite*," with steam at 300 pounds and upwards, was less economical in fuel than the Leila, carrying about one-third that pressure. Emery has stated that a limit seems to be found at about 100 pounds to economical increase of pressure; and Stevens finds a limit due to the geometrical character of the indicator diagram, inside of 250.

One of the most interesting and curious, as well as important, deductions from the rational theory of engine efficiency is the existence of an "absolute limit to economical expansion,"—lying far within the previous accepted limit—due to the fact of increase of cylinder condensation and waste with increase in the ratio of expansion, which places an early limit to the gain due expansion, *per se*. It seems possible, if not certain, that this point is often actually reached in ordinary engines within the range of customary practice.

All these facts combined point to a probability that we have little to hope for in the direction of increased steam engine economy with our standard machinery. Change in the directions that I have already so often indicated, are evidently to be our sole reliance—changes limiting loss by cylinder condensation. Probably the surrounding of the steam by non-transferring surfaces is our only resource, in addition to, or in substitution for, the now well-understood expedients of high piston-speed and superheating. Until that is done, steam jacketing remains a necessary and unsatisfactory method of reducing losses. With a non-conducting cylinder, were it procurable, we might secure very nearly the efficiency of the ideal engine, friction aside, as it would be a "perfect engine," and no natural limit would then exist to increasing economy. Were this accomplished we might at once reduce the cost of steam power by about one-half in our best engines, and to probably one-fourth or one-fifth the present cost, in ordinary machines.

In steam engineering, both physicists and engineers are more than ever attracted to the study of those phenomena which produce the familiar and enormous differences, even in the best practice, between the thermodynamic and and the actual efficiencies of engines. The subject lies in that "march-land" territory between science and practice, which few of the profession can explore from both sides, and it has remained less known than it would otherwise be were it either a matter of purely physical science or of practical experience. Fortunately, we are likely soon to see it thoroughly studied. The debate which arose not long since between Zeuner, the distinguished physicist, as a representative of pure science, and Hirn, the no less distinguished engineer, as an experienced practitioner and skillful experimentalist, in which the differences, to which I have so often called attention, of fifty per cent, or more between the "theoretical" efficiency and the actual performance of the best steam engines, seem for the first time to have been given prominence in Europe, has led to a much closer study of the matter than could possibly otherwise be brought about.

On this side the Atlantic the discussion of steam engineering efficiencies has been carried on earnestly, if not always with that knowledge that should precede criticism, and it is to be hoped and anticipated that the engineer may ere long be put in possession of positive facts and real knowledge that may aid him in so designing and so applying this greatest of modern inventions as to attain the *maximum maximorum* of economy.

Ten years ago, nearly, I took occasion to state in a report to the President of the United States on the exhibition machinery of the Vienna exhibition of 1873, printed later with the other reports of the United States Scientific Commission, that "The changes of design recently observed in marine engines, and less strikingly in stationary steam engines, have been compelled by purely mechanical and practical considerations. The increase noted in economy of expenditure of steam and of fuel is,, as has been stated, due to increased steam-pressure, greater expansion, and higher piston-speeds, with improved methods of construction and finer workmanship. These several directions of change occur simultaneously and are all requisite. To secure maximum economy for any given steam-pressure, it is necessary to adopt a certain degree of expansion which gives maximum economy for that pressure under the existing conditions.

"This point of cut-off for maximum efficiency lies nearer the beginning of the stroke as steam-pressure rises. For low pressure a much greater expansion is allowable in condensing than in non-condensing engines; but, as pressure rises, this difference gradually lessens. For example, with steam at 25 pounds by gauge, the best economical results are obtained when expanding about three times in good condensing engines and about one and a half times in non-condensing engines. With steam at 50 pounds these figures become five and two and a half, respectively; and at 75 pounds the highest efficiency is secured in condensing engines, cutting off at one-fifth, and in non-condensing engines with cut-off at one-third stroke.

"Owing to the decreasing proportional losses due to back-pressure and to retarding influences, the departure from the economical result indicated for the perfect engine becomes greater and greater, until, at a pressure of between 200 and 250 pounds, the proper point of cut-off becomes about one-sixth or one-seventh, and very nearly the same for both classes of engines, and the increase of efficiency by increase of pressure and greater expansion becomes so slight as to indicate that it is very doubtful whether progress in the direction of higher pressure will be carried beyond this limit."

These conclusions were derived from careful observation of the performance of unjacketed "single cylinder" engines and a comparison of the ratios of expansion of those exhibiting greatest economy. It is interesting to note that later, and probably reliable methods of comparison than were then familiar go far in confirmation of the opinion then expressed. I think that I have been able to prove the existence, as just stated, of an "absolute limit of economical expansion," which, whatever the ratio of steam pressure to back pressure, in all ordinary heat engines, probably falls within the range of familiar practice. Advance beyond the best efficiency of to-day in ordinary engines seems likely to be very slow and not at all likely ever to be very great.

Extended experiments will be needed to secure all the facts demanded by the designing engineer and to furnish constants for the approximate theory of efficiency, which only is, as yet, his sole guide. An exact theory is one of those things for which he hopes, but which he does not expect soon to see. Some experiments have already been made, but they contribute only the first step.—*President R. H. Thurston's address to American Society, Mechanical Engineers.*

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By request of many manufacturers in various parts of the country, we renew our publication of market reports of metals and engineers' goods, which was dropped some months ago, it being found a great convenience.

These quotations are made by the houses represented, who alone are responsible for the statements. While every effort will be made to insure strict accuracy, we disclaim any liability that may arise from changes without notice or typographic errors.

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Number 1x	$25½@$26	
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Enlarged, 1883.

New York, February 3, 1883.

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ENGINES OF THE "SAN BLAS" S.S.

By John Roach & Son.,

NEW YORK AND CHESTER, DEL.

(AMERICAN MARINE ENGINES.)—NO. VII.

We illustrate herewith the engines of the *San Blas, S.S.*, by John Roach & Son, which, in connection with others in this series, afford an instructive example of modern American Marine Engines.

These engines embody the principal features adopted in the designs of Messrs. Roach & Son, and which have been found satisfactory in their extended practice. The engraving explains itself, as regards general arrangement of parts, and is so clear in detail, that an inspection is an explanation.

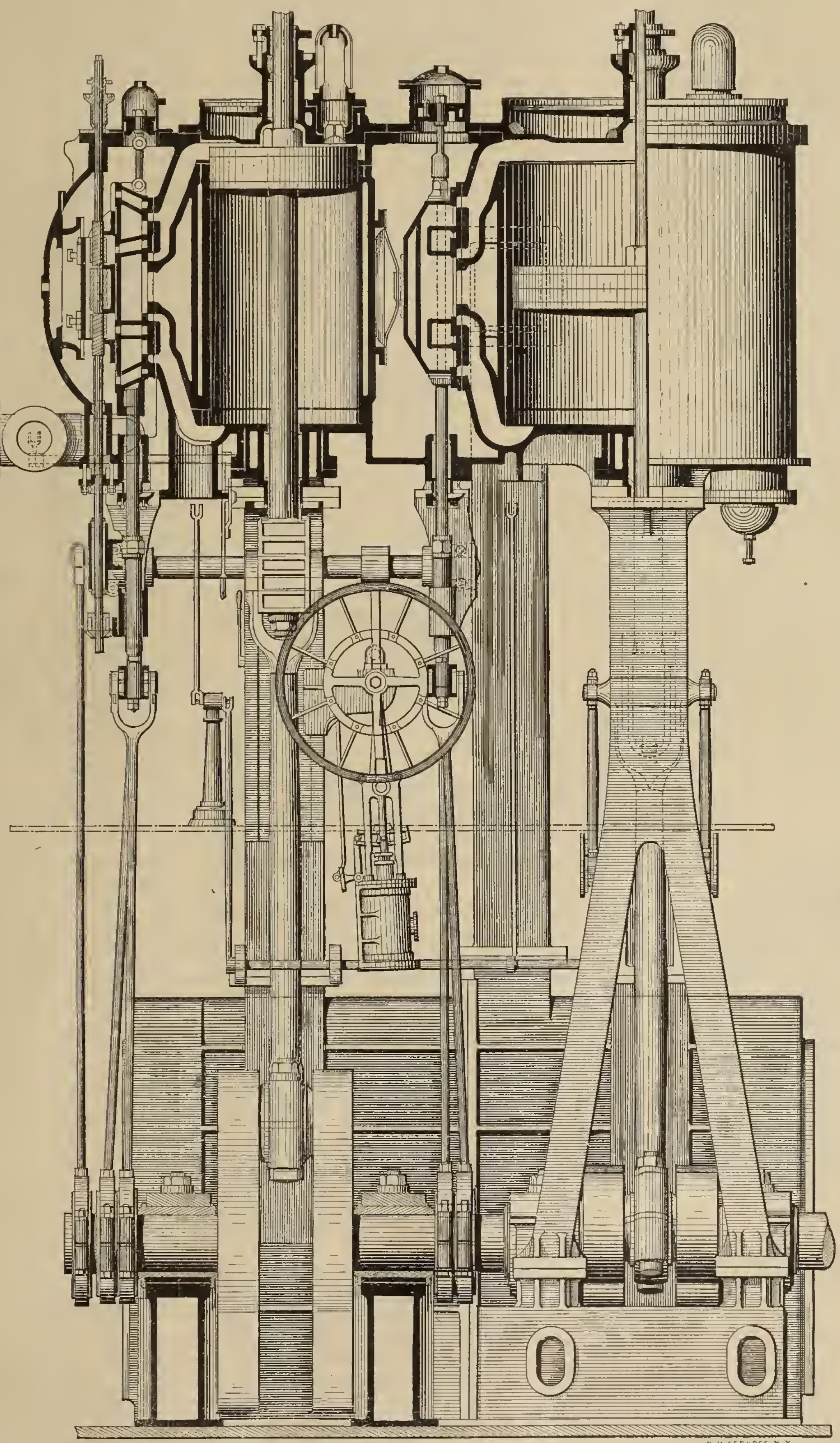
The dimensions of parts are as follows: High pressure cylinder 34″, low-pressure 62″ by 54″ stroke, driving a wheel 14′ diameter by 22′, 6″, mean pitch. Steam follows half stroke in high pressure cylinder, and two-thirds in the low pressure.

The shaft is 13″ diameter, and the crank-pin 12½″; pressure of steam 90 lbs.; with which the engine makes 64 revolutions per minute.

The crank-shafts made by Messrs. Roach & Son are models of workmanship in this line, and must be seen to be appreciated. The details are all best forged scrap, bored, planed, and fitted to size. The several parts are then shrunk together, and the pins and main journals turned on their own centers, the whole shaft being swung in the lathe. This ensures absolute rectitude of one bearing with the other, a matter not to be attained in any other way. For this reason, largely, the breaking of crank shafts is unknown almost in the practice of Messrs. Roach & Son.

The vessel runs in the Pacific Mail service.

The attention of engineers is directed to the correct drawing of our engraving, as well as its clearness in the most minute details.



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* * *

Binders now ready, price, $1 by mail.

CHALLENGED!

Friend Hall of the *Grain Cleaner*, alleges in his last issue that we said something about belts, which he reprints, and gives us credit for. We wish he had charged it to some other fellow's account, for we never said it! Doubtless we say a great many other things quite as silly and useless to mankind, but our own sins are enough; we don't want to go out into the wilderness scapegoat for mechanical babes and sucklings generally.

Look here, now! Where and when did we say this? Never, sir, anywhere. It was some other party.

> "The *Mechanical Engineer* says that a new belt, especially if riveted, takes some time to get bedded down to the pulley, those spots which do not touch being shown by remaining unsoiled long after those which do touch and are blackened. * * * * When the belt commences to get full of animal oil and dirt it loses its efficiency. Leather belts running wood-working machinery have less driving power than others where they can remain soft and pliable, as the fine wood dust chokes up their pores and lessens their pliability. * * * Printers' ink may give temporary relief to slipping belts, by momentarily increasing the grip but it causes glaze and hardness, especially in leather belts. Coal tar and flour has recently been recommended for exposed belts running close over water but the writer thinks that this would be useful only in such extreme cases."

If our enterprising and genial contemporary will reprint some of Tyndal's discoveries in Science, or Rankine's observations, and credit them to us, we will be greatly obliged, and pretend to overlook it, but "when printer's ink," "coal tar and flour," etc., on belts is charged to our account, we dispute the items.

At the convention recently held in Cleveland by wholesale druggists, some data respecting commercial travelers were presented. It was stated that, in round numbers, there are 200,000 commercial travelers in the country, costing their employers on an average $3,000 each for salary, car fare and expenses. The total outlay in this direction, therefore, is $600,000,000 per annum.

This is a wild estimate. Commercial travelers in this country will not average $1,000 per annum in salary, taken through all lines. Their expenses will not average $3.50 per day, making in all only $1,350 instead of $3,000. We say this from an intimate personal acquaintance with the facts.

WHY SODA-WATER PREVENTS RUST ON FINISHED IRON.

It is well known to machinists that common sal soda dissolved in water prevents iron from rusting after turning or planing. The reason why is not so generally known. Sir William Thompson says:

"The philosophy of this method of preservation, is as follows: The preserving effect of alkali upon steel seems to be due to the alkali neutralizing the carbonic acid in the water, for the presence of carbonic acid in water is the great cause of iron being corroded. The fact is well-established that iron will remain perfectly bright in soda-water rendered akaline by a little lime. Caustic soda is a more sure material, because with it we can make more certain that the water is really alkaline." A solution of common sal soda in the water can of a lathe or planer, answers for all kinds of wrought iron work. On cast iron of course no water is used.

* * *

Read special notice on editorial page.

WHAT A MODERN ENGLISH MACHINE SHOP IS LIKE.

The main building covers an area of about four acres in extent. It is about 400 feet in length, and is about the same distance in width, and except in a few parts, where low brick walls divide certain departments, the interior is open from end to end. All the light is obtained through the roof, which is composed of glass and iron, and in the entire works there are no less than two acres and a quarter of glass. The interior is divided into six spans, separated by iron columns, strengthened by girders. The columns support the roof, and the height of the girders above the floor is 47 feet 6 inches. The weight of the iron used for pillars, girders, &c., is 3,500 tons. There is only one entrance to the works, and that is on the north side. A large gateway gives direct admission to the machine shops, and at either side of the entrance is a staircase leading to the gallery, on one side of which are the commercial office and the secretary's private office, and on the opposite side is the chief drawing office. In the centre of the large drawing office are placed several drawers, in which plans are deposited, and instead of the drawers having tops made of wood, they are covered with slabs of slate ; and gentlemen, when giving instructions for work, will be able to sketch upon the slabs plans illustrating their ideas. Among the articles kept in the store-room are Whitworth's rules ; and in order to insure accuracy in measurements no workman is allowed to use his own rule, but must take the gauges by Whitworth's rule. The general store-room opens into a long narrow office, and along the full length of this office are windows opening into the factory ; and from these windows the stores are delivered to the workmen on the production of orders from the foreman. In this office there are large "pigeon-holes," one for the drawing of each portion of a marine engine ; and the name of any workman who takes away a drawing is written down, and the return of the drawing is recorded ; and by this means every drawing can be easily traced.

The departments above described occupy the two western bays—each 50 feet wide—of the main building ; and east of them is the large machine shop occupying a bay 60 feet wide and 200 feet long. Along one side of this shop are placed lathes, and at the other side are a number of planing machines of various sizes, each driven by an independent steam engine. Some of the planing machines weigh one hundred tons, and one of them—which will plane a width 26 feet by 19 feet high—is the largest machine of its kind in Great Britain.

In the center of the machine shop are machines for boring cylinders, and the largest machine is capable of boring a cylinder of 130 inches diameter by 7 feet stroke. Overhead are two traveling cranes, one to lift up to 20 tons, and the other to 40 tons. In the center of the floor of the department is a surface-table, 18 feet square, upon which all bed-plates and cylinders are marked off.

A large, detached building is set apart for the storage of patterns which have been used in the foundry ; and, by this arrangement, the danger of the patterns being destroyed in case of fire is lessened. Inside the factory, lines of railway are laid in various directions, and by means of these and the traveling overhead cranes, heavy weights can with ease be moved, until finally taken out of the works and placed on board steamers. Everything has been done that can be suggested to lighten manual labor, and to secure economical and efficient workmanship. Attention has been paid to the sanitary arrangements, and to insure the comfort of the workmen at meal times, two large smoke rooms have been provided for their accommodation. Work has been commenced, and when in full operation there will be about 1,200 men employed. As already stated, two streets of houses have been erected by the company, and these houses are now occupied by about 400 persons.

◆

Smoking pipes are now made from stale bread mixed with other binding material, and pressed into form by hydraulic pressure.

GUINOTTE'S VALVE GEAR.

The valve gear shown herewith, is one recently introduced in Belgium, and is illustrated for the purpose of giving the designs of foreign engineers as they appear. We cannot say that this gear has any advantages over those in general use, but has some special disadvantages, such as expense of construction and many parts in motion over a large space, which might have been avoided. Figs. 8 and 9 show the details.

The main-slide, A, is arranged in the usual manner, and the expansion-valve, B, is a simple plate. The first named is worked off its spindle, a, and eccentric rod, b, from the eccentric, c.

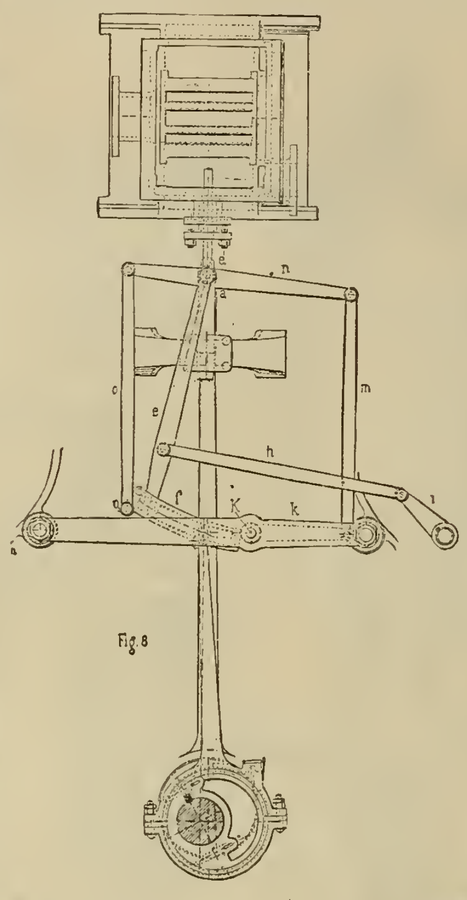


Fig. 8

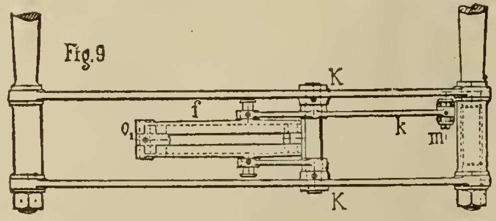


Fig. 9

The expansion-eccentric, g, keyed at an advance angle of 90°, carries by means of the rod, g', the link, f ; this link oscillates round a center, which forms the working point of the eccentric-rod. The same center is also in the eye of the double-armed lever, k, oscillating on the fixed point, K. A second double-armed lever, n, has its fulcrum mounted on the stud, a_1, which is fixed to the main-slide rod. Through the connecting rods, m and o, the motion of the first named lever, k, is transmitted to the second lever, n, to be again transferred on to the extremity, o' of the link, f, which by the forementioned motion of the two points, K, and o_1 is moved in a certain rotary-oscillating motion ; the fulcrum, a' of the lever, n, has the same movement imparted to it as the main-slide.

One end of the rod, e, may be pushed into the link, f, while its other end, being fastened to the stud, e' of the expansion-slide spindle, d, transfers the motion of the link to the expansion-slide. The shifting of the working point, x, of the rod, e, on the link, is effected by the rod, h, suspended on the lever, i, being worked off the hand-wheel, H, and spindle, s.

◆

A fine engraving of a three-legged duck appears in a recent number of the *Scientific American*, but we are left in ignorance as to its dimensions and velocity in miles per hour !

◆

THE MECHANICAL ENGINEER starts out the new year with a new outfit, presenting a handsome appearance. It deserves prosperity and is getting it.—*Trade Review.*

CROWNING PULLEYS.

A correspondent of a foreign paper says :

"What is the proper crown to have on a pulley ? I have been led to ask this question because it is of more importance than most people think. It is thought of so little consequence that it is generally left to the discretion of the turner. We all know that the crown on the pulley affects the running of the belt. It must also affect the wear of the belt and the grip it takes round the pulley. It is only reasonable to suppose that if the pull, or constant strain, on a belt be greatest towards the middle and least at the edges, that it will not only be stronger, but will last longer. That is to say, other things being equal, a belt running on a straight pulley will not stand so long as it would running on a pulley with a certain amount of round on it. What that certain amount should be is the question. It ought not to be left, as at present, to the fancy of Jack, Jim, or Joe, or even to the draughtsman.

"I often find draughtsmen anything but practical men. I once saw a person who had temporary charge of a large engineering concern, give orders to have the round turned off all the main pulleys. Happily he was prevented before he did much mischief. Another genius thought that if pulleys were turned hollow instead of round they would do better. I know an establishment where the boss makes his man keep a tin can full of fine emery and oil to smear anything with that has to be a tight fit, such as putting a shaft into a crank. He says it makes it seize much better. This Solon tried to increase the power of an engine by scooping out the piston like a dish ; he said it increased the 'area.' But pardon this digression ; I wish to know where I can find a scientific rule for the crown on a pulley ? 'Molesworth' says ½ an inch to 1 foot—a rule taken, I suppose from the usual practice of machine makers."

◆

OBSTACLES TO SIXTY MILES AN HOUR.

There is not in the world a train timed to run at sixty miles an hour, although it is, of course, certain that that velocity is often exceeded. So far as the machinery of a railway is concerned—the road, the rolling stock, and the signals—there is nothing to prevent an average speed of sixty miles an hour being maintained. That it is not attained is certain. It is worth while to inquire why.

The first essential to great average speed is that the runs shall be long ; and this is necessary, not so much because of the time lost in a station, as that spent in getting into and out of it. The station must be approached and left at comparatively slow speed, because it would be dangerous to do otherwise. The next essential is that the train shall be light, because the engine ought to be able to maintain a high speed up hill as well as on a level. High speed trains cannot fully avail themselves of the compensating effect of inclines. Let us suppose that the maximum speed attained must not exceed 70 miles an hour. Then if the up and down inclines balance each other, the speed of the train must never fall below 50 miles an hour, or else the average velocity cannot be 60 miles an hour. If the maximum speed permitted was 60 miles an hour and the average speed 40 miles an hour, then trains might ascend grades at 20 miles an hour and still make time. Success would depend entirely on keeping the load hauled so small, that engines might be worked at a speed never under 50 miles an hour.

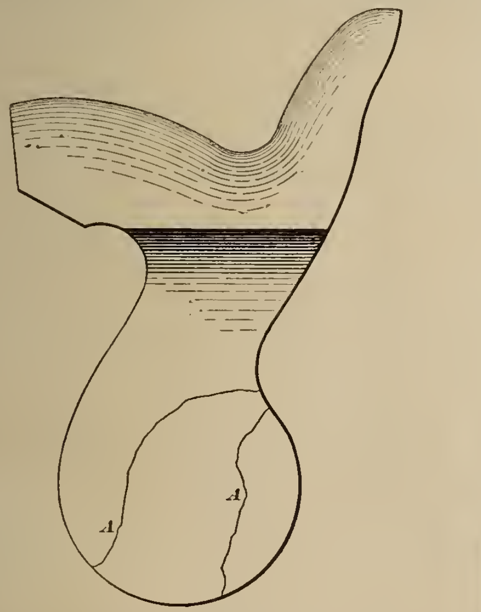
It must not be forgotten, however, that although the load would be small, the excessive speed would make large demands on fuel and water. It would not be safe to reckon a less consumption of coal than 40 lbs. a mile, so that the tender would have to carry about 3 tons ; allowing that each pound of coal evaporated 10 lbs. of water, including waste, the tank must hold 5,400 gallons, or 24 tons of water. It would be objectionable to attempt to carry such a load as this, and water troughs supply a way out of the difficulty. On a grate of 20 square feet the consumption would be at the rate of 120 lbs. an hour, which is too fast for comfortable or regular working, and a special design of engine would be absolutely indispensable, one with a very long grate being required to provide the requisite surface.

It will be seen that the engine which could comply with the required conditions has yet to be designed. The fastest train in the kingdom is, as we have said, the *Flying Dutchman*, and this is 7 feet gauge. The speed advantage conferred by the 7 feet gauge is that it permits an enormous boiler—and particularly an enormous grate—to be used. The *Great Britain*, for example, has nearly double the heating surface of powerful express engines on other lines. Engines of this class have 1,953 square feet of heating surface and 21 square feet of grate. The *Flying Dutchman* consists of engine and tender weighing 65 tons 18 cwt., one eight-wheeled van 16 tons, and five eight-wheeled coaches weighing 88 tons ; total, 169 tons, 18 cwt.

The principal reason why high speed trains are not run is that it is difficult to provide locomotives of sufficient steaming power. It is evident that if an engine could be produced which could do as much work with 20 lbs. of coal per mile as the existing engine does with 40 lbs., an enormous advantage would be gained ; but it is not at all probable that any great saving can ever be effected in the consumption of coal. The designing of a locomotive to make long runs at 60 miles an hour average speed presents, however, an interesting problem, which will, perhaps, be attacked some day. Locomotives are so absolutely interwoven in the dimensions of parts, if we may use the words, that to augment the area of a grate by one-half will suffice to almost revolutionize the proportions of an engine. That a good engine of this kind could be made we have, however, no doubt. It remains to be seen whether England or America will have one first.—*London Engineer.*

A MECHANICAL CURIOSITY.

Our engraving represents a curious effect produced on a wrought iron forging by a human hair. The forging was in a cold press, that is a powerful press used for finishing the forging after it is shaped. During this process, it is put between two hardened steel dies and subjected to a pressure of 200 tons per square inch. At one of these operations, a hair taken from the head of a bystander was placed on the face of the forging toward the reader, and the full pressure applied. The result was that the hair was driven into the forging and imbedded in it, as shown by the outline, *A A*, near the base. The hair itself was uninjured during the operation, and was removed intact by Mr. Manning Merrill, of the firm of Merrill Bros., at Williamsburg, N. Y., manufacturers of drop presses, upon whose authority these representations are made. We shall be glad to hear what our friends have to say on this matter by way of explanation ; that is, how an elastic flexible substance can be driven into material many times denser than itself.



This experiment is certainly almost incredible in result, and quite the reverse of what might have been expected. It is doubtful if a steel wire of the same diameter, in the same position, would have presented the same results. Those curious in such matters, in this city, can see the forging in our office for a few days.

MILLS' DIRECTORY OF STEAM USERS.

J. W. Mills Pub. Co., 165 Broadway, N. Y., issue a directory of steam users in Pennsylvania and Ohio, which is of great value to persons selling goods to that class. It gives the number of boilers in use by each firm, and also nature of the business carried on. It is indispensable to a thorough canvass of these States.

The Engineer and Machinist's Drawing-Book is one of the oldest standard publications extant on the subject, and contains between its covers the whole art and mystery of the craft. It is indispensable to thorough knowledge, and should be in every engineer's library.

This publication is based on the celebrated work of Le Blanc, with several entirely new chapters supplied from the personal knowledge and experience of the editor; the Engineer and Machinist's Drawing-Book, therefore, it is not a servile translation, but a new and distinct treatise, combining what was good and worthy of reproduction in the best French works, with the needful supplementary contributions from English experience.

A suit involving $60,000 has been commenced in England by the Cunard Company against a forge company by reason of the failure of the *Servia's* crank shaft and delay in supplying other forgings, whereby, it is alleged, that the ship was delayed five months. The defendants allege that the shaft did not fail, if it did it was not their fault, and lastly—they don't know anything about it any way !

Sample copies are sent once, only, to parties. Papers are always discontinued on expiration of the time paid for; and no names are entered on our subscription books until paid. A newspaper is an article of merchandise, and we see no more reason for sending it after a subscription has expired, than there would be in a steam engine manufacturer giving a new engine when the first one was worn out.

An English paper says that four steel steamers, to make thirteen knots an hour regularly, are being built on the Clyde, Scotland, to run on Lakes Huron and Superior ; that is from Collingswood to the western part of Lake Superior. They are for the Canadian Pacific R. R., and are set up in Scotland, then taken down and shipped in sections, and put up again in this country. When this extra work is considered they might have been made as cheaply in this country—and better.

A locomotive engineer on a certain road, upon which color-blind regulations had been in force, was formally examined and pronounced incapable in consequence of defective vision. The engineer was discharged from service. Not long afterwards he rigged himself up as a farm laborer and presented himself to the expert, saying that something was the matter with his eyes and requesting to be examined. The oculist did not recognize him, and after a careful examination gave him a certificate that his capacity of discriminating colors were perfectly normal.—*Nat. Car Builder.*

Any of our readers who may take a notion to engage in the manufacture of fictitious "butter" will find a formula for the same herewith :

> "The proportion of the several ingredients may be as follows: To make one hundred pounds of 'creamine.' or 'butterine,' I take twenty parts, by measurement, of sweet cream, sixty parts oil of tallow, fifteen parts oil of lard, ten parts oil of butter, five parts of any of the vegetable oils mentioned, ten pounds of salt, and half a gill of annatto, annatoine, or other suitable butter coloring matter."

Very nice indeed !

The sprightly Mechanical Engineer, which has just begun its third year, is congratulated upon its greatly improved appearance. It is now as handsome as it is enterprising, which is saying all that is necessary, as its readers well know.—*Manufacturers' Gazette.*

Mr. John A. Coleman, a well-known eastern engineer, recently lectured before the *Rhode Island Association of Stationary Engineers*, upon boilers, and in the course of his remarks, said :

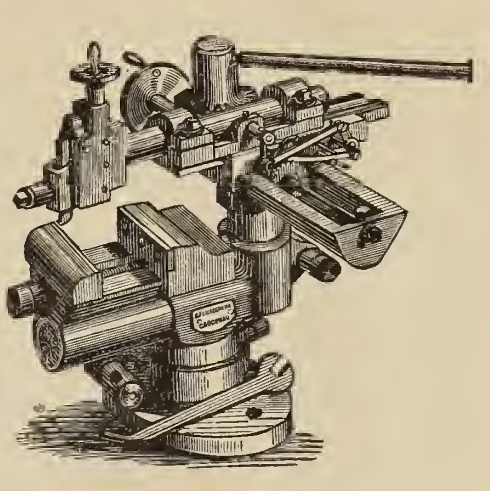
> "The cause of explosions is an over-pressure of steam on a boiler too weak to stand the strain. Most of the explosions occur soon after starting up, or upon the sudden introduction of cold water, or something to cause a violent disturbance of the heated water and the steam, causing the exertion of a great force upon one point. In regard to the economy of fuel, men will expend large sums of money on improved machinery and engines, and on bells and office furniture, but when it comes to the boiler, the heart and lungs of the whole system, they appear to think that almost anything will do, and they pinch to save fuel, quite regardless of their great risks."

Truth in a nutshell ! Friend Coleman "knows whereof he affirms."

ARTIFICIAL FUEL.

Efforts are being made, with some success, to use culm for steam purposes by molding it into blocks. One of the most successful is known as Loiseau's Artificial Fuel, and is thus described by the inventor:

Mr. Loiseau said that the aim of inventors has been to manufacture small lumps in paying quantities, and, so far, the attempts have been failures. Sixty-eight fuel factories are successfully operated in Europe, but they all make brick-shaped lumps, too large for family use. Mr. Loiseau claims to have solved the problem, and states that the Loiseau Fuel Co., at Port Richmond, cannot supply the rapidly increasing demand for the small egg-shaped lumps, (weighing about 2 oz.), which they manufacture at present. Mr. Loiseau describes, at length, his process, and the machinery used for mixing and pressing into lumps the coal dust and the pitch, of which the fuel is made. He replied to the criticism of pitch fuel, with regard to its odor, by the practical exhibition in the grate, and presented the following as the result of the tests made in the American Institute of New York, by Prof. J. E. Denton, of the Stevens Institute of Technology: 1st, that the Loiseau Fuel evaporates more water to the pound of coal than ordinary anthracite; 2d, that the quantity of ashes is smaller; and 3d, that these ashes contain no clinkers. Mr. Loiseau demonstrated its insolubility by the exhibition of specimens which had been placed in jars of water. In the consumption of the fuel in the grate no offensive odor could be detected, and it was noticed that the lumps retained their shape while burning and threw off a great amount of heat.



A USEFUL HAND SHAPER.

A convenient tool for use in railway and other repair shops is that here illustrated. This particular one is made by a German manufacturer, but, unless we are mistaken, it is a copy of one originally made in this country, by whom, we do not know. This is a special machine and has its own vise attached. It is not meant for attachment to any vise. It is self-feeding, and can be used for a great variety of purposes, as our readers will see at a glance.

A coat of zinc has a slippery soap-like character, and would surely be a good means to diminish friction and improve the effect of ships' screws, says a foreign engineer.

Next to him that wins, he that loses is the wisest.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

A RAID ON BOILER MAKERS.

Editors Mechanical Engineer.

In your issue of January 6, appeared an interesting article from *Smoke Arch* on Safety Valves. I think the last paragraph where he gives advice to boiler makers needs more attention from the trade alluded to. I would like to ask how many boiler makers in the country know, or care, what style or size of safety valve is needed on boilers they build? I do not allude to large engine and boiler establishments where they conduct their business on scientific principles, but to the thousand and one seven by nine shops, where they make boilers a specialty. If the average boiler maker can knock a boiler together out of inferior iron and inferior workmanship, and put on a two inch safety valve, where perhaps a three inch is needed (most likely charge a three inch price to offset it), why he is happy. What matters it to him if on turning a flange on a tube sheet or head, it cracks? The pene of a hammer will fix it all right, or perhaps a little putty and paint will serve his purpose better. What if the tube holes are not in line with each other from head to head, and they stand on all kinds of angles, so much so that if any engineer could look through the shell at them, it would make him seasick or cross-eyed for life. Mr. Editor, there are a number of defects in boiler making that I could cite, but will not at this time take up more of your valuable space; in conclusion, I will say there is a good feature in our steamboat law, viz: The marine engineer is protected against the cussedness of boiler makers; until there is a similar law on land, requiring users of steam boilers to employ competent engineers and have boilers built under their supervision, protected by Government inspectors, just so long will boiler explosions continue. Trip Shaft.

[We print our correspondent's favor, but fear that he is rather hard in his strictures on a class No doubt but that there are plenty of careless boiler makers, just as there are careless men in all trades, but there are boiler makers who are conscientious workmen, fully aware of their great responsibilities.

The trouble with all boiler makers that we have ever had anything to do with, is that they despise the principles of their business, and appear to think that success in it depends upon intuition, or following some method they have always followed, regardless of whether it was right or wrong. Expansion and contraction, in fact any of the commonest rules of philosophy they reject contemptuously as "book knowledge." It would be better for the public at large if they had a little of it. —Eds.]

HE WISHES TO GET ON THE ROAD!

Editors Mechanical Engineer.

Why is it so hard to obtain a situation on a railroad? I am a young man, 23 years of age, and it has been my sole ambition ever since I can remember to become a railroad engineer; but this seems impossible, for I have been trying to get a situation as fireman for the last six months, with no success. I have tried every road in this city, and there are six of them, but the answer is always the same; no firemen wanted. I have good recommends, but they do no good. I have been told by several parties that the only way to get on the road is to bribe the Master Mechanic, but I think this is absurd, don't you?

Do all metals expand by heat? I like your paper better than any I have ever taken before, and I guess I have had a try at almost all of them. I wish it a Happy New Year and many of them. I do not say this to get an answer to my questions, for I know I would get an answer, praise or no praise; I have one fault to find with your paper, however, and that is, it is too cheap. Please make it 10 cents, as I hate to break my dimes.

Cleveland, O. Nemo.

[We sympathize with our correspondent in his pursuit of a situation under difficulties, and would gladly advise him right into a place, if such a thing were possible. In a case like this, however, advice availeth little; nevertheless we will do what we can. A young man in pursuit of a place on a road must remember that he is only one of a multitude, all bent on the same thing, and that his chance is just one in whatever number there are seeking such places. In a city like Cleveland, Ohio, and its surrounding towns, there are, doubtless, a thousand young men who want to get on a railroad at any price whatever. These young men besiege the Master Mechanics of Cleveland, and the Superintendents as well, by letter and in person so often, that it becomes wearisome from its very repetition, and they turn a deaf ear to all such applications. This is why it is difficult to get on a railroad. Another reason is that there are but few vacancies comparatively speaking. When a young man gets a chance after long seeking for it, he holds on to it and lets the other chaps outside serve a little time at trying to get in! There is, in fact, an over supply of help for such places, and like everything else in this world it is a question of the survival of the fittest. That is to say the men best able to get places get them; not by bribery, however. If we were trying to get such a place as our friend speaks of, we should endeavor to cultivate a personal acquaintance with some influential engineer on the road. There are many such who have the ear of the Master Mechanic, and can do more for our friend than any one else. If he is successful in gaining the friendship of such an engineer, it is pretty certain that if he has any fitness for the place, he will. in due course get an opportunity, If he is an honest, sincere, manly, straightforward young fellow, without low associates, or vulgar speech, if he shows in all his actions and conduct that he is sincere in his aims, he will surely succeed in them. He has large capital to start in business with.

All metals and all substances, solids or liquids, expand by heat, but in varying degrees. That is to say they are larger and occupy more space when hot than cold. Regarding the price of The Mechanical Engineer we are glad to know that our friend feels that he gets his money's worth, but then, not all are so reckless of two cents as he is. We would like to publish it for five cents; that would meet the views of a great many others, perhaps, who feel that is about its value!—Eds.]

THAT ROTATING SLIDE VALVE.

Editors Mechanical Engineer:

In your last issue I find an illustration of a new English slide valve which is designed to wear tight by being partially rotated, or moved sideways, in its travel to and fro. If this is necessary in order to keep a valve tight on its seat, the end can be attained much easier than as shown in the engraving in your paper. I do not think it is necessary, as slide valves can be kept tight without any side motion. Imagine what this detail would amount to on a large valve! Only the smallest could be so moved.

If a slide valve is fitted properly it will wear tight from the start; if it is not it will cut from the start. I know a great many will condemn my views, but I fully believe that scraping slide valves is a mistake on small areas. Mind I do not say large valves. I have seen valves put in locomotives that were planed merely, and in a few days they had perfect seats, that kept perfect for years. The seat was planed one way and the valve another way, so that the tool marks crossed; there never was any trouble with them. The oil got into the tool marks and stayed there until the face was worn to a perfectly level surface. I am free to say I would make small valves, not over 100 square inches face, in that way now.

It would be as you say. if dirty grease got into the the details of that English slide valve, it would be inoperative in a short time, or else tear the insides out of the whole thing.

New York. J. McCauley.

AN ERECTORS' EXCEPTIONS.

Editors Mechanical Engineer:

In a paper which professes to give instructions for practical men, I read some methods of erecting engines, recently, and find this among them. I came across it in the *Machinist*:

"The next important point is 'hanging the rod.' First, firmly key it up at the cross-head end, and see that it will go in the brasses on the crank pin without springing; if it will not, the cross-head brasses must be scraped in such a way as to throw the rod over in proper position. Then put the cross-head near or at the centre of stroke; move the rod up and down, seeing that it travels parallel with the crank; if it does not *one guide should be lowered and the other raised in such a way as to make it travel parallel.* If it is not advisable to move the guides, scraping must be resorted to again."

There is more in the article like this. Now I would like to ask my brothers in the trade what they think of raising and lowering guides to make a rod hang square? Seems to me that is botch work. I think so for this reason. The first thing a man does in setting up an engine, after the foundation is ready, is to level his cylinder and set the guides exactly square with the bore in every direction. Now this is fixed and cannot be altered. This man says if his rod does not hang square he cocks the guides one way or the other, to make it come right! He could not set any engine for me. Another place he says he scrapes the cross-head brasses to make the rod hang square. This is wrong again. If he scrapes the brasses on the pin-side, he does it independent of the bearing on the pin, so that, in a little while, it wears to the pin and throws the rod all out again; then the crank pin begins to heat, and the engineer don't know what makes it. Mr. Editor, this man seems to have given instructions without any warrant to do so, for he misleads others. What he wants to do to make the rod hang square, and stay so, is to take off metal on the brass where the rod butts against it, one side or the other. A cocked rod comes from the butt of the rod not bearing square against the brass when keyed up. Scraping a bearing is of no use. I like The Mechanical Engineer for the reason that I have never yet found it in an error on standard work, but I am going to try to—if I can.

New York. An Old Engine Erector.

GOOD IDEA.

Editors, Mechanical Engineer:

As bearings are apt to spring when being babbitted, it would not be a bad plan to keep them moving at a slow speed while the babbitt is being poured in. I have never tried this, but I think it a good idea.

New York, Old Babbitt.

[We are glad to hear from "Mr. Babbitt," as we supposed he had given up business long ago.—Eds.]

ABOUT THE BELT.

Editors Mechanical Engineer:

I hope some time during the coming year, the belt question—what makes it run to one side—will be settled, for after reading all the letters on the subject, pro and con, I am still in the dark!

Philadelphia, Pa., George W. Nock.

[Belts run to one side of a pulley for the following reasons: Ends not cut square when laced, and holes not punched square with the ends; this hauls the belt in on one side or the other, and makes it lead to one side, one-half a revolution, and then cross over to the other side. Also, they run to one side when the belt is made from poor material, belly pieces for instance, which are soft and spongy, and stretch under strain. This makes one side longer than the other. Friend Nock can put these down as two things certain, to cause a belt to run on one side of a pulley.—Eds.]

MR. CHAPMAN IS WANTED!

Editors Mechanical Engineer:

In answer to Mr. W. A. Chapman, of Ravenna, O., in your issue of Jan. 20th, I am inclined to think that his proposition "to drop the crank end of connecting rod when the cross-head is in the center of stroke, and have the center of the box fall short of the center of the main shaft," would hardly hold true. However, if he means that a perpendicular dropped from this point would fall short of shaft center, I agree! I would very much enjoy reading an explanation of his second theory; that is, about cylinder hand bolts.

Blakeslee M'fg. Co., G. F. Blakeslee.
Du Quoin, Ill.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors Mechanical Engineer:

Societies in the following places are now tributary to the National Association: Boston, Lynn, Worcester, and Springfield, Mass.; Providence, R. I.; New York and Brooklyn, N.Y.; Detroit, Mich., and Chicago, Ill.; nine in all and more in the wind! You have improved The Mechanical Engineer *big*.

A. M. Davy, Sec'y.

MARINE ENGINEERS' ASSOCIATION, No 7.

Editors Mechanical Engineer:

Officers and committees for 1883, are as follows: President, William K. Rhodes; Vice-President, Henry W. Lindsey; Recording Secretary and Treasurer, Thomas B. Merrill; Corresponding Secretary, George H. Coyle; Chaplain, Thomas Burgess; Conductor, John F. Sanborn; Doorkeeper, Joseph Guilford; Delegate to National Convention, William K. Rhodes; Trustees and Business Committee, George Cushing, James H. Merritt, Edwin B. Clapper; Investigating Committee, Henry W. Lindsey, Frank D. Howe, Richard Wade, James Burnic, John F. Sanborn.

Portland, Me, Thomas B. Merrill, R. S.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors Mechanical Engineer:

Please find officers elect for ensuing term of *Brotherhood Stationary Engineers* of this city:

Chief Engineer, N. J. Sarazin.
Assistant Chief, E. C. Parker.
Recording Secretary, A. H. Goff.
Financial Secretary, Richard Williams.
Treasurer, Wm. T. Blatterman.
Conductor, H. A. Voden.
Guardian, John Murphy.
Sentinel, Thomas G. Williams

We all like the new dress of *our* Mechanical Engineer. A happy and prosperous New Year to you.

St. Louis, A. H. Goff.

[Thanks The wish is cordially reciprocated.—Eds.]

FIRST CLASS ENGINEERS RUNNING ON THE MISSISSIPPI RIVER.

A friend in St. Louis, Mo., sends in the following names and addresses of Western engineers:

Lewis Clanton, No. 1116 Jefferson ave., St. Louis, Mo.; Jas. Chandler, Milton, Ill.; Fred Bortham, Kirkwood, Mo.; Geo. Clifford, No. 1312 N. Market st., St. Louis, Mo.; Edward Cole, Seventh and Morgan sts., St. Louis, Mo.; Jos. Crawford, No. 1603 Monroe st., St. Louis, Mo.; Benj. Fichner, Sixth and Washington sts., St. Louis, Mo.; Thos. B. Farrell, No. 55 Hunt ave., St. Louis, Mo.; Jno. B. Gill, No. 2700 Pine st., St. Louis, Mo.; Wm. Gleishman, No. 1833 North 9th st., St. Louis, Mo.; Ned Golly, 90 Carr's Boat House, Memphis, Tenn.; Cyrus Graham, No. 3016 N. 13th st, St. Louis, Mo.; Lander Geer, No. 1423 Washington st., St. Louis, Mo.

Hope this will meet your approval together with the other two lists you have.

Yours very truly,
Everett B. Chester,
No. 2021 Sidney st.

SIZES OF ROLLED IRON.

At a recent meeting of the Master Car Builders Association, this subject came up for discussion, eliciting the following interesting information :

The Chairman said that one of the objects of the meeting was to ascertain how near to standard sizes, bolt iron could be rolled without increasing its cost. He requested Mr. Wilson (of Pittsburgh) to give his views.

Mr. Wilson.—Iron can be rolled accurately to a given gauge ; it is only a matter of cost, that is, of keeping the guides and rolls in perfect order. But the practice has been to order iron full, and that "full" had no limit. It might be an eighth or a thirty-second or a sixty-fourth. Iron of exactly $\frac{3}{4}$ in. or other diameter can be had if it is ordered, but in order to have the rolls turned up frequently and keep them absolutely correct, it would cost a little more. To maintain exact sizes it would be necessary to turn the rolls oftener. I think whenever the iron is found to be $\frac{1}{64}$ or $\frac{1}{100}$ in. above size that the rolls should be dressed. That is a question for the men who use the iron to decide. Our rolls are returned when they are $\frac{1}{64}$ larger than the standard size. We are now using a steel guide and can make more iron without change than heretofore. Of course if we have to dress the rolls oftener we must charge more.

Mr. Garey.—The car builders want to learn what is the limit of least variation in the size of iron that can be specified, without increasing its cost. If they required iron to be made of exact size, the rolling mill men would have cause to say, "we must have more money for making it." What we want to do is to fix the least limit of variation in the size of iron which will not increase its cost.

Mr. Emery.—If the car-builders require that iron shall be rolled to within a hundreth of an inch of the standard size, they will certainly get it. The bolts made from such iron will take 10 per cent. less material than is used now, and will require less work to cut them, and the bolts will be a better fit. For such iron they can afford to pay more.

Mr. Forney.—If I had an order for 100 tons of $\frac{3}{4}$ in. iron, and should specify that the bars should enter the gauge on the table, which is $\frac{1}{100}$ in. larger than $\frac{3}{4}$, but should not enter the other, which is $\frac{1}{100}$ in. smaller than $\frac{3}{4}$ in., the difference between the two being $\frac{1}{50}$ in., would Mr. Wilson charge any more for the iron than he would if there was no specification of that kind?

Mr. Wilson.—No.

Mr. Forney.—How close to standard sizes can you roll iron without increasing the cost? Can you roll within $\frac{1}{32}$, $\frac{1}{64}$ or $\frac{1}{100}$ in?

Mr. Wilson.—To roll iron to standard sizes we should require to have another set of rolls. At present chain iron is rolled scant, bolt iron is rolled full ; now if we had orders to make iron to standard sizes, we would require still another set of rolls. Car manufacturers frequently say in their orders, "Please make this iron scant all over."

Mr. Forney.—I have served for several years on the Committee on Standard Screw-threads, and one of the difficulties encountered in their introduction, has been that of getting iron made to standard sizes. It was therefore proposed to the Pratt & Whitney Company that they should make limit gauges for the size of iron, which could be used by the rolling-mill men in making, and the railroad men in inspecting the iron. It was proposed to have one gauge a little larger than the standard size, and the other a little smaller, and then specify that the iron should enter the one and not enter the other. Now, I will ask Mr. Wilson what he thinks the difference between the standard size and that of the gauges should be?

Mr. Wilson.—I should say $\frac{1}{75}$ to $\frac{1}{100}$ larger and smaller than the standard would be a good margin to work on.

Mr. Garey.—How much time would it be necessary to give to the rolling-mills in order to have them supply iron rolled by such gauges? Would there be any difficulty in placing an order in January to be delivered in March?

Mr. Wilson.—There would probably be no difficulty in delivering it in February.

A representative said that if his company received orders sufficient to warrant it in getting the necessary rolls, it would roll the iron to the limit required. It has been its practice to roll bolt iron $\frac{1}{64}$ in. full. He suggested $\frac{1}{100}$ in. each way as the allowable limit, to be reduced in the smaller sizes.

Mr. Burdict.—We use a great deal of iron in the manufacture of bolts. We furnish all the mills from which we buy iron with gauges, and we allow them to vary from $\frac{1}{64}$ to $\frac{1}{100}$ in. It is almost a matter of impossibility to get iron to those sizes. I am glad that there are men here who can roll iron to within $\frac{1}{100}$ in. of the exact size.

Bolts are sold by the hundred usually, and many manufacturers use their iron scant. The bulk of the bolts are sold that way. If we made fits exact, and offered such bolts to a purchasing agent, the next maker, who uses scant iron, whose fits rattle, would come along, and we would get left on one-half per cent.

EIGHTH ANNUAL CONVENTION OF THE MARINE ENGINEERS' ASSOCIATION AT DETROIT, MICH.

The eighth annual convention of this important body, occurred on the tenth instant, at Detroit. It was a source of keen disappointment to us that we were unable to be present, owing to the distance and time involved. Another year, however, if we are spared, we do not mean to be left. We return thanks to the many engineers who have written to us expressing regret at our absence, and assure them that we regard it as a personal loss to us from every aspect. As gathered from local sources the transactions of the body, so far as made public, are appended.

Address of welcome was read by James H. Reed, of Detroit:

Most Worthy President and Delegates of the National Convention:

At your annual meeting in the City of Philadelphia in 1882, your brethren in Detroit extended to you an invitation to hold your next annual meeting in their city, which you accepted.

In the name and in behalf of the marine engineers in this city, I bid you welcome and extend to you their brotherly greeting.

Your presence here as the honored representatives of our sister associations, coming as you do from all marine ports of this wide dominion, charged with grave responsibilities as the representatives of subordinate associations, to consult how best you may promote the general good, to account as faithful stewards of a sacred trust, to make known your work and its fruits within your respective spheres of action.

By our combined exhibit of accumulated power for future ministrations, to gladden the hearts of as noble a band of men as the world has ever known, may we, my brethren, in view of these things, measure up to the just expectations of a generous and enlightened constituency, remembering always our mere representative capacity and the large interests, as such, confided to our care. Whilst our present status, in its contrast with the past and in its auspicious presage as to the future, justly challenges admiration; and as our mission is to care for the widows and orphans, we have never failed to recognize our dependence for this reward upon a higher than human power. We render our first offering to the Great Disposer of human events, for His care and deliverance of each of us from the many perils which we are subjected to. In behalf of my brothers in Detroit, I bid you welcome to this council chamber; may harmony and good will prevail, and as the result of your deliberations, when you have returned to your homes and the things done are conveyed through you to your respective associations, may the voice of universal commendation rise to greet you from a constituency prospering, and continuing to prosper through your instrumentality. Once more welcome to our hearts and hands.

The convention was then opened in the second degree, the credentials of those present examined, after which E. D. Bateman, Most Worthy President, read his address, which was substantially as follows:

PRESIDENT'S MESSAGE.

The President opened his message by wishing that the deliberations might be tempered with justice so that the greatest amount of good should be done to the greatest number. He thanked the officers of the association for the able assistance they had extended to him, and stated that since the adjournment of the last convention at Philadelphia, Pa., one year ago, he bad charters for four associations, as follows: No. 34, at Parkersburgh, W. Va.; No. 35, at San Francisco, Cal.; No. 36, at New Haven, Conn.; and No. 37, for Jersey City, N. J., all of which are progressing finely, and are in a prosperous condition. In establishing the San Francisco Association the President encountered many serious obstacles, but being determined that an association should be established on the Pacific coast, he used every effort, and finally succeeded. The association is now in splendid condition.

A charter was issued for an association at Gallipolis, O., but owing to a sudden rise in the river, there were not engineers enough at home to organize with; for the same reason the association at Wheeling, W. Va., was not reorganized, but the organization at both these ports, he thought, was only a matter of time.

Nothing had been heard during the year from Milwaukee. All other associations are in good condition except those at Memphis and New York City. The President had no doubt but that several associations will soon be organized on the Pacific coast, also at Brooklyn, N. Y., Boston, Mass., Sandusky, O. and Toledo. O.

He spoke of the success of the Committee on Reduction of Licenses, which had managed to have the fee reduced from $10 to fifty cents, as an illustration of what can be done by organization.

He had decided several cases appealed to him, the most important being in regard to setting a standard of wages. This was provided for in the following clause: "But no association shall set a standard of wages for its members," and his decision was rendered accordingly.

The President recommended, among other things, that this convention adopt some form of funeral ceremony, to be used when an association attends a brother's funeral; that each sub-association be granted the privilege of having certain honorary members; that legislation be had in regard to members whose licence is revoked; that each sub-association be empowered at a regular meeting to decide by a majority vote whether a brother shall be retained or dropped from the books when his license is suspended or revoked; that the convention urge upon the different sub-associations the strict enforcement of the rule which reads: "Occasional intoxication shall subject a brother to the censure of the association, and habitual intoxication shall be considered sufficient cause for expulsion ;" that the per capita tax in the Mutual Aid Department be placed at a rate sufficiently high to meet the expenses that are necessary in the organization of new associations. The President concluded by thanking the members for the honor conferred on him.

The minutes of the previous convention were next read and approved, and reports from the various associations considered, after which the convention adjourned to meet the next day.

SECOND DAY.

After the minutes of the last meeting had been read and approved, a committee was appointed to audit the President and Secretary's report, and one on grievances. The convention next decided that a committee should be appointed by each sub association to present their views to a committee of five, the latter to go to Washington and endeavor to secure such legislation as is deemed necessary to advance the standing of marine engineers and secure certain changes in the present inspection laws, so that engineers who serve their time and master every detail of their calling, shall not be interfered with by others who learn their trade only in a superficial manner and obtain special certificates. Marine engineers stand alone among mechanics, being the only ones who are licensed by the United States Government. They have formed their association with the object of elevating the members of it to the highest posible position among mechanics. It is the sense of the convention that a man who has mastered his trade sufficiently to be worthy of the position of engineer on one steamer, should be deemed qualified to hold a similar position on any other boat of that class. They also think that a man who cannot be intrusted with one steamer should not be given a position on another. It has been the custom heretofore to grant, in certain cases, special licenses to engineers, allowing them to run a specified steamer and no other, and to have this power taken away from inspectors is one of the principal objects of the committee. It is held that an explosion or other accident on one steamer is an injury to all; that one incompetent man reflects discredit on the others, and as no good reason can be advanced for the issuing of special licenses, the convention thinks special licenses should be abolished in the interest of the profession. The committee will also endeavor to have inspection laws amended to suit different localities, the difference in the requirements of engines for river and lake navigation being so great that a special rule should be adopted for the Ohio, Mississippi and other rivers where shallow water is encountered.

At the afternoon session the Secretary and Treasurer of the Mutual Aid Department made their reports which were fully discussed, after which the convention adjourned to meet again this morning at 9 o'clock.

THE BANQUET.

In the evening the delegates and a goodly number of invited guests assembled for a banquet at Phœnix Hall, and a very enjoyable time was spent. The toasts were as follows:

"Our Invited Guests"—Response by J. H. Reed, of Detroit, President of the Detroit Association.

"Our National Convention"—Response by Ed. D. Bateman, of Cincinnati, President of the Convention.

"Sister Associations, What They Desire to Make the Marine Engineer"—Response by J. H. Harris, of St. Louis, Secretary of the Convention. Mr Harris after responding, read a very interesting and original poem which was well received

"The Mutual Aid, the Support of the Widows and the Orphans"—Response by R. Doty, of Cleveland, Treasurer of the Convention.

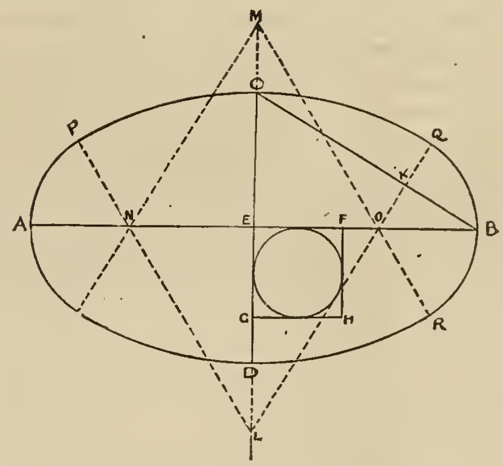
"Our Employers, Capital and Labor Hand in Hand"—Response by W. E. Russell, of Pittsburgh.

"The Press, Its Usefulness and Power"—Response by G. W. Jones, of Detroit, editor of the Detroit Marine News.

"The Ladies Our Companions in Prosperity and Adversity"—Response by W. K. Rhodes, of Portland.

Song by Brother W. Daly, of Detroit.

* * *



TO CONSTRUCT AN OVAL.

Let *A B* and *C D* be the two diameters of the oval, set off half the short dia., *C E*, or *E D*, from *B*, as *B F;* upon the remainder of the long semi-diameter, *E F*, construct a square, *E F G H*, in which describe a circle touching the four sides of square. Join *C B* and draw *K L* at a right angle with *C B*, and tangent to the small circle inscribed within the square, the point, *L*, will be the center of arc, *P C Q*, and point, *O*, the center of arc, *Q B R;* the other two centers can be measured off from the center lines.

I. G. Sowter.

TOO LATE.

We regret to state that engravings intended for this issue are not at hand; through no remissness of our own however. This leaves us scantily furnished in that respect, a short coming we are sensitive upon. When a man has committed a great crime he generally asks a suspension of opinion, until he can be proved guilty. We ask a suspension of opinion !

* * *

Mr. Thomas Shaw is a prominent candidate for Chief Engineer of the City Water department, of Philadelphia, and is supported by a strong array of prominent manufacturers. No better choice could be made for this post, for Mr. Shaw is not alone an engineer, he has executive ability which would fit him for so important a position.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

THE UNIVERSAL TOOL.

If one had to carry on the machine business with small means, he could get along very well with a lathe and vice bench only. That is to say, there are few jobs in a shop that cannot be done with these simple tools. The lathe will not only turn work, but it will supplant the planer, the milling machine, the bolt cutter and the gear cutter, for many of the jobs usually done in these several machines, can be done in the lathe. Where work can be held in a chuck it can be faced off to a flat surface much quicker, and quite as accurately, in a lathe as on a planer. Take a slide valve for example, and where it can be gripped readily the lathe will face it up true before the planer will, for equal surfaces. This for the reason that the valve can be set more quickly in the lathe, is constantly under the cutting tool, and can be run at a higher speed. A lathe may be called a circular planer, with the advantage that it can do other work that the planer cannot. When it comes to cutting gears, if a lathe is provided with simple fixtures having an index plate, (such as the centers used on a planer for instance) the finest work in this class can be done. A gear cutter is nothing more than a special machine, with a revolving spindle, and a wider range of capacity than the lathe.

We might pursue this line of illustration at length, but what we have said sets forth the universal and indispensable character of the lathe as a machine-tool, and this being admitted, the methods pursued in its construction are of the first importance. The first necessity is strength and stiffness. Everything else must be subordinate. Every appliance for convenience and facility of access should be sacrificed sooner than absolute rigidity and immobility. The bigger and heavier it is the better it is. No man ever saw a lathe that was too heavy, and he never will. If the bed was a solid block of iron without ribs, legs, braces, struts, or any other abomination, that would be the ideal bed. If the head stock and tail stock were similar, the cone-pulley solid throughout, a mere block of iron with the proper steps on it for speeds, a great advance would be made, for the object is to prevent all vibration, spring, and distortion. These ends are obtained only by absolute absence of elasticity, and the absorption of disturbing forces. Want of material in the tool is its greatest weakness, and one not compensated for by anything else. A light lathe is a chattering lathe, for the reason that if it is put up to its utmost capacity, it springs and communicates its spring to the work. which in turn is acted on intermittently. Other things tend to make lathes chatter, such as light spindles and springy carriages, etc., etc., but a prime fault is want of material in the proper place. Why should a lathe bed not be solid down to the floor; a parallelogram of iron without legs, or supports other than its own bottom. Custom cocks it up on stilts on each end, because lathes always have been so made, and because it seems handy to have it so. When we say solid, we mean like a box without a cover, turned upside down, not solid iron from one side to the other as we mentioned in a previous illustration. Some machines are so made now; milling machines and gear cutters, for example, and it would be just as reasonable to mount them on four long legs, as to build lathes in that manner. If the cost is an objection it should also be considered in the case of other machines, but the fact is that mere material is the least obstacle. It is so many pounds of iron, at so much a pound, which could easily be added to the price without demur from the purchaser. If lathes were made in this way there is no question of their rapid sale, the mere appearance and common sense of the design would commend them on sight.

It seems to us that the machine tools of the future will be a great advance upon those now in use, and accepted as beyond improvement. New men coming into the business will bring new ideas. The technical schools will impart instruction which will be used to advantage by its pupils, to the great gain of the artisan of the rising generation.

SIXTY MILES AN HOUR.

In another part of this issue will be found an article from a foreign contemporary discussing the feasibility of a speed of sixty miles an hour upon railways as a regular duty for express trains. The conclusions arrived at are that engines can be built to make that time, provided certain proportions it mentions, could be obtained. In all of our contemporary's calculations, however, we find no consideration given to the line itself, but it argues its case in favor of sixty miles an hour solely upon obtaining sheer foot pounds of force from the locomotive.

We think it can be shown from data that is in existence, but which we have not now access to, that locomotives at present in use in this country are fully capable of sustaining sixty miles an hour, as a constant duty, provided all the conditions favorable to that speed are present. These conditions are that the road shall be a straight line without grades or curves; that is all. An engine and its train once set in motion upon this level could maintain a speed of sixty miles and over, per hour, with less danger of accident than now exists at far lower speeds.

What is needed is not more powerful locomotives but better railroads, and when we have them the force we now have will be used to better advantage. When we have to climb grades of some ninety feet, and over, to the mile, at comparatively low speeds, and hope to make up an average by going down the corresponding incline at break-neck velocities, it will be seen that our present engines have no opportunity to show their capacities; they are actually working at great disadvantage.

High speeds are only possible on railways by practically perfect surfaces for trains to run on. If it were feasible to produce a railroad with absolute planes, in straight lines, there would be no mechanical difficulties in running at speeds which now seem absurd to speak of.

CIRCULATION OF WATER.

As most persons know, the steaming capacity of a boiler depends in some measure upon the circulation in it. Water is a poor conductor, and if layers of it, so to speak, remain in contact with the plates for any length of time, or without being moved, the body of water outside of the layer will remain cold for an indefinite period. This is well known to all working engineers, and many attempts at artificial circulation have been made. That is to say mechanical devices have been employed for agitating the water where it is sluggish, and keeping it moving. Marine boilers, especially modern cylindrical tubular-boilers, are comparatively cold at the bottom for a long time after the fires have been started. To remedy this some engineers connect a steam pump to the bottom of the boiler and pump the water out, throwing it over into the steam space. Another plan used by some is to run a pipe from the donkey boiler into the bottom of the main boiler, and blow live steam in for twenty-four hours before starting up. Still another is to start the lower tiers of furnaces first, for some time previous to the upper tier, and in this way overcome the inevitable strain attendant upon two extremes of temperature in the boiler.

All of these plans are more or less effective, and serve their ends, but we were recently shown a remedy for defective circulation in cylindrical tubular-boilers, which sets up a natural current inside, so that very excellent results are obtained. The device in question is difficult to describe without a drawing, but it consists, mainly, of a sort of diaphragm attached to the back tube plate, (inside of course) and projecting at right angles to the length of the boiler. This brings it directly across the water space, but there is a passage below the plate, and through this the water is compelled to dive, so to speak, directly against the bottom of the boiler. When the boiler is fired up, the bottom water heats almost as quickly as the upper.

Want of circulation is a fatal defect, and, by whatever means it can be accomplished, vitally necessary. Natural circulation, or that induced as above described, is better than a forced circulation, which is apt to be local.

DIRT.

The greatest foe to safety and durability of a steam boiler is—pure and simple—dirt. We use the word in its broadest significance, including everything that does not arise from defects of construction. Dirt is a worthless incumbrance and obstruction. In this sense, scab in a steam boiler is dirt and rubbish, that should be removed before it has had time to form. The place to look for dirt of this character is remote from the accessible portions. It hides in nooks and corners, and gets swept by the circulation into the bottom of the legs, when there are any, or into the bottoms of the water spaces, except in cylinder boilers where there are none. In vertical tubular boilers it forms on the crown sheet among the tubes, and it adheres to the sheets all round as high as the water line.

There are facilities for removing dirt from most boilers, but they are of no value if unused. Hand-hole plates are not put on for ornament, or for strength either, but should be taken off, no matter how troublesome to get at, and the dirt removed through the hand-holes. Stir up the dirt thoroughly and often, if the water used is bad, and wash it out with a hose if there is a steam pump in the vicinity, and means to drive pump when the main boilers are out of use.

Dirt is scale not formed, and to get ahead of it one needs to be active. Boilers will not purge themselves, nor run themselves; they need careful, conscientious, and constant attention from men of experience. From this alone, a boiler that is not well proportioned, but is kept in good condition, will do better service, than one properly proportioned full of dirt.

THE ENGINE ROOM.

An engineer in a steady situation spends his life in the engine-room, or in and out of it. It is natural, therefore, that a man with nice perceptions of the fitness of things should endeavor to keep his surroundings decently, and in order. If an engineer is in charge of a handsome machine, everything else should harmonize; the chances are, under such circumstances, that the cost of power will be low. If this seems a far-fetched deduction we have only to consider that it follows from the influences. When an engine-room is attractive and a man feels at home in it, he naturally endeavors to keep the engine itself in its best condition; not indeed as regards mere external appearance, (though that is much) but also in its details throughout. Such a man will have no leaky valves, no wheezy pistons, no pounding connections, and no belts slapping to and fro through want of lacing. His oil tank, if it is in the engine-room, will have zinc laid all round it, with a ledge on each side, and clean sand or sawdust within the enclosure to catch the inevitable drips. The windows will be clean, the paint bright, and the floor covered with oil-cloth. Why should an engine-room not have all these accessories to neatness and comfort?

MISSING PAPERS.

In answer to some complaints that papers are not received regularly, we can say that we appreciate fully the importance of regularity, and to that end the personal attention of one of our firm is given to every mail, and every paper is put in the bags properly addressed. What is done with them after that we cannot say. Detroit and Chicago post offices have given us more trouble than any other. If subscribers will drop us a postal card when they fail to receive papers duplicates will be sent at once.

SLIGHTLY INVOLVED!

The Mechanical Engineer is favored with a proof reader who is a precisian, insisting upon correct renderings. In our last issue we wrote: "*Indexes for Vols. III. and IV. now ready; price one dollar.*"

This was printed "Indices for Vols. III. and IV. now ready, price one dollar."

This is correct, and so is our expression, and as a matter of business we prefer it. The average reader would be rather perplexed as to the meaning of "indices," and wonder what sort of a looking thing it was for one dollar! We simply meant to advise our readers that *binders* were now ready, not indexes; they belong in volumes III. and IV., and are not charged for extra.

WELL WATER FOR BOILER FEED.

In the office of the Babcock and Wilcox Company of this city, can be seen a curious collection of pipes, flues and dogs for hand hole plates, destroyed wholly, and in part, by well water. That is, the feed for a boiler in a certain locality, was taken from a well, with the result above stated. The details mentioned are not covered with scale, but look as though they had been subjected to immersion in acid. In some places, particularly in mining regions, the natural filtration through the soil washes through strata, or comes in contact with ores, that seriously affect the water for steam purposes. Where any such action is suspected it would be wise to have an analysis made.

◆

One of the handsomest papers in any class that comes to our office is the *Builder and Woodworker*, a paper devoted to building, cabinet making and house decoration generally. Our readers generally are not in this line but the low price at which it is afforded, $1 per year, together with the character of its contents, makes it well worth its price to any one. Send for a sample copy, 176 Broadway, N. Y.

THE CAT IN THE MEAL TUB.

In Esop's fables there is a graphic account of a sly old cat, who, finding he could catch no rats by fair means, resorted to all sorts of stratagems. As a last effort he hid himself under the meal in a tub, thinking to spring out when the rats came to feed. This device was readily seen through, and to this day all schemes which profess to give something for nothing, are suspected to contain a cat under the meal, somewhere. In connection with this subject an advertisement appears in a city paper, offering to send an illustrated journal free, year in and out, to any one who will send their address.

Naturally such an offer appears quite attractive, but engineers, at least, know that in their business, it is impossible to get something for nothing, and one of them, curious to see where the cat in the meal tub came in, sent for a copy of the paper and received in reply the letter appended:

New York, Dec. 18, '82.

Mr. ———

Dear Sir:—Your postal in reference to sending you our monthly journal came duly to hand. We will mail it to you with much pleasure, also to any other gentleman of the society to which you belong. Our aim is to publish the said journal every month which, as our circulation gets larger, we intend to form into a stock company [thus ? Eds.] giving each engineer so many shares free. He in return to send us what orders comes [thus ? Eds.] within his power, so as to help us and himself along at the same time. Every month we intend to declare a dividend on our capital stock, which at first, of course, will be somewhat small until we get more engineers in line.

If you will mention this to your fellow members, and send us a list of names who wish to subscribe to have the journal sent free to them, also putting a cross after every man's name who you think would be a good man in our Company, and who also could control orders from his employers, we will give you a commission on all sales which may come through those channels, and also a larger share of stock, as you would have merited it by your extra exertion. Hoping to hear from you in relation to this matter, I am,

Respectfully Yours,

The writer of the above seems to have a very limited knowledge of three things, publishing a mechanical paper, the integrity of engineers, and the English language. If he had come to us before issuing his prospectus, and his journal, we would have given him a little advice with great pleasure; we will give it to him now, and if he acts upon it he may still save money. Let him publish his mechanical journal in open market, solicit support upon its merits, and do all the business he can. Let him sell his goods, of whatever name or nature, in connection with it, and offer them to engineers as all other manufacturers do, in a straightforward manner. Let him beware of trying any cheap devices of commissions, or bribes to engineers to make sales. The members of the *National Association of Stationary Engineers* are beyond any such inducement, and no instance can be brought forward where any member of it, since its organization, has been bought for a price. Naturally they resent such imputations upon their honor, and the person who tries to bribe them to sell goods to their employers, shows commendable caution in using the mails instead of personal interviews. Engineers have as much commercial intelligence as men of any other class in the community, much more than the writer of the letter quoted, and they easily see that a scheme which proposes to make a stock company of all the engineers in the United States is rather too comprehensive to be profitable!

THE STATE OF TRADE.

Commercial journals report the general condition of trade throughout the country as very satisfactory in the business centers, and principal towns. In Philadelphia, there is marked improvement over last year. In Cincinnati, satisfaction is expressed and in San Francisco, business is fairly active, "trade highly satisfactory."

SPECIAL NOTICE.

We are happy to inform our connection that we have consolidated the interests of The Mechanical Engineer in a company, with ample capital, and facilities for the prosecution of them. No change will occur in the general features of The Mechanical Engineer or its editorial control, which will remain, as heretofore, under the direction of Egbert P. Watson.

Due notice will be given of the style of the company so soon as the necessary arrangements have been perfected.

NOT TO BE COMMENDED.

A Mr. W. Martin writes to a foreign contemporary concerning testing boilers by the expansions of water. It is evident from his instructions, that he is not acquainted with the principle involved, and has never seen the plan he mentions used. He says:

"If, then, we desire definite information concerning the strength of boiler flues, they must be tested under conditions similar to those which obtain in practice. In the United States in a few cases, tests have been made by filling the boiler as full as it will hold with cold water, and then lighting a small fire in the furnace; the water will then rapidly expand, and while still nearly cold will put on the requisite pressure Such testing requires to be very carefully done or the boiler may be irreparably injured, and the system has the disadvantage that the test is still a cold water test; our method of experimenting on boiler flues is, so far as we know, new. The flue must be fitted in a shell having a very much higher bursting pressure than the collapsing pressure of the flue. Let this shell be filled with cold water within a few inches of the top, and let the fires be lighted *and hard pushed, just as they would be in practice in getting up steam,* and as soon as the water has reached 212 deg. let the force pump be put on, and the flue tested to destruction, the fires being left burning all the time The boiler being in a suitable building, with no one in it, no accident would occur when the boiling water began to run out. A large force pump should be used, competent to run up the pressure to the required point in a couple of minutes at most, and to crush the flue, even after ring seams had been started."

We admit the novelty of this method, but not its propriety. So far as we have had experience, fires under boilers are not pushed hard in getting up steam in this country, and we do not believe they are in England. English engineers are as well aware of the mischief of such a practice as any others.

Water will not expand rapidly when cold—except at the freezing point—and a small fire will not answer for testing by the expansion of water. No fire at all is needed if live steam from another boiler is available.

THE PROFESSOR IN THE MACHINE SHOP.

No. XXVI.

Some one opened the shop door not long since, while I was busy on accounts, and came up to the desk. I did not look up at the moment and forgot all about the presence of a stranger, until the shop whistle blowing for six o'clock caused me to exclaim at the lateness of the hour. Then I saw Bill Paul standing waiting for a chance to speak.

"Well, William," I said; "how does the world use you? What can I do for you?"

"I want my time, Mr. Moulton," he said.

"Want your time, what do you want of that? Not going to leave I hope!"

"Yes sir, I am," said Paul, rather hesitatingly.

"What's amiss?"

"Nothing that I know of but I am going into business for myself."

This took me a little aback for the moment, and I suppose I showed some surprise, for when I hesitated, Paul said: "There's nothing so very strange in that, is there?"

"Not in itself, no; but it seems to me that this town is hardly large enough to support two shops, William."

"I aint going into the machine business, Mr. Moulton, I am going into an outside business."

"Oh," said I, "that's another matter! What are you going to do, if I may ask?"

"I am going into the grocery business."

I looked at him a minute and said: "William, what has started this idea in your head?"

"Well," he answered, "I am sick of working for wages, and I want to get ahead a little faster, that's all."

"You are going to leave a shop where you have been many years, and go into a line of trade you never had any experience in, against others who have had a life long experience; isn't that so?"

"Yes sir," said William, a little nervously.

"Sit down, Paul, let's talk this matter over a little. You know I am a friend of yours and would be glad to do you a service; perhaps we look at this matter in different lights. When are you going to start?"

"As soon as I can get a stock laid in."

"Then you haven't bought any goods as yet?"

"No, sir; I was calculating to begin about the first of next month."

I turned over the book, and looked at Paul's wages, and saw that he was getting $18 a week, then I said to him: "How much do you expect to lay out on stock?"

"About a thousand dollars," he answered. "That will buy as big a stock as I want to begin with."

"Do you know anything about the business of a grocery?"

"No more than to buy as cheap as I can, and sell as dear as I can. I suppose that is about the whole of any business."

"Do you know what things to buy cheap and sell cheap, and which to sell dear?"

"I don't understand you, Mr. Moulton."

"What I mean is, that some goods sold in groceries pay no profit at all; sugars for example; others pay very little, coffee for example, and flour. Now, if you don't know these things how are you going to come out at the end of the year?"

"I suppose my chance is as good as others," said Paul.

"It don't look so to me," said I, "and for this reason: that carrying on a grocery is just as much a trade that has to be learned, as the machine business is. If you fancy that it means buying an article for seventy-five cents, and selling it for a dollar, you are mistaken, Paul!"

"He shifted one foot over the other and said: Well, the fact of the thing is that I must do better as I told you; I never shall be any younger than I am now, and if I am ever to have any trade of my own, I must begin at once. I have looked this thing all over, and so far as I can see there is money in it. I don't expect to make any great trade in a year, but I can do a growing trade."

"So far as you can see is well put in, Paul. Suppose you don't see very far, or far enough? How many times a year can you turn your stock over?"

"How do you mean, Mr. Moulton?"

"How many times can you sell $1,000 worth of groceries in your locality? What kinds are most in demand? Are they staples, tea, coffee, sugar, butter, flour, etc., or will your trade buy lots of fancy goods, wines, etc?"

Paul grinned. "Well," said he, "I guess there won't be much wine sold, or many fancy goods. Where I mean to locate, mostly workingmen's families buy, and there ain't a great deal of fancy trade among them."

"Have you ever counted on the support you are likely to get? About how much can you reasonably count on as regards weekly trade?" He made no reply.

"Can you sell one hundred families a week, do you think, the first year?"

"Yes," said Paul, "I think I can."

"Well, that will be an average, say, of $3 per family per week, will it not, take it by and large they use at least that amount of groceries?"

"Nearer $6," said Paul.

"Never mind outside figures, take inside, the least you are likely to get is $3 per head."

"Yes, sir."

"Well, that makes a trade of $300 per week the first year on an average, or $15,600 yearly; that figures up pretty large for a capital of $1,000, don't it?"

"Yes, sir; larger than I supposed."

"It is much larger than it would turn out to be actually. Suppose you do only half of this, you will do well to accomplish that. Now do you know how much profit there is in the grocery trade, how much per cent. I mean?"

"No, sir; I know I pay pretty well for goods we have, according to price lists. I suppose it is at least one-quarter profit."

"Twenty-five per cent., William, in the grocery business! Why, it will not average half of that. A member of a large firm in this line told me once, that if a grocery man cleared ten per cent. on his trade he was doing a tremendous thing, and that the majority did not make seven per cent. If you do as well as the average, and sell $15,000 worth of goods the first year, better say half of it, $7,500, you will have just exactly $525 profit for your year's work. This supposes no bad debts, nothing paid for experience, or anything else. You now get $864 a year, without any sort of risk; out of which you ought to be able to save something, and have, or else you wouldn't have $1,000 to risk in the grocery trade. Paul, my advice is for you to let this matter stand for awhile. Think it over. I am a good deal older than you, and have seen no end of machinists and other tradesmen start grocerys, and come back to the shop in a few months, stripped of everything. It is better for you to be contented with small and sure gains, than risk your savings in that way."

Paul said nothing, but still lingered, hesitating.

"Come back to-morrow to work, as usual, Paul, and take a little more time over this question. Maybe it will look different to you then."

Jake came in as Paul went out, and said: "What's the matter with him?"

"He's got small grocery on the brain," said I.

"Don't it beat the d——l," said Jake. "Nine machinists out of ten think if they only had a small grocery they would be made for life! A groceryman would make just as good a machinist, as a machinist would a groceryman, that is neither would be any good at all out of their places."

MECHANICAL DRAWING—NO. V.

BY EDWIN H. MARBLE.

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The pentagonal prism furnishes us with a good model from which to study projection, and assuming it to be $3\frac{1}{4}''$ high and the diameter of the circumscribed circle, $3''$, we will construct two views as shown in *Fig.* 5.

In connection with this I will give a short graphic method of construction, as applied to the pentagon. By this, I mean a method in which one uses his instruments wholly without recourse to any figuring or mental calculation. Such methods are often of great value from the fact of their ready application.

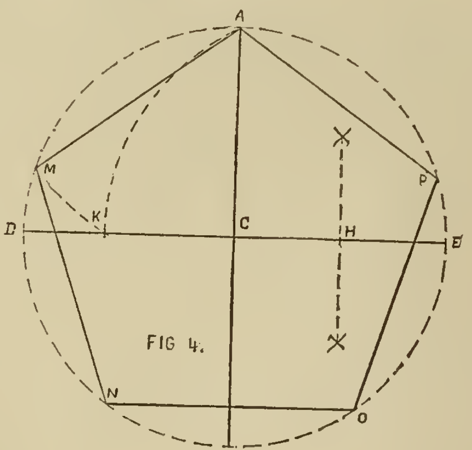


FIG 4.

Having first drawn your circumscribing circle $3''$, draw two diameters at right angles, or perpendicular one to the other, as $a\ b\ d\ e$, bisect, $c\ e$, at h. From h as a center, and a radius equal to $h\ a$, cut off k on $d\ c$; from a as a center with radius, $a\ k$, cut off, $a\ m$, upon the circle. Set off $m\ n$, $a\ p$, $p\ o$, equal to $a\ m$, join these points and you have the pentagon required.

This drawing will so clearly show the full details of construction, that there appears to be little need of full explanation. The only point would be the line, $F\ L$, as shown in dotted or broken line, as indicating that the part represented by that line is hidden from sight by the remainder of the model; such means of indication, are frequently used to denote certain lines, or parts, which it is desirous of placing, and which are behind other parts of the object.

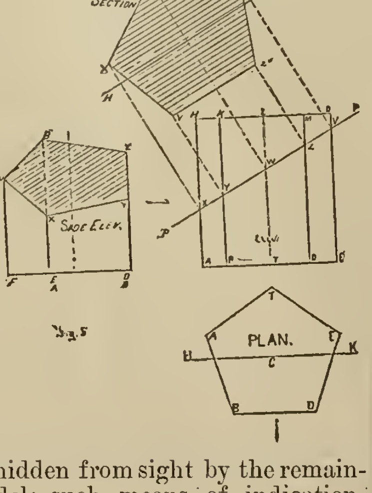


Fig. 5

In connection with this figure, we will take up the subject of sections. These it will be remembered, are views of an object obtained by cutting with imaginary planes. The section in this case we will obtain by cutting along the line, $P\ P'$, by an imaginary plane, perpendicular to the vertical, and inclined at an angle to the horizontal plane of projection.

It is our wish now to obtain a view of this cutting that will show its correct size and shape, and we first make a side elevation of the portion of the prism below the cutting plane, as seen from the direction of the arrow; which view we have in Fig 5, side elevation. This view gives us the correct lengths of the lines $a'\ x$–$b'\ y$, etc., but it is very evident that the distance $x\ v$ as shown in elevation is not the same as shown in side elevation by $x'\ v'$. It is also evident that we have forgotton one of the first principles of projection, which is, that a surface to be seen in its true dimensions, must be at right angles to the line of sight. Having had this brought to our remembrance we will try again, and proceed to represent the view as seen from the direction of the arrow, C. This view will be easily constructed, since we have but to set off the points $x''\ y''\ 2''$, etc., by perpendiculars, and the distances from $H'\ K'$ as seen and measured in our plan.

The section thus obtained shows a figure similar to the plan, but elongated along the line of cut, as shown by a comparison of the measurment upon the center lines, $H\ K$ and $H'\ K''$. This method of determining the shape of the section will apply equally well to any figure. This pentagonal prism we will also use to obtain practice and familiarity with another subject, but little used or studied, and abused by many, we think, more because of the want of knowledge of the same, rather than through any real failing. This subject is called *development*, and is one of the best of all studies that the student can pursue, being the process of unrolling or flattening out the bounding surfaces of an object, and will give one a much better idea of the the same than any other method of delineation. To sheet iron and plate metal workers it will be most valuable.

Development is the unrolling, or flattening out upon a plane surface, the bounding surface of the object which we wish to examine, and will give us several distinct views of the object, which will soon be readily recognized after a little practice.

When applied to curved figures it will show such marked change of curvature, from either plan or elevation drawing, that but for a proper construction, one would be almost at a loss to prove it to be correct, the curves being much distorted apparently.

We will now proceed to *develop* the part of the prism below the cutting plane. From the plan we can obtain the measurements of the length of the sides, $a\ b$, $b\ d$, etc., and as the figure is a right prism, these sides or faces are in the same straight line, when developed. Drawing the line, $A\ B$, Fig. 6, indefinite, and from f set off the distance, $f\ a$, Fig. 5 plan, as many times as there are sides, which in this case will be five from each of these points, $a\ b\ c\ d\ e\ f\ a$.

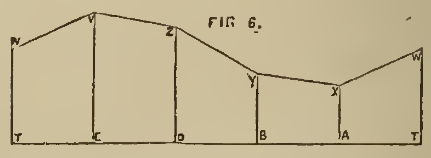


FIG 6.

We will erect perpendiculars, $a\ x$, $b\ y$, etc., since the lines, $a'\ h$, $b'\ k$, etc., in the elevation are shown to be perpendicular to the ground line, or base of the prism. We wish now to obtain the heights of these lines, a, x, etc., and by referring to the side elevation, we have them clearly shown, which measurements we will transfer to the corresponding lines, $a\ x$, etc., in development, and connecting the points we have the figure, $a\ a'$, $x\ w\ v\ z\ y$, $x\ a$, giving us the developed surface, as representing the boundary surface of the original figure as cut off by the plane, $P\ P'$.

To better understand this subject, it would be good practice to make a practical application of this principle, by drawing the development of a figure upon stiff cardboard, slightly creasing it along the lines which are to form the corners, to better keep it in shape, and then forming the cardboard into the figure it is intended to represent.

I wish now to add two words to what has been already said, and will, for fear you forget as soon as you see them, place them in large type.

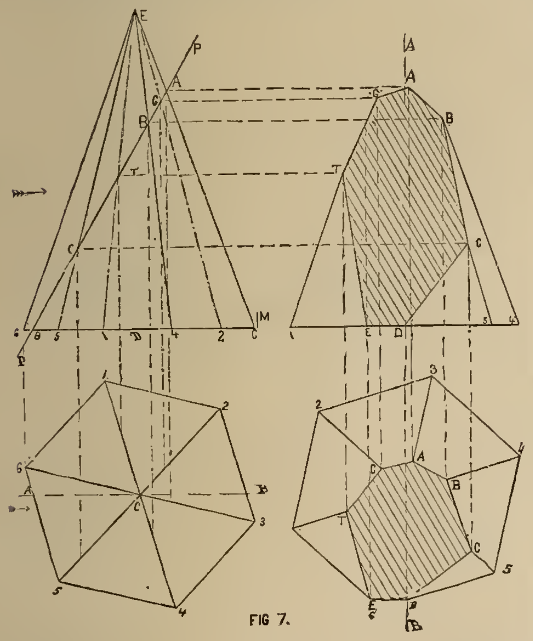
DON'T COPY.

Make your figures as unlike mine as possible, so long as you cover the principle. If I tip mine to the right at an angle of 30°, you tip your object to the left, at an angle of 20° or 37°, in fact, do anything but copy.

None of you would think of taking an old issue of *Harper's Weekly*, and, laying a piece of thin paper over a picture, trace it, and persuade yourself to the belief that you were an artist ; or copy a picture of a house and think yourself an architect. Study the principles and try to apply them to something not drawn by the writer.

From the prism we will take up a pyramid as giving us a new outline, from which to obtain additional practice in the study of projection. And in this figure we notice several peculiar features, two of which are quite marked. First, the side of the figure nearest us is not at right angles to the line of sight; secondly, the sides which before, in our models, have been rectangles, are in this, triangles.

Assuming this pyramid to be 6¾″ in height, and the diameter of the circumscribing circle, 5″, we will make a drawing of the same, first placing the ground line *G H*, upon which the pyramid is supposed to stand, and the center lines, *A B* and *D E* of the Plan and Elevation. These lines we shall find of great use to us in our measurements, much more than in either of the other figures previously studied.



About the line, *A B*, with the point which is the projection of the line, *D E*, for a center, we will describe a circle of the diameter assumed. A new difficulty now presents itself. Though we have a regular figure, none of its sides are at right angles to the line of sight, so we must draw a diameter 6, 3, which shall make the angle required. With this diameter as a base, we will set off upon the circle, the points 1, 2, 4, 5, equal distances apart, and joining the same we find the regular hexagon in the position required.

From the definition of the pyramid we have sides which terminate in a point called the vertex, and this being a *right* pyramid, the vertex will be at *v*, directly over the point, *C*, in the base. Now drawing the lines 1*v*, 2*v*, etc., from the points already found, we have the *Plan* of the pyramid; from the Plan we will turn to the elevation, and set off on the line, *D E*, *D V*, the assumed height of the pyramid (6¾″). The points, 1, 2, 3, 4, 5, 6, we will now project on the ground line, and they are found in the corresponding points, 6′, 5′, 4′, 3′, 2′, 1′, looking from 6 around the base to the right.

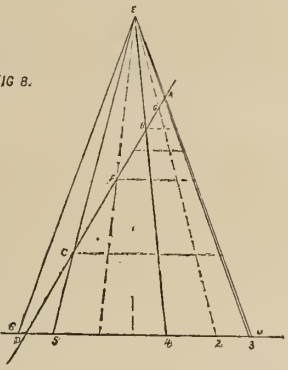
The elevation of the point, *v*, will of course be found at *v′*, and we now have the two extremities of the lines, and can readily draw the lines representing the corners of the pyramid. The lines, 1′*v′*, 2′*v′*, will be dotted, being behind the object. The plan and elevation as now drawn being complete of themselves, and giving all the desired measurements.

For the sake of further study, let us cut this pyramid by the plane, *P′ P*, and examine more closely the section formed.

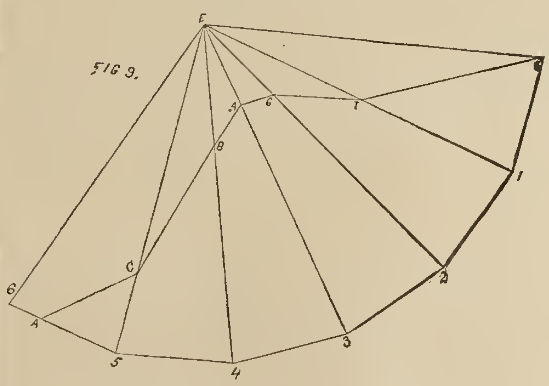
This plane we use is one perpendicular to the vertical, and inclined to the horizontal planes of projection. Before commencing our study of the drawing, let us retrace our steps and see what has been done. We have drawn the object at an angle to the line of sight and cut it by a plane, with, or parallel to the same line; in other words we have anticipated ourselves, for had we drawn the object at right angles, and the cutting plane at an angle, we should have had to revolve, or turn upon its axis, the object. This is something we have not yet studied.

As we are now situated, it is but a review of the same subject as first taken, with the exception of triangles instead of rectangles to work upon, and the construction of *side elevations*, and plan of section, is evidently but a matter of little difficulty. As shown, we have the side elevation of the pyramid, with the section at the right, the points, *a b*, *c d*, *f g*, being carried over from the elevation by horizontal lines to the corresponding lines in the side elevation, and the plan of section being constructed the reverse of the process of finding the elevation, that is by dropping perpendiculars, the whole being so much a matter of review, that it will be unnecessary to take it up in detail.

FIG 8.



In the development of this object we may be able to discover several new practical applications of the subject of problems. If a line be drawn upon the side of the pyramid, 5′ 4′ *v′* perpendicular to the base of triangle 5′ 4′ from its middle point, we should find it would pass through the point *v′*. We may thus find a line, from which it will be easy to obtain the necessary measurements. Or by another method, the points, 1′ 2′, 3′ 4′ 5′ 6″ are all at a distance from *v″* as measured upon any of the connecting lines which shows the true length, and as all the sides are at an angle to the line of sight, we must revolve the pyramid so as to obtain such a measurement. This we can readily do by revolving the point 3 in plan until it is on the center line at *m*, shown in Fig. 8, to better advantage. Obtaining the projections of this point at *m′*, and connecting *m′ v′* we have the desired measurement, or slant height of the pyramid. Passing to our development and first locating the point, v^2, we will describe a circular arc with a radius equal to *b′ m′*, Fig. 6. Selecting any point as 1, and set off from it distances, 2, 3, 4, etc., equal to the length of the base of the triangular side, 1 2, Fig. 7, as many times as you have sides, which are in this case, six. Connecting these points with *V*, and you have the developed figure of the entire pyramid.



To determine the figure either below or above the cut we must set off from either, the point, *V*, or from the points, 1, 2, 3, etc. Measurements upon the corresponding lines as shown in elevation, Fig. 7. The only line shown in its true length is *m′ v′*, and to this we must refer all other lengths. When the line, 5′ *v′*, is revolved so as to show in its true length, the point, *C*, will fall one *m′ v′* at *o*. The point will be found at *p*, and the other points at *q*, *r*, *s*, which measurements we will set off on corresponding lines, as just referred to. Connecting these points, and we have represented the developed section above or below the plane, *P P′*.

PATTERN MAKING.

BY A PATTERN MAKER.

No. VI.

We have now arrived at that stage, in the consideration of our subject, which justifies the commencement of practical work.

Pattern making is a trade of endless variety. A man in this business may turn out a piece of work to-day, the like of which he never before saw or imagined, nor may he ever be required to make the like again. If this were an essay on shoe making, we should start right in now and make a shoe ; because one shoe, practically, is the same as another, but as we are dealing with an art which takes in all manner of shapes and sizes, from a 20 foot screw propeller down to a toy pistol, our advance may not be so rapid. To take a pattern, *any pattern*, and explain its construction would be of very little advantage to us, because of the dissimilitude of forms with which we have to deal. We must view this matter in a different light—that one in which all patterns appear to be alike. There are certain operations (processes), not very numerous, which the pattern maker has at his command, adapted to the peculiarities of the material in which he works. All patterns are alike in that they are the result of certain of these processes ; then, however diversified their forms, they are, with rare exceptions, but different combinations of a straight line and a circle.

Again, all patterns are alike in that they must work favorably with the conditions governing molding. I think I may state right here, that the qualifications of a good pattern maker are now clearly apparent ; let us shortly enumerate them :

Firstly. He must possess a knowledge of the principles of mechanical drawing, and be able to make full size working drawings from them.

Secondly. He must be competent to perform the operations that the work requires, which, of course, includes the ability to handle the tools used in those operations.

Thirdly. It is absolutely necessary, that he should have a thorough insight into the practice of the molder.

As I have said, now is the time for practical work, which means evidently not to construct a pattern but to investigate some of the processes of pattern making.

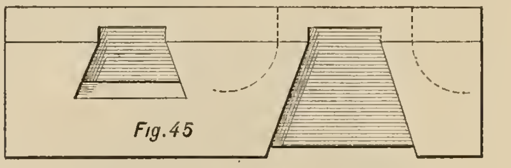


Fig.45

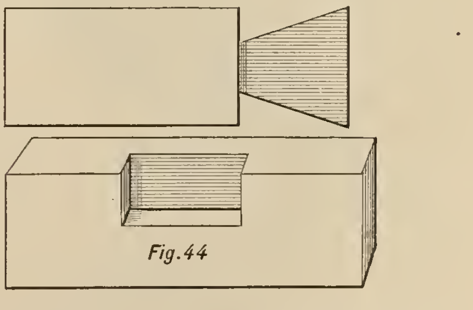


Fig.44

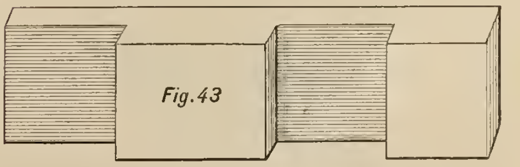


Fig.43

To join two pieces of wood together by the half check:

The method of performing this simple operation seems so apparent upon looking at fig. 43, that I shall dismiss it with very few words. Select one side of each of the pieces to be joined in this manner; call that side the face, and make a mark with a pencil to indicate the face side. Set a gauge to half the thickness of the stuff. Gauge lines on the edges where the pieces are to be placed. Always gauge from the face side, then if the gauge was not set exactly to half the thickness, the joint will still come even. Screw the pieces together, then take them apart and put on glue, screwing together while the glue is hot.

Corner half-checks are generally cut the whole width of the stuff, as in fig. 43, but for middle pieces the check is sometimes made short, so as to leave a portion of the lumber the full thickness, adding thereby to the strength of the frame as in fig. 44.

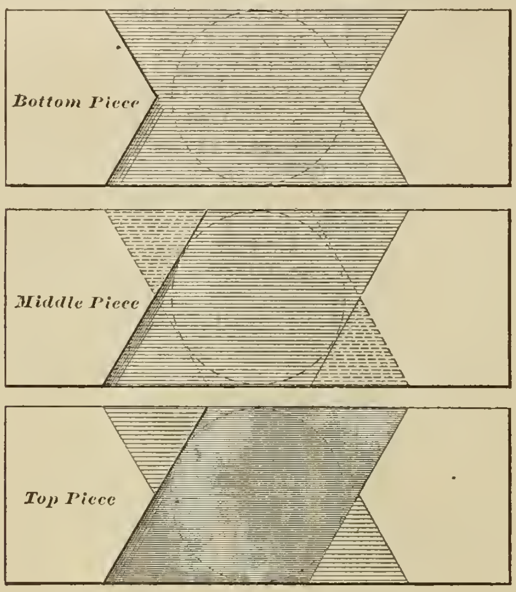


Fig.46

The pigeon-tail half-check is shown in fig 45; it is used, not so much to hold the pieces together, as the glue and screws would be sufficient for that, as to enable a portion of the frame to be hollowed out, as indicated in dotted line, and yet not reduce the cross grained parts (where the pieces butt together) so much as to make them weak and brittle.

The same purpose may be served by using the ordinary half-check, provided the tongue and space it fits, be made narrower than the stuff is wide.

The three-part check, used for wheels that have six arms, and other purposes, is illustrated in fig. 46; by means of this process three pieces may be joined together in the thickness of one. Find the centre in each of the three pieces; then, with a radius equal to half the width of a piece, describe a circle on one side of the top and bottom pieces, and on both sides of the middle piece. Set a bevel to 60 degrees, and with it draw lines touching the circles, as shown in the figures. Divide, by gauge lines, the thickness of the pieces, into three equal parts. Let all the shaded portion of the bottom piece be cut away, for two-thirds of the thickness of the piece. The middle piece is to be cut in on both sides, as drawn in the figure, leaving one-third part in the centre. Cut away according to the full lines on one side and as the dotted lines on the reverse side. The top piece must have the part, represented by the dark shading, cut away for a depth of two-thirds of the thickness, the parts in light shade for a depth of one-third.

The four-part check is used for similar purposes as the three-part, an inspection of the figures, 47, may convey an idea of the manner of performing this operation. As before, describe circles on one side of No. 1 and No. 4, and on both sides of Nos. 2 and 3. Set a bevel to 45 degrees and draw lines to it touching the circles. Three quarters of the thickness of No. 1, must be cut away as represented in the figure by the part darkly shaded. Nos. 2 and 3, are exactly alike on one side; the part cross-shaded must be cut down two parts, or half the thickness; the little corners for a depth of one part only; the other side marked back, is to be cut away one part. The darkly shaded part in No. 4 is cut down three parts, and the corners lightly shaded, one part. VERNI NOIR.

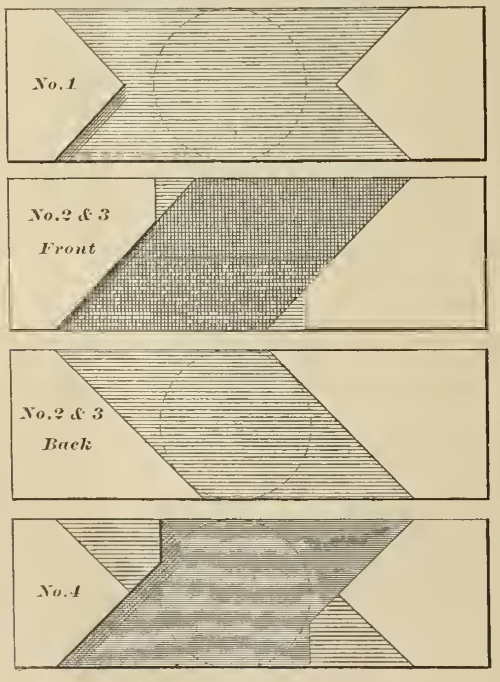


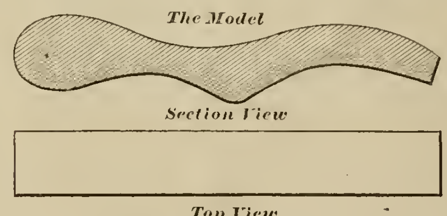
Fig.47

[TO BE CONTINUED.]

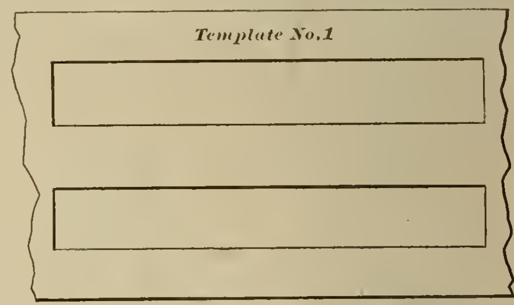
DIES AND DIE-SINKING—No. IV.

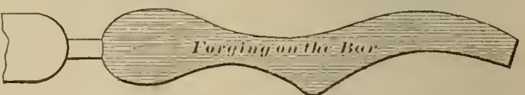
BY A DIE SINKER.

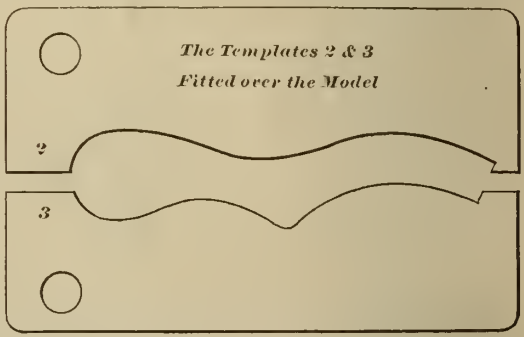
We will now begin another forging, and select for our purpose one that can only be made with hand tools. Of late, it has become the custom among some writers to decry the use of these, and to assume that, if men were expert in their use, they were necessarily ignorant of the uses to which machine tools can be put. Of course in building large engines and heavy machinery of any kind, hand work should be used as little as possible, and in many cases can be dispensed with. But there are still many branches of the machine business where the man who is skillful with bench tools, has a great advantage over him who is merely a machine tender, or operator. The methods of manufacturing are continually changing, so there will always be machine work that can not be done solely by machinery, and strange as it may appear to some readers, the building of special machinery is done for the most part by shops that have no special machinery worth speaking of. In old times when the machinist set about designing a machine he always tried to get the parts round or flat, as these were the easiest to make. Simplicity of form was a great object with him. It was the same in all metal manufactories. Now things have changed; it does not matter how intricate the shape of an article is for an engine, sewing machine or watch, or even to a coffee-pot, if it serves its purpose best, straightway tools or dies are made to produce it. Eventually it becomes cheaper to make it than if a simpler form and older methods had been retained.

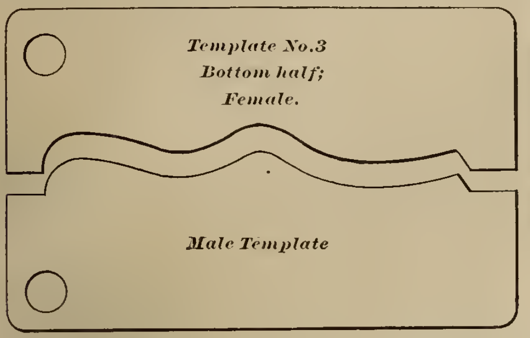


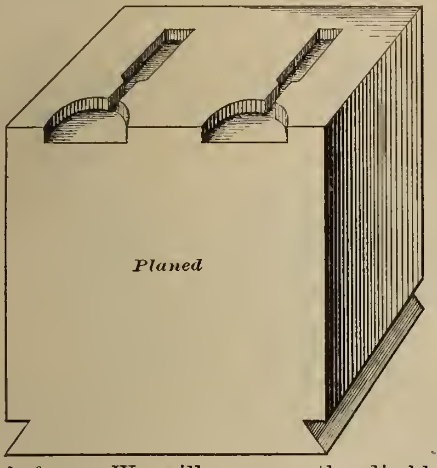
But I am writing now for mechanics and they well know the value of these tools, so perhaps it is out of place for me to occupy time in telling them, but my object will be gained if I can in any way counteract the evil influence upon the younger members of our calling, of the teachings of those theorists who have served their time in colleges and schools and are entirely ignorant of practical work. But let us return to the subject. I said we would take one that could only be done by hand tools and I will select another sewing machine part for illustration; here it is in fig. 1. I have begun with these sewing machine parts, as I find them peculiarly suited for these articles, for there is such a variety of shapes. They embody, as it were, the whole *A B C* of die sinking for drop forging work, and the man that can make them all successfully need not be afraid to undertake any job in this line. Suppose we have a model like the sketch handed to us, with orders to sink dies for it: the first thing we do is to examine it carefully to see how to make it in the simplest way. We must take into consideration that we have to make forces for it. This is important, and should never be lost sight of. By referring to the sketch we see that the outline of the forging is rectangular, looking at it one way, the other way it is of irregular form, so it will be the easiest way to put the irregular part towards the bottom of the die. That is, the part below the center line in the sketch will go into the bottom die, and the part above the center we will put into the top die. The outline of the forging on the face of the die will be a rectangle. Now we make a template for this rectangle in the same manner as we made the template for the shuttle outline, but in this instance we make two outlines of our forging in the template, one on each side of the center line, perfectly parallel to it, but not too far apart. Our reason for making two outlines on the template is because we are going to make two impressions in the die-block, one for blocking and one for finishing, but we make these exactly alike, so that the forger can use which he chooses for finishing. Sometimes in working the finishing die gives out soon; then he uses the other one for finishing and the damaged die for blocking. Now we draw a center line along the model from end to end, as in the sketch. This will serve as a guide, to make the templates of top and bottom. Make the top template the shape of the irregular outline above the center line, reaching down on each end to the line. Make the bottom template the same way; each of these, will give you the idea, of the shape, of the dies separately. If you put them together, placing them as you fitted them over the model you have the outline of the forging, (see sketch). These templates are females, it will be necessary to make males to fit them to assist you, in cutting out the die, as you continually refer to them to see how you are progressing by placing them in the die you are cutting. It will be clear now to our readers, that we require two forces for this die; one to represent the top half of the die, the other, of course, the bottom. The sides of this model are flat, a very favorable shape to make the forging stick in the die, so we overcome it by putting a little taper on the sides of the forces; about 1½ degrees will be sufficient. The die sinker will find the exact taper for good practice depends on the depth the die is sunk. As the depth increases so should the taper, but in a very slight degree. We make the force on exactly the same plan as we made the force for the shuttle described in a previous article; that is, by fitting them into template No. 1, and then filing the face of them (one each) to templates, 2 and 3, finish them nicely and harden











them. A good many of our readers may say we could dispense with forces for a die like this, and so we could, but it is doubtful if any time could be gained by doing so. I have made these and similar ones, with and without them, and found it was as speedy to make the forces, and then sink the die as it was to sink the die alone without them, to say nothing of being more exact. Further, when you have the same dies to make again, you will have the exact counterparts of those made previously, perhaps years before. We will suppose the die-blocks are planed ready for sinking, so we lay them out by drawing a center line across the faces, and place template No. 1 on the blocks so that the center line on it will coincide with the center line on the block. Scratch around the inside of the outlines with a sharp scriber and we have two impressions laid out on each block, parallel, and in exactly the same relation to each other in both blocks; so we go ahead and cut them out, using the male templates as guides for the shape of the bottom, and when we get a sufficient depth, use your forces, in exactly the same manner as in sinking the shuttle die, taking care that the two impressions do not change position in sinking, as they can easily do when you are drifting. Great care must be bestowed on this, and you can watch how you are getting on by occasionally placing template No. 1, on the die-block as you are working, and shape your course accordingly. This is very necessary, so that when the blocks are fixed in the drop hammer, both impressions will be in exactly the right position. These are comparatively easy dies to sink. Any machinist that can cut a key seat can make them. The only thing difficult to a stranger, is how to go about it in the simplest manner. It requires some experience to find this out, as the old hands at this work do not give any points away, and the only place to get them is in the columns of The Mechanical Engineer, for these articles are written expressly for it. There are still the hot and cold trimming dies to be made for this forging; the reader will know how to make these, if he has read the previous articles on the shuttle, but there is one little point I wish to show, and that is the punches for both the hot and the cold trimmers must be made, the form of the top of the forging on the face of the punch, otherwise they would crush them (the forging), out of shape. I will not again speak about trimming dies in these articles. The reader must always understand, they are necessary, unless it is some exceptional shape die; when we come to such a one, I will point it out. There are others, that we will have to make differently to suit circumstances. These also I will mention, but for general purposes, the way we made the trimmers, for the shuttle, is all that is necessary, and we will make that the standard to go by. To prove whether we have sunk our dies right after we have milled out clearance for the bar in the blocks, and cut a gate from the clearance to the die, (see sketch), we put the dies together as they will be in the hammer, and place them so that we can pour some lead in, leaving $\frac{1}{32}$ space between the faces of the blocks to represent the thickness of the burr, or fin, that will be on the forging. After the lead is poured in, place the dies upright and strike the top one two or three heavy blows; this will drive the lead up solid, into every part of the dies; then you can take out the lead, pare off the fin or burr with a sharp knife, try it every way, with the templates, and if these instructions have been carried out skilfully, we will have the exact counterpart of the model.

[TO BE CONTINUED.]

VALUE OF AUTOMATIC ENGINES.

It is impossible, without considerable investigation, to say what is really the most economical engine to adopt in any particular case; and as comparatively few users of steam power care to make this investigation, a vast amount of wasteful expenditure results. As a rule, it may generally be assumed that an engine employed for driving a manufactory of any kind cannot be of too high a class, the saving effected by the economical working of such engines in the majority of cases enormously outweighing the interest on their extra first cost. So few people appear to have a clear idea of the importance of economy of fuel in mills and factories, that I give an example showing the saving to be effected in a large establishment by an economical engine. I will take the case of of a flouring mill in this city which employed two engines that required forty pounds of water to be converted into steam per hour per indicated horse-power. This, at the time, was considered a moderate amount, and the engines were considered "good." These engines indicated 70 horse power each, and ran twenty-four hours per day on an average of 300 days each year, requiring as per indicated diagram, 40,320,000 pounds of feed water to be evaporated per annum, which, in Philadelphia costs $3 per horse-power per annum, amounting to $420. The coal consumed averaged 5½ pounds per hour per horse-power, which at $4 per ton, costs $11,088.

Cost of coal for 300 days	$11,088
Cost of water for 300 days	420
Total cost of coal and water	$11,508

These engines were replaced by one first-class automatic engine, which developed 142 horse power per hour, with a consumption of three pounds of coal per hour per horse-power, and the indicator diagrams showed a consumption of thirty pounds of water per hour per horse-power. Coal cost $6,134. Water cost $426.

Cost of coal for 300 days	$6,134
Cost of water for 300 days	426
Total cost of coal and water	$6,560

The water evaporated in the latter case to perform the same work was 30,672,000 pounds of feed water against 40,320,000 pounds in the former, a saving of 9,648,000 pounds per annum, or 31 4-10 per cent. And a saving in coal consumption of 87½ per cent., or a saving in dollars and cents of $4,954.

In Philadelphia no allowance for the consumption of water is made in the case of first-class engines, such engines being charged the same rate per annum per horse-power as an inferior engine, while, as shown by the above example, a saving in water of 31 4-10 per cent. has been attained by the employment of a first-class engine. The builders of such engines will always give a guarantee of their consumption of water, so that the purchaser can be able in advance to estimate this as accurately as the amount of fuel he will use.—*W. Barnet Le Van.*

LATENT HEAT.

When steam is being made, it is known that after a certain temperature has been reached the water becomes no hotter. It then boils, and steam is formed. It is commonly stated that the heat poured into the water after ebullition commences ceases to be sensible, becoming "latent" or hidden in the steam. This word "latent" is misleading, because it gives the idea that the heat still exists as such, and very ingenious hypotheses have been formed and published to explain why a thermometer could not take cognizance of its existence. But no hypothesis of this kind is needed. The truth is that there is no such thing as latent heat. The w not suffice, however, to indicate the nature of certain phenomena; and this being the case, we do not desire to see them expunged from the dictionary. But we do wish to see them used with an intelligent perception of what they mean. A pound of steam at a pressure, say, of 100 lb. on the square inch has that intensity of heat vibration corresponding to 328 deg. Fah., and it contains a quantity of heat equivalent in thermal units to 328 × 772=253,216 foot-pounds, and this is absolutely all the heat which exists in 1 lb. of such steam. But there has been imparted, besides to it, heat enough to do work on it equivalent to 883 × 772=681,576 foot-pounds. But this heat has no existence in the steam. It is not there, and consequently the thermometer cannot indicate its presence. So far from being latent or hidden it has absolutely no existence at all. What, then, has become of this enormous amount of energy, equivalent to lifting a weight of 304 tons 1 foot high, or of lifting one ton to the top of the dome of St. Paul's?

Water is supposed to consist of a multitude of excessively minute spheres, retained in close propinquity to each other by some force, the precise nature of which no one knows anything definitely about. These spheres have two kinds of motion among themselves—first what may be termed mechanical motion, or currents, set up by external influences, or when a vessel containing water is shaken; and secondly, a motion due to the presence of heat—in other words, thermal motion. The precise nature of this motion is not understood. Those who are familiar with mathematical investigations and the works of such men as Rankine and Thomson need be told nothing on this subject; but we are not writing now for mathematicians, but for those who having no time for abstruse thought, nevertheless wish to acquire some accurate conceptions of the true nature of processes going on before their eyes daily. For these it will be enough to say that the heat motion of water is assumed under one hypothesis to be in the nature of a whirlpool; that is to say, the molecules are continuously rotating around centres among themselves. If there was no heat at all in water it would be a dense hard mass—an extremely solid ice in fact; and as soon as sufficient heat motion is taken out of it, we know that the whirling of the molecules among themselves to a great extent ceases, and we have ice. Now when steam is made, the whirling motion becomes more and more rapid and intense as the temperature of the water increases, and at last a point is reached when the force retaining the molecules in propinquity, to which we have referred above, is entirely overcome, and the molecules then fly apart. The result is steam; and the molecules of water in the shape of steam have then another kind of motion besides that of heat. They are assumed to move in straight lines, and coming continually in contact with the walls of the vessel in which the steam is confined, they rebound from them, and being multitudinous past all conception, this constant bombardment produces the effect known as pressure. Besides this longitudinal movement, however, the molecules also retain heat motion, which is capable of affecting a thermometer, which the other motion is not. Thus, then, we have in one pound of steam two sets of motion—one heat-motion, equivalent to 253,216 foot-pounds of work, and the other pressure-motion, equivalent to 681,576 foot-pounds. Thus, then, it will be seen that latent heat does not exist. It is not to be supposed that the statements we have made regarding the motions in water are more than theories. Nothing is, of course, certainly known on the subject; but the theories are generally regarded by competent authorities, as in the main satisfactory. They have received developments and modifications, to which we need do no more than barely refer here. The broad fact, however, remains, that the heat said to be latent has really been converted, expended in overcoming the force which retained the molecules of water close to each other, and it is no more heat than is the journey performed by a train running from London to Liverpool. The engine fire has done work in two ways—it has produced steam, and it has conveyed a heavy train some 200 miles; but it would be just as correct to say that the heat of the fire had become latent in the train, as to say that it has become latent in the water.

The conversion of heat in this way into work is not peculiar to water. Thus, whenever any body, as ice or a metal, is melted, heat is said to become latent. In reality it is converted into work expended in overcoming the coherent force of the thing melted. Thus, the latent heat of ice is in round numbers 140 deg. Fah. That is to say, if we take a lump of ice, and having raised it to 32 deg., if we go on applying heat it will become no hotter, but it will begin to melt, and 1 lb. of it will require 140 × 772 = 108,080 foot-pounds for complete fusion. Mercury is solid at temperatures below—39 deg. Fah.; its latent heat is only 2·82 deg. Centigrade; that of lead 5·4, while that of silver is 14·25. Returning to steam, we may divide the work done on a pound of water in raising it from 32 deg. Fah. to 212 deg. Fah., and boiling it all away at that temperature in the following way: Increasing the temperature of the water from 32 deg. to 212 deg., and lessening the coherence of the molecules, 180·89 thermal units, equivalent to 139,653 foot-pounds, and representing about 15·77 per cent. of the whole work done on 1 lb. of water, The work of destroying the cohesion of the molecules—making steam, in fact—represents 893·66 thermal units, and 689,910 foot-pounds. Increasing the volume of the water from what it had as water to what it has as steam, 72 thermal units and 55,610 foot-pounds, the total is, omitting fractions, 1146 units and 885,000 foot-pounds. The distribution of the work done will vary as the pressure augments, less heat being converted into water as the pressure rises, because the molecules cannot be separated so far from each other; more heat therefore remains in the steam—in other words, its temperature rises with the pressure. At about 1200 deg. we should have no steam whatever formed. The pressure would be considerably over a ton on the square inch, and all the heat would be sensible. Jacob Perkins actually made water red hot in this way in the early part of the present century.

It may be said that the heat cannot be lost because it all reappears again when steam is condensed. That it reappears is quite true; but that is simply due to the fact that the work done on the molecules in separating them reappears as heat when they coalesce again; but there is one important fact to be taken into account—the heat never reappears of the same intensity. In order to obtain it, a surface colder than the temperature of the steam must be provided. If it is not colder, condensation will not take place. In other words, what Sir W. Thomson has called degradation of energy occurs, and this degradation, we may add, is going on constantly in the universe, the tendency being to the production of an average temperature throughout it. Thus, when we burn a pound of coal we get heat of a certain intensity; but there is no known process of nature by which this heat could be made to reappear in the same quantity and intensity. Thus, for example, we can burn coal and produce a heat of, say, 1800 deg. in a furnace, and we can employ an engine to drive a dynamo, and work arc lamps with a temperature of, let us say, 4000 deg. Here there is apparently an exaltation of energy; but it is only apparent, the quantity of heat produced by the arc lamp being quite trifling when compared with that expended by the engine. If we are asked why it is that steam in condensing returns in the shape of heat the work expended on it, we reply that we cannot tell; nor can anyone else. But we do know that if any portion of the pressure-motion to which we have referred be taken out of the steam by letting it do work in a cylinder on a piston, then the whole of the so-called latent heat will not reappear. The difference precisely represents the amount of work done by the engine., and this fact has been used as a means of determining the efficiency of an engine. This is done by ascertaining the weight of the steam used in the engine in any given time, and the weight of condensing water employed, and finding out how much the temperature of the latter is raised. If the steam did no work the whole of the heat put into it would reappear in the condensing water. It is clear that the greater the work done the less will be the heat found in the condenser.—*London Engineer.*

THOUGHTS ON BELTS.

A noted feature in many manufactories is unnecessary tension of belts, which not only shortens the life of them, but absorbs considerable power that should be utilized in doing useful work; and the resultant of the power wasted is the heating of journals and melting of babbitt metal. Moreover no shaft can remain long in line where belts are run needlessly tight, and the extra coal burned is of no little importance, besides wear and tear of the plant, and delays caused by broken belts, etc.

It will be much more effectual and satisfactory to decrease the tension of the belts and increase the diameters of the pulleys, or width of belts, rather than run them too tight.

More than one instance could be chronicled where as high as fifteen per cent. of the power used, was consumed in overcoming friction caused by tight belts.

The driven pulley on line shafts should be placed as near the center of the work as possible. When it is not convenient to locate the driven pulley at, or near, the center of the work, it is desirable in all cases to have bearings both sides of the pulley, and in close proximity to it, to receive the pull of the belt. Narrow belts are more usually run extra tight than wide ones, owing to the extra duty required of them, in proportion to their strength, than larger ones.

The experiments of both scientific and practical men differ so widely, and the results are so unsatisfactory, that an ordinary individual can gain but little knowledge from them which would be of utility, consequently he has to use his judgment, and depend upon common sense and the circumstances existing, in producing details and dimensions to meet his requirements. There are so many circumstances and conditions that influence the driving power, and satisfactory working of belts, that no infallible rules can be laid down, nor advice given, which would give the same results, or efficiency, in all cases. The locality also has much influence on the life and performance of belts. Leather belts should not be used in damp places, but if used, should be kept well oiled, and the laps should be sewed instead of riveted to give the best results.

Increasing the tension of belts by the use of tighteners (so called) should be avoided if possible, as they conduce to ruin the belt, and require care, oil, power, and repairs.

SMOKE ARCH.

EXPERIMENTS WITH THE SHAW LOCOMOTIVE.

Quite recently Mr. Robert Grimshaw made a series of indicator tests of the four cylinder locomotive Henry F. Shaw, which was tested on Wednesday by the Franklin Institute committee. These tests were for the purpose of noting the amount of friction, using different cylinder oils, and incidentally to note the correctness of the valve gear at various points of cut-off. The throttle remaining at the same point, the link lever was put at the various notches from the front to the sixth, inclusive, and each end of each cylinder of the right-hand side of the engine, was tested by the indicator, lard oil being used. The lever was then put at the seventh notch, and the engine run for a moment at a speed corresponding to about seventy-five miles per hour. It was the opinion of those present that the ordinary two-cylinder locomotive would, at that rate of rotation, have jumped off the jacks and gone through the side of the round-house. After this test a second series was made using refined petroleum oil, making in all forty indications.

The records of these tests are regarded by Mr. Grimshaw as valuable, not only as bearing upon the valve movement, but as showing a greatly reduced friction consequent in using refined mineral oil.—*Philadelphia Press.*

* * *

Says the Railway Age: We have the rather doubtful statement from Troy, N. Y., that Mr. W. H. Vanderbilt, about a year ago, directed the master mechanics of his road to prepare plans for large and speedy locomotives, capable of drawing fifteen heavy drawing-room cars over any part of his road at sixty miles an hour. It is said a prize of $50,000 was offered for the most perfect locomotive capable of the marvelous speed. It is announced that four locomotives, each one of a different plan, have been constructed, and one of them will be given a trial trip early this month.

This is of a piece with round-house rumors generally. Bigger locomotives have been built, and faster time has been made alongside the stove, than was ever made on a railroad!

* * *

The Brush Electric Co., of Cleveland. Ohio, have ordered from H. B. Beach & Son, of Hartford, Conn., a 100-horse power boiler to be set with Mahony's Patent Furnace Improvement; his corrugated grate bars will also be used.

* * *

Any one needing a beam engine, 60″ by 10′ stroke, can hear of a second-hand one in good order at a low price, by addressing us.

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By request of many manufacturers in various parts of the country, we renew our publication of market reports of metals and engineers' goods, which was dropped some months ago, it being found a great convenience.

These quotations are made by the houses represented, who alone are responsible for the statements. While every effort will be made to insure strict accuracy, we disclaim any liability that may arise from changes without notice or typographic errors.

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English Foundry	$22 @	
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Lake Copper	18¼@18½	cts.
Arizona Copper	17½@	"
Baltimore	17¼@17¾	"
Tin	21¾@23	"
Spelter	5¼@ 5¾	"
Antimony	11 @13	"
Babbitt Metal	8 @25	"

American Tube Works quote:

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Per pound, $\frac{3}{8}$, 50c.; $\frac{9}{16}$, 45c.; $\frac{11}{16}$, 40c.; $\frac{13}{16}$, 40.; $1\frac{1}{1}$, 35c.; $1\frac{5}{16}$, 30c. Same price to $3\frac{1}{2}$ diam. Copper tubes for above sizes respectively, 63c., 58c., 53c. 48c., 43c, 38c., for $1\frac{5}{8}$, and same price up to $3\frac{1}{2}$″ diam. Special price for large orders.

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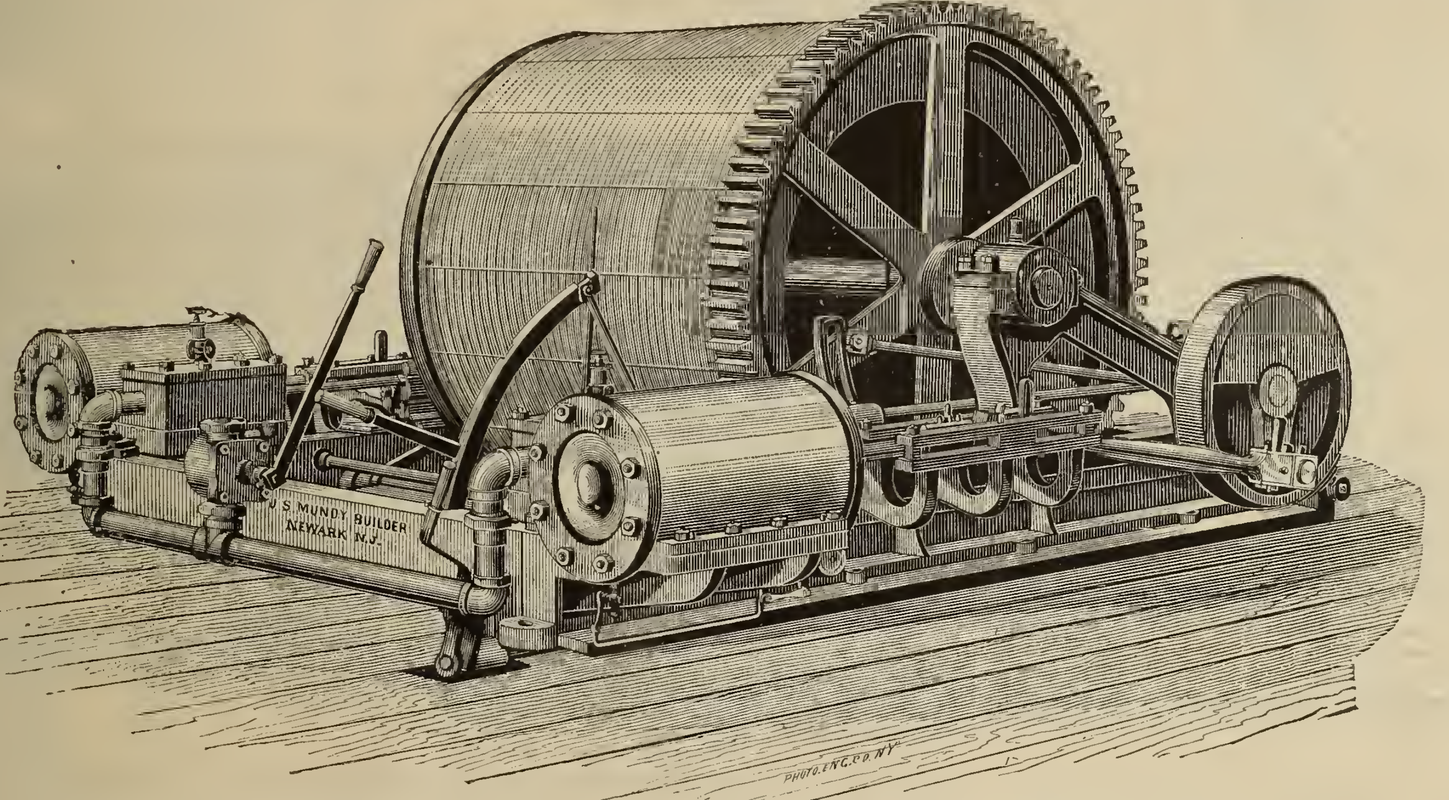
NEW COAL HOISTING AND MINING ENGINE MANUFACTURED BY J. S. MUNDY,

NEWARK, N. J. (U. S. A.).



It is a well known fact that persons using steam for various purposes, if, about to put in new boilers, endeavor to get the best for generating steam. That is, to generate the greatest amount with the least fuel. This should be true of steam engines. Hundreds of thousands of dollars have been spent in experimenting with new valves and valve gear of various kinds, simply to obtain the greatest amount of power from the smallest amount of coal consumed. From the old style engines made many years ago, (one of which, 6″ × 36″, can be seen in the U. S. Mint in Philadelphia, running every day, about 36 rev. per minute, turning off from 5 to 8 horse power) to the engine of more modern build. A modern engine, with 6″ × 12″ cylinder, running 380 revs. per minute, should give out 25 to 30 horse power with adequate steam pressure.

The engines here illustrated, are plain in construction, have large wearing surfaces, guides and cross heads of the locomotive style. Also reverse link-motion, and improved brakes on the crank discs. These latter are balanced, making the engines very steady while in motion.

Mundy's hoisting engines are well known throughout the whole country. He is the inventor of the well known patent friction drum, that has brought hoisting engines, for other purposes than the above, so near to perfection. There are several of the above engines in use, giving the best of results,

Catalogues and price lists furnished on application to J. S. Mundy, 22, 24, 26, 28, 30, 32, 34 Prospect Street, Newark, N. J.

⁂

Respecting wire cloth, a manufacturer writes to the *Milling World* as follows: "The 'mesh' in wire cloth is the distance from center to center of the wire. I mention this, as many take it to be the opening, or space, between the wires. I note you state cloth as fine as 120 is sometimes made. It has always been made by us and also 130 mesh. Wire is used as fine as 47, American gauge, in the manufacture of the finer grades of bolting wire cloth. I might add brass wire cloth used by paper mills is 16, 50, 60, 70 and 90 mesh."

⁂

Please note change of style in our address, editorial page.

GRINDSTONES BY MAIL.

We believe we mentioned in a previous issue that we had received a grindstone by mail, but do not remember when. This one came as a New Year's present, from Grindstone City, Mich., a place evidently founded on a rock. The grindstone is beautifully fashioned and clear grit. Its weight is 2,238 lbs. less than a ton.

⁂

NOTICE.

We regret to state that the articles on mechanical drawing are omitted from this number by reason of the drawings not arriving in time.

WHY MACHINISTS WILL NOT ENLIST IN THE NAVY.

The report of the Chief Engineer of the Navy contains this significant statement, but it omits to give the real reason why machinists will not enlist, and that is because no man of any self-respect could stay on a ship. "Rank," pride of office, rules, and the officer, who on shore, would be a mere atom—a molecule—so to speak, in the mass, lords it over all beneath him. Station fixes no man's status, and no official title can rate him. He rates by what he is as a man. The poor coal heaver may outrank the captain.

Chief Engineer Shock says:

> "Some provision must be made for the care and management of the steam machinery of the Navy, as it is physically impossible to keep officers of the Engineer Corps at sea continuously, and equally impossible for one assistant to perform all the duties required of an engineer in the engineer department of a war steamer.
>
> The only recourse must be the employment of mechanics, or machinists, so called. Such a system, after a trial of eleven years in our Navy, had to be abandoned, for the reason that competent, respected mechanics, could not be found, and with such as were obtained the record shows that the repairs required to machinery were numerous and extensive, often involving the expenditure of large sums of money. Every inducement was held out to secure and retain good men; their pay was increased from $55 a month to $61.50, then to $76.50, the latter but little less than the pay of the educated cadet engineer; but all to no purpose, for none, with a few rare exceptions, except the idle or the intemperate, would enlist, and in the case of the exceptions noted. many availed themselves of the first opportunity and obtained their discharge.
>
> It must also be borne in mind in considering the machinist system that the United States has no large merchant steam marine, like Great Britain, from which to draw a supply of machinists, thoroughly trained in the duties of the engine-room. It has been asserted that the engineer department of the British navy is managed upon this principle. This is not strictly true; but granting it for the present, it must be remembered that the social system prevailing in Great Britain is vastly different from that in the United States. In the former country, the laborer, the mechanic, the artist, and the merchant are educated from childhood in the belief that those in official positions in the army and navy and nobility, are of gentle blood, a higher race of beings than themselves, occupying a plane whose level they never can attain. Not so in the United States. Here every boy is taught that he is a possible "President," and the intelligent, educated American mechanic is not less ambitious than his fellow-men in other walks of life, in his efforts to elevate himself and family in rank and standing among them.
>
> Whenever Congress says to the mechanical classes of this country that, whatever your merits may be, you cannot, shall not, rise above the social scale in which you were born, and this declaration is acquiesced in by the public, then, and not till then, will the navy be able to obtain such a class of skilled mechanics by enlistment as is easily to be had in England, and other monarchial countries."

⁂

The criticism of the *London Engineer* on the Kinzua viaduct is as follows:

"A railway viaduct has recently been completed across the Kinzua Valley to carry the New York, Lake Erie, and Western Railway. Its loftiest pier is 297ft. in height, and the average is 176ft.; but although they are close together, the girders having each a span of 61ft., they are so light that the whole viaduct, except the superstructure, has the appearance of a monster wire fence.

Without going carefully into the calculations of strength, we should not like to say that the thing would not carry its load a few years; but we should rather not cross it during a heavy wind, and would rather walk across the valley at any other time. Too much dependence is placed on each individual member, to commend the design to English engineers, and not enough sectional area has been given to the diagonal ties to confine their elongation within limits safe for the structure."

⁂

Some idea of the quantity of small wooden boxes used in New York, weekly, can be gained from the fact that four trades alone, soap, starch, tobacco and cereals, takes 36,000 pieces, two other trades use 6,500 daily.

⁂

President J. H. Reid, of the *Marine Engineers' Association*, is taking an active interest in its affairs, and is personally attending to the various local societies. He has just returned from Bay City, Mich., and writes us an interesting account of his doings there, which will appear in our next issue. It comes too late for this. President Reid is another instance of "the right man in the right place," and we are heartily glad at his accession.

NEW ENGLISH DYNAMOMETER.

A new dynamometer has just been introduced in England, and is here illustrated from the *London Engineer*,

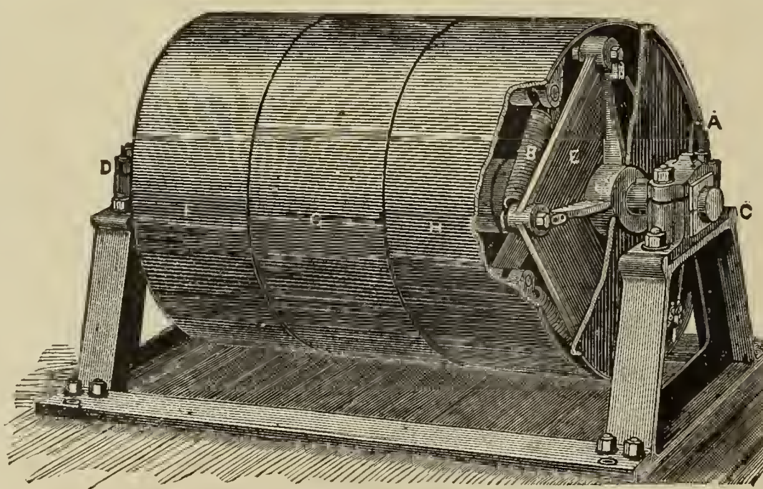
It is for the purpose of measuring the power transmitted by belting from one machine to another. *F*, is a pulley rigidly fixed to the shaft, *C D*, turning in two plummer blocks carried by *A* frames resting on the floor or by brackets fastened to the wall; *g* is a loose pulley, and *H*, is a pulley loose on the shaft but joined by the spiral springs, *B*, to a ribbed plate, *E*, which is rigidly fixed to the shaft, *C D*. The engine belt is put on *F*, and the belt to the dynamo electric, or other driven machine, on *H*, or *vice versa;* hence the pull to drive the machine is transmitted through the spiral springs, which are consequently stretched, and the amount of stretch measuring the twisting force transmitted. To measure this stretching the following device is employed—An arm fixed to the plate, *E*, on a small link motion, seen at the right hand lower corner of the figure, and which causes a bright bead, *A*, at the end of the left arm to approach towards the centre.

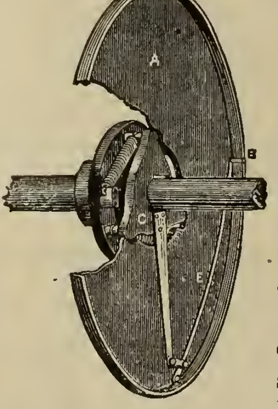
Consequently the radial motion of the bead, *A*, records on a magnified scale the extension of the spiral springs. As the bead revolves a bright circle of light is seen, the radius of which diminishes as the pull on the springs is increased. Hence the horse-power being transmitted at any moment is at once known by observing on a fixed graduated scale supplied with the instrument, the radius of the circle of light described by the bright revolving bead and the speed of rotation.

To obtain great delicacy for powers varying within certain limits from that normally transmitted, the arm carrying the bead is made slightly flexible, so that when no power is being transmitted, the bead is pressed with a certain force against the rim of the front plate, hence the plate does not commence moving until a certain pre-arranged horse-power at a given speed is being transmitted, and its whole radial motion therefore is completed for a certain additional transmitted horse-power, the necessary addition depending on the power of the springs and the leverage of the circle motion. Consequently a large change in the radius of the circle of light is produced by a small change in the transmitted horse-power.

Further, one of the pins in the links can be taken out and put into another hole, which has the effect of greatly altering the leverage of the links, thus increasing the magnification and causing the motion of the bead to be completed for another range of power—for example, the springs and link motion may be arranged so that with one of the adjustments the bead may commence to move when 8 horse-power is being transmitted, and may complete its whole motion from the circumference to the center, when this transmitted horse-power varies from 8 to 12. With the adjustment, the bead may start moving when 4-horse power is being transmitted, and the entire travel of the bead from circumference to center completed by the transmitted horse power increasing from 4 to 6.

Fig. 2 shows a dynamometer coupling. The plate, *C*, carried by one of the shafts of the coupling is attached to the plate carried by the other by means of the spiral springs, and the stretching of these is therefore a measure of the transmitted twist. The angular motion of the one plate, *C*, relatively to the other causes the bright bead, *B*, to approach the centre, and as before, the radius of the circle of light measures the horse-power transmitted at any particular speed. The arm, *E*, carrying the bead is also, as before, slightly flexible, so that when no power is being transmitted the bead, *B*, is pressed with a certain force against the rim of the larger plate.





ON THE RIGHT HORSE!

It is not always in this world that the saddle gets on the right horse, but it did in one instance we know of, and that was when A. M. Davy, Esq., was elected Secretary of the *National Association* of *Stationary Engineers.* He writes Jan. 17, specifying the numerous applications he has for charters from cities all over the United States, and adds:

> "I had twenty-two letters to-day; fine, is it not, to be secretary, and have all that business to attend to?"

Besides it he has his own daily bread to get, so that it will be seen the position is no sinecure.

The Engineers of the United States will owe a good deal to the pioneer officers of the National Association; it is the men who break the road that feel the stiffness of it. Make it as easy for them as you can.

◆

A POINT FOR US.

Regarding the constant breaking of crank shafts of English marine engines, we said, nearly two years ago, page 52, Number VII, upon this subject:

> * * * "If it is admitted that for every effect there is a cause, we do not think it necessary to look far to find both reason and remedy for this state of things. Both heating and breaking come from the same source, and that is the instability of the foundation, and the persistent attempts to make the shafting rigid on an elastic base. However solid the hull of a ship may be in appearance, and in a state of rest, it is not so when laboring in a sea-way, balanced at one point in one moment, and hung suspended from both ends at the next, and buffeted by tremendous forces at all times. * * * The struggle is between the strength of the hull and the strength of the shaft, and as the latter is the weakest, it must sooner or later succumb." * * * * * * * *

We confess to some pleasure at finding these views endorsed in a late number of the *London Engineer.*

It says upon the same subject:

> * * * "Mr. W. Parker, chief engineer surveyor to Lloyd's, has, perhaps, done more than any other man living to put the cause of the breaking of shafts in its true light, and he has been ably aided by his assistants, and backed up by Lloyd's, who have spared no pains and no money to arrive at the truth. It has now been established beyond fear of refutation, that crank and screw shafts break because they are not kept in line, and it is very difficult to keep them in line because a ship's hull is more or less flexible. When a shaft is not in line it is bent at every revolution. The bending may be imperceptible to the senses, but it is none the less effective in destroying the shaft. As Mr. Parker and Mr. Milton have pointed out, the rapidly altering strains of great intensity, first tending to bend the shaft in one direction and then in another, coupled with the sudden changes in the form of the metal, unavoidable in a crank shaft, are extremely fatiguing to the metal, and even the best material is at last strained beyond the limit of endurance by a much less force than it would have previously borne." * * *

A FRANK ACKNOWLEDGMENT.

Mr. George W. Gageby, so many years foreman of the Cambria Iron Works Machine Shop at Johnstown, Pa., has resigned his position, and accepted a similar one at Chattanooga, Tenn., with the Tredegar Company. Mr. Gageby's associates — the men in the shop — presented him with a handsome gold watch and chain as a token of their good will on his retirement, and Mr. Gageby's response in acknowledgment is so unique and pertinent that it may well serve as a model for all similar occasions. We reprint it:

> "I hardly know what to say. You all know I am a worker, not a talker! For this munificent gift, thanks. I will wear it to the credit of you who gave it. It is true, I was an apprentice boy in this shop and rose to foreman. I always worked to that end, although I never expected it, and if I have been successful as a foreman I owe it partly to you. Our relations have not been always pleasant, but I have tried to do what I thought right, and for the hands I have done all I could. That we are still friends I hold the proof in my hand. Since the reduction in steel and wages it seemed to me all the fire and energy had gone out of the men, but lately it has returned, and I think you will soon be as good men as ever. I have stayed here as long as I could do well for myself, and when a better chance offered itself I accepted. I have not always been successful here, and don't know whether I will be succesful in my new field of labor or not. For my successor I would say, do as well for him as you have done by me and you will get along as well, if not better, than you have with me. Thanks again for this. Good-bye."

This sounds almost like a verbatim, that is, a word for word, report, and is more sincere, and correct in fact, than the stereotyped formula used on such occasions. There is no doubt of Mr. Gageby's success anywhere.

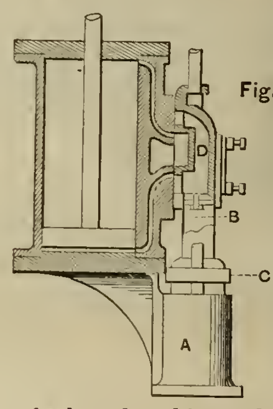
◆

AN UNBALANCED SLIDE VALVE.

The subject of a recent English patent is shown in our engraving. It professes to be a balanced valve. Since the pressure comes immediately on the back of the valve that does the work it is hard for us to see what use balancing the steam pipe is!

The claim is as follows:

Fig.1



The chief object is to neutralise the pressure on the back of sliding valves of steam engines. The steam, after passing through an ordinary fixed steam pipe, A, passes through the sliding steam pipe, B, to the slide valve, D, and while so passing is prevented from escaping into the atmosphere by means of the gland or stuffing-box, C, through which the sliding steam pipe moves backwards and forwards, the back of slide valve, D, being boxed over. The steam is distributed, as in other engines, by means of the slide valve, D, the inner portion of which acts precisely as an ordinary slide valve, and the outer portion by what is termed a movable valve chest. In order to keep the valve tight to its face and prevent any leakage of steam, its back is pressed upon by means of four set screws which work in the cross pieces which extend over the back of the valve, and are bolted to projections cast solid with cylinder.

If the inner portion of the valve, *D*, is the same as an ordinary valve, and acts like it, it has pressure on it; it is difficult to see where the advantage in it over others lies.

RAILWAY EXPOSITION ITEMS.

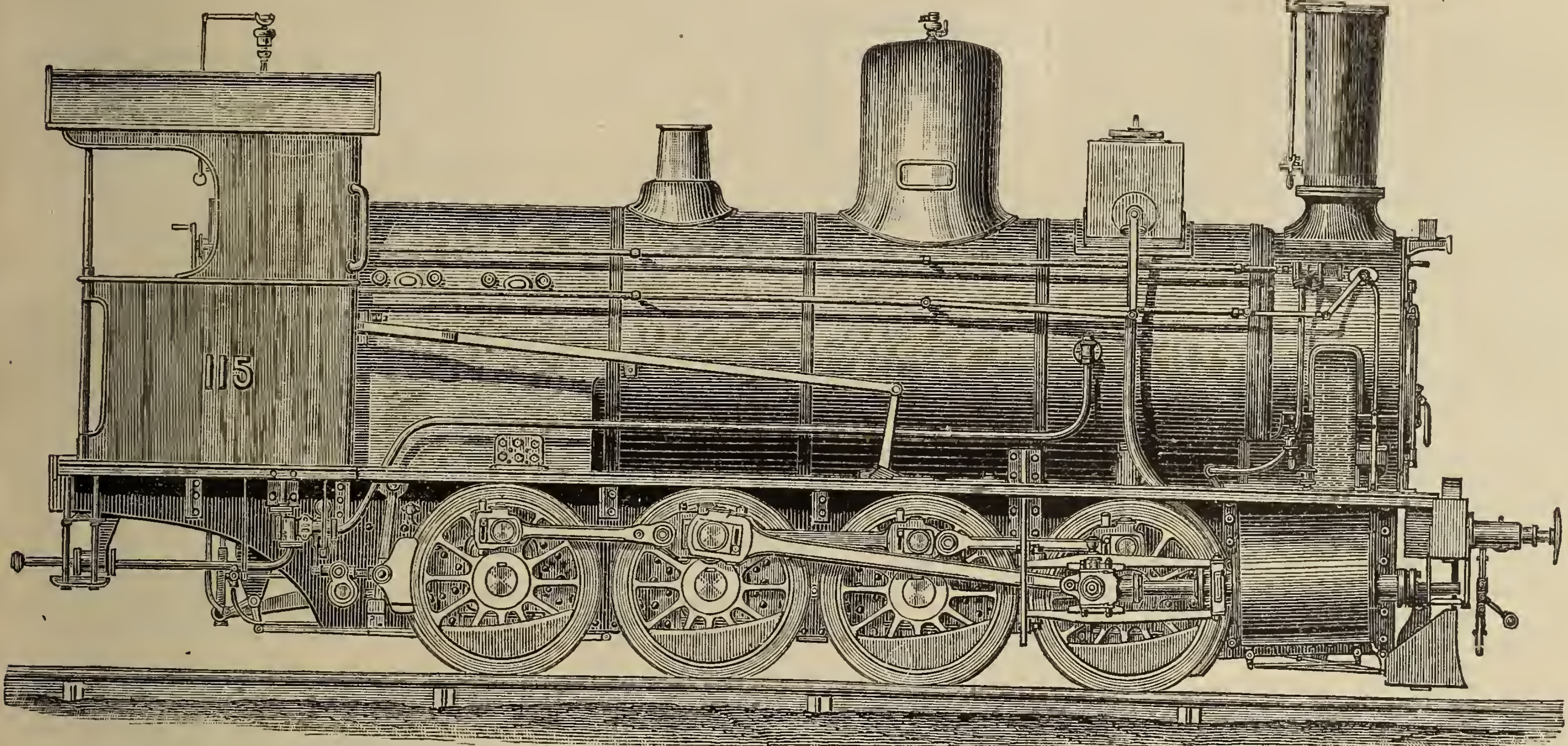
The Chicago Common Council has granted the privilege of laying tracks through the Lake Park into the Exposition building for the exhibits of cars, locomotives and heavy machinery, also of erecting an annex at the south end of the present building.

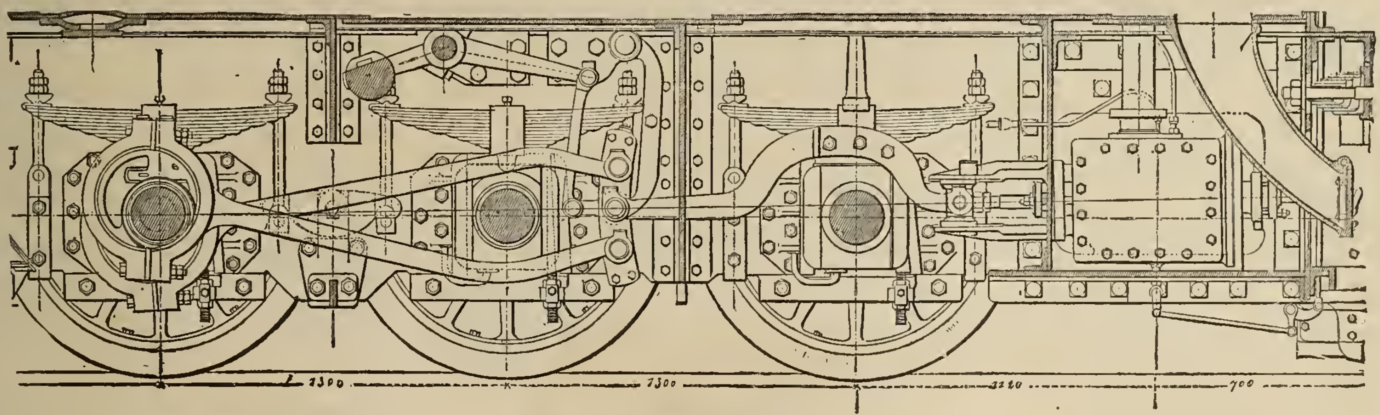
Laying 1500 bricks on outside and inside walls is given as an average day's work for an English bricklayer. On facings and angles and finishing around wood or stone work, not more than half of this number can be laid.

◆

It is asserted authoritively that English passenger steamers average $90.000 receipts per voyage, to England and back to this country. Of this sum 25 per cent is said to be profit.

LOCOMOTIVES USED ON THE ST. GOTTHARD RAILWAY.





Our engraving illustrates a locomotive used on the St. Gotthard Railway, Switzerland. It possesses some peculiar feature to American eyes, that are doubtless useful and necessary, as the designer is the master mechanic of the road in question, and is probably the best judge in the matter. These peculiarities are found all over the engine, not alone in the valve gearing, but in the frames, connections, and piston-rods. These latter, it appears, have tail-rods, such as are used in marine engines. The eccentrics are attached to the axle next the fire-box—third one from the front—which arrangement involves numerous crooks and bends in the connections to the valve gear, and lengthens the steam ports to an extraordinary degree. This design is not found necessary in American engines of the same class. The frame consists of numerous short pieces connected by the main journal boxes with a great many bolts and nuts. These engines draw a load of 500 tons on grade of one foot in one hundred, at fifteen miles an hour. The dimensions of them are as follows: Cylinder 20½ inches by 24 inches stroke. Wheels, 20½ inches, driving axles at journal, 7⅞ths by 9½ inches, crank pins, 5 inches, boiler, 60 inches diameter of shell; length over all 24 feet; tubes, outside diameter 2 inches, length 13 feet; number of same 225; heating surface 3,307, square feet; pressure 150 pounds; weight, in working order 50 tons.

* * *

Some novel electrical experiments have been carried out lately at the Trafalgar Collieries, in England. They are using an electric motor to drive a pump in the underground workings. The total vertical lift of the electric pump is 115 feet. The electricity is generated by a dynamo machine at the surface of the colliery, and the wires connecting this with the pump extend down the shaft a distance of 500 yards.

PECULIAR METHOD OF "BURNING SMOKE."

An English paper says: "Is it possible to produce self-contained heating furnaces, let us say, which shall be hand-fired and yet shall produce little or no smoke and prove, at least, fairly economical? It is not improbable that something may be effected in this way, and that by very simple means. We call to mind a case which came under our own notice some years ago. A heating furnace, used for wash heating shingled blooms, produced dense clouds of smoke. It was an unusually large furnace and was very hard driven. The mill manager thought he would try an experiment to get rid of the smoke, so he had about 10ft. of brickwork built on to the top of the chimney stack, which was already 35ft. high, and just at the base of the chimney he had several holes made in the brickwork. The result was very satisfactory; the air admitted supplied the oxygen wanted for the intensely hot gases going up the stack and ignited them. Instead of smoke, bright flame came from the top, and the draught, instead of being injured by the air-holes at the bottom, was improved, for, in the first place, the stack was raised 10ft. or so, as we have said, and in the second, the temperature within it was considerably augmented by the firing of the gas. Of course all the heat thus produced was wasted, but the end had in view was achieved; the smoke was prevented."

To which we may add, that in a short time the chimney was probably destroyed from the intense heat within.

* * *

Among lubricating oils, fine mineral oils stand first on the list of those which adhere well to metal surfaces, but are without perceptible molecular cohesion. Sperm oil stands second; neatsfoot third; and lard oil fourth. Which is the order of their fitness for use on machines.

Our friends, the marine engineers of the great inland seas, have a fine time of it in the winter in these days! Far better, in point of fact, than we had twenty-five years ago, at this season, in their section. There were no balls then, among the fraternity, as there are now. We have before us an invitation to the eighth annual ball of *Marine Engineers Association No.* 4, of Chicago, which is not only literally gilt edged, but backed by a strong array of officers and committee of arrangements, who evidently know what a good time means and are prepared to have one. We are pleased to receive these remembrances and regret that we cannot share in the festivities.

* * *

Please note change of style, editorial page.

A new English ocean steamer is now building, intended to be faster than any now afloat, the *Alaska* not excepted. The new vessel is called the *Oregon*; she will run in the Guion line, and will probably be out about autumn. Her displacement is about the same as that of the *Alaska*, but she will have very much greater power. Her engines will develop 13,000 horse-power, used through one screw, 24 feet diameter, with 40 feet pitch.

* * *

For drilling glass M. Gougy, of Paris, says is is not sufficient to know that spirits of turpentine, or spirits of turpentine with garlic, forms the best lubricant for the drill. The drill must have a certain form. An ordinary drill will often split the glass. A three-cornered saw-file sharpened up to a point like a three-cornered scraper is often recommended, but M. Gougy says the best drill is the three-cornered file sharpened in this way, but with one corner taken off, so that the cross section of the drill near the point is that of a truncated cone, and the point of the drill is a chisel point from ·5 to 1 millimeter in width.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

MR. CHAPMAN RESPONDS.

Editors Mechanical Engineer:

In reply to Mr. Blakeslee's criticism of my article in your issue of Jan. 20, I would say that I accept it as all correct, but, in explanation. I would wish to say that the article was considerably abridged by the publishers. The original was to this effect: "*If the crank end of the connecting rod be dropped when the cross-head is in the center of the stroke, the end of it will fall short of reaching a point directly underneath the center of the main shaft.*" I also offered an explanation for this which the editor, for some good reason, I suppose, saw fit to omit.

As your correspondent wishes an explanation of my proposition concerning cylinder head bolts (and here it is evident the printers make him say what he does not intend to) I will endeavor to do so.

Let us suppose that the bolts are set up with a pressure of 3,000; lbs. that is the gasket or point of contact between cylinder head and end of cylinder will be subject to a constant pressure of 3,000 lbs.—a reservoir of force stored up there ready to act when required.

Now, suppose that a steam pressure of 2,000 lbs. be applied to the inside of the head, it seems to me evident that the strain upon the bolts cannot be increased so long as the pressure upon the inside is less than the pressure previously applied upon the outside. The result, however, will be that the gasket or point of contact will be relieved of 2,000 lbs. pressure, and that the same will be transferred to the end of the piston.

If the steam pressure be increased to 3,000 lbs., the pressure upon the end of the cylinder will be *entirely* removed, but the strain upon the bolts will still remain the same.

The foregoing is upon the supposition that the bolts are always subjected to more strain in setting up, than any steam pressure that is applied in the cylinder.

W. M. Chapman.

Ravenna, O.

Regarding this letter, we publish herewith, Mr. Chapman's first communication entire, as he sent it. The portions he speaks of as being omitted, and the abridgement, are in italics to distinguish them.

Editors Mechanical Engineer:

As your invitation to your subscribers to write as the spirit moves, is cordial, I venture to come again. Although all of the paper is good, I think the correspondents' department most instructive. and for one, wish that subscribers would write oftener. There is scarcely an engineer but has had some experience, peculiarly his own, which would be full of information for your readers, if written up. Something, perhaps, with reference to a boiler explosion, or the bursting of a fly wheel; defective draft and its remedy; a change from a throttling engine to an automatic, with the result, etc., etc.

I venture to make a few suggestions which may, *possibly, not be considered of much importance by the older heads, but may, possibly give the younger ones some new ideas.* First, *there are two strokes of an engine for each revolution.* When an engine has made one half of a stroke, the crank pin has not made one-fourth of a revolution. In other words, when the cross head is midway, the crank pin has not reached a point half way from one center to to the other. As the length of the connecting rod is the distance from the center of the main shaft to the center of the cross head pin, at mid stroke, it will be readily seen that if the crank end of the connecting rod be dropped when in this position, that it will fall short of reaching *a point directly underneath the center of the main shaft. As the connecting rod starts on the stroke, it deviates from a parallel line during the first half of its travel, and returning again to parallelism during its last half of the stroke.*

Again, when a cylinder head is *placed* in *position*, and the bolts properly set up, there is no more strain upon them (the bolts) when the engine is working, than when standing without steam on. Should anyone question this proposition, I should be pleased to see it discussed.

W. M. Chapman.

Ravenna, Ohio.

For reasons, we sometimes excise portions of letters sent to us, for the interest of correspondents themselves; that is, when they strike us as irrelevant to the illustration, or case in point.

As to the stress on cylinder head bolts (*hand* bolts—in Mr. Blakelee's favor, was a typographical error, marked, but not corrected in proof) we do not intend to take any part in the discussion.

Prof. W. D. Marks, of the University of Pennsylvania, has an interesting illustrated article elsewhere on the subject, which defines his position clearly. We do not traverse it.

May we ask. upon our own account, (if it is not doing what we said we would not—discussing it)—that if action and reaction are equal, what becomes of the steam thrust on the cylinder head in the act of moving the piston? Is it not just so many pounds added on the cylinder head, independent of whether the bolts are screwed up or slack?

Further: suppose the bolts, or nuts rather, to be set up with a wrench, to the last ounce they will bear (as they are too often) will they break or hold on if steam is let on to the piston?

Mr. Chapman's letter, like Mr. Burdekin's, elsewhere alluded to, is interesting to us from analogous reasons.—Eds.]

LETTER FROM A CLOSE OBSERVER OF FIRING STEAM BOILERS.

Editors Mechanical Engineer:

On the question of combustion, as in many others connected with engineering, a difference of opinion exists among engineers. Some claim that, to produce perfect combustion, a supply of air must be admitted above the fire. Others stoutly contend that the admission of air above the fire cools the gases and is wholly unnecessary. Now, most furnace doors have registers although many boiler-makers provide no passage for air except through the ash-pit. I have a register on my furnace door, but as to its usefulness I know very little. I would like to ask how, where and when should air be admitted to the fuel, to get the best possible results?

I have read of a factory where the doors were fitted with registers, and the firemen were instructed by the engineer that after putting coal on, they were to open the registers and let them remain open until the color of the flame changed from a blue to a reddish white. Then they were to close the registers.

The firemen obeyed orders. During the day, the boss came into the fire-room and saw the fireman open the register after coaling. . He asked, very savagely, why he did so. The engineer put in his appearance and explained matters. He said the use of the registers was to assist combustion. The boss said: "No, they are not for that purpose at all. They are to prevent the fires from burning too fast; because. I have one on my stove, and when I dont want the fire to burn so fast I always open it."

It seems to me the boss was right. Now just examine the method of firing a coal stove: They generally have a damper (or register) both below and above the fire. If you want a brisk fire, do you not close the upper one and open the lower? If the fire gets too fierce you shut the lower and prevent air from entering through the fuel, while the upper register is opened and a current of air allowed above the fire. It is all a mystery to me. Surely combustion is the same whether it takes place in a coal stove or in the furnace of a steam boiler! I burn screenings (very fine coal) and use an artificial draught; the air is blown under the grate. I find that if I open the register, even when the blast is on, that there is a strong current of air flowing in through its opening. I can tell by holding a torch that the flame is drawn in. Now, ought I to allow a steady stream all the time? I understand that a furnace after a fresh supply of fuel, requires more than double the quantity of air it did the instant before.

I find that two inches of coal is all I dare keep on the bars. I fire on the "pancake" plan. It does seem a poor way to shovel the coal all over the grate, 'till every bright spot is covered! It must lower the temperature, and certainly does not improve the boiler, but it is the best way I know. I have tried side firing, but it requires too close attention. I keep the coal of a uniform depth. Another thing is, I keep the chimney damper nearly closed; for the fan cannot but help to rush the hot gases and flames up the chimney unburnt, but by throttling the gases by means of the damper, leaving just sufficient opening to let the gases escape, I imagine, and it is a reasonable theory, that the gases are burnt.

Now, Mr. Editor, will you have your say about the matter. I merely write for information on a subject which I am sure is none too well understood by firemen.

Walter Burdekin.

[See remarks on editorial page. The Management of a Boiler.—Eds.]

CAST IRON CRANK SHAFTS, ETC.

Editors Mechanical Engineer:

I wish to inquire through your valuable paper, if a 3″ shaft with two round heads, 3″ wrist between, can be made of cast iron all in one piece, wrist and all, to "stand" to run a 56″ circular saw, from belts on two pulleys keyed on the ends of shaft? The engine is 8″ x 12″; 18 indicated H. P. at 300 rev. per min. horizontal rubber belts; driving pulleys 30′ from line shafts. Would not the strain come direct on the cast iron wrist and break it? I ran a little yacht from Buffalo, up to Little Traverse last June. The engine (10x12) was brand new, never having been run enough to wear the bearings smooth. Nevertheless after running three hours (having stopped twice in that time to key up) I was able to take off the coolers and run her the rest of the way without them. About a week after we got to our destination one day, the wrist got warm and from that time on, I had to keep the coolers on. The pillow block, and all the other bearings, ran perfectly well without coolers. I did everything to the wrist that could be done, except to babbitt it. It has always been a mystery to me why it was so; and I would be pleased to hear an explanation from you or some of your readers.

Michigan. Reason for it.

[Our correspondent sends a sketch of the arrangement he speaks of, but as it is simply a double-disc crank-shaft, we do not think an engraving needed. We should say it was extra hazardous to make such a shaft in the manner described. Moreover, it is far more expensive to fit up, than the one alluded to below. To turn the wrist on our correspondent's device, is a troublesome matter and a slow job. The tool must project from the tool-post far enough to allow the back side of the discs to swing clear, which makes a long, springy, chattering, job.

A much better way, and a cheaper one, would be to cast the discs as usual, leaving a spot on the face where the wrist is to enter. Counter-bore this for half an inch in from the face the size of the crank pin. Do the same to the other disc. Then turn a wrist-pin from steel, or wrought iron, drill a 1″ hole clear through it, and through the discs also, and run a bolt through discs and pin. This gives an excellent job and not an expensive one, for it is all straight work which can be done without rigging up the lathe. It also gives a wrought pin that is less liable to break, when only entered in the discs, than it would be if it went all the way through. The counter bores in the disc take all the strain off the bolt. This device is shown in Vol. IV, number 10, p. 110 under the head of "*A Little Notion.*"

As regards the trouble with the crank pin it seems to us that the heating was due to a roughening of the surfaces. A very little of this will make trouble. In testing lubricants in oil testing machines, the bearings are of hardened steel, thoroughly fitted. Professor Thurston asserts that keeping these bearings in proper condition is a task of no small magnitude, the slightest scratch even, affecting results. The average bearing on an engine is a comparatively crude affair, being something near round, revolving in a box intentionally made oval. That is to say the box is wider at the sides than at the other diameter. It is not strange they should heat when any work is put in them.—Eds.]

Editors Mechanical Engineer:

In your issue of Jan. 20th, you mention an English Tank Locomotive, used for charging coke ovens, and suggest the advisability of using engines for the same purpose in this country.

There are several works in the Connellsville region where "Larry engines" are in use. I might mention Moorewood mines as an instance—7x10in. is the size of their cylinders.

As to charging: In this country one man, with a horse or mule, charges about fifty ovens—sometimes sixty, as against fifteen in England, according to your paper, and with a locomotive, hauling three larries, about two hundred, against ninety in England. I cannot account for this great difference, unless it is because the American Eagle flaps his wings so much faster!

In commenting on my "Locomotive Notes," published in the same number, you seem to think that the shape of the reach rod has but little to do with an engine handling hard. Since then I have quizzed several old runners and they all agree with me that engines with very crooked reach rods are universally hard handlers. As to a man being pitched out of the front window when he undertakes to reverse an engine with the eccentrics at full throw: How does it come that engines are daily reversed when running at a good speed and yet the engineman stays in the cab? Or why does he not get jerked out when he "hooks her back" as she gets up her speed?

In the same number, *Siphon Gauge* speaks of having trouble with the brasses of his shaft bearings from their gripping the shaft. The same trouble frequently occurs with car axle brasses and is due to the metal of the bearing being condensed by the weight upon it—and perhaps by shocks—and occurs most with comparatively thin brasses. You suggest a good remedy, using a cast iron bearing. Another remedy which is sometimes quite successful is to relieve the box slightly on the outside, right on the center line of the shaft by filing. "Half-moon" brasses seldom cause such trouble, and "half hex" brasses are the worst, while square ones are better than the latter, though not so good as the former.

Pittsburgh. L. O. Danse, C. E.

[As to reach rods: We qualified our remarks by stating that the spring might have some effect in "hard handling." We have known instances where "engineers," or persons acting as such, have found themselves on the running board instead of the foot board. If this is not owing to the pull of the eccentrics acting through the links on the reverse lever we do not know what it is owing to. In hooking back, the valve is traveling in one direction and is easily handled. The conditions are different in reversing an engine.

Our correspondent's advices as to charging ovens and the relative amounts of work performed here and in England are interesting.—Eds.]

TRUE INWARDNESS OF THE HAND SHAPER, ETC.

Editors Mechanical Engineer.

Noticing in your issue of Feb. 3d, a cut of a Hand Planer, which you say you think was a copy of one first made in this country, I would reply thus: On page 222 of "*Maschinen und Werkzeuge,*" by Franz Wencelides, being 12th Division of Report of Austrian Commission of Centennial Exhibition, and at fig. 126, is a cut which might be called the exact counterpart of one in The Mechanical Engineer, except that it is taken from the other side of the machine. It is here stated as made by the Old Colony Rivet Works, and exhibited by James L. Hall, of N. Y. It was undoubtedly first known in Europe through this report. Wencelides further states that one of them, capable of planing 6″ was purchased by the Chamber of Commerce and Industry. of Lower Austria, and one by the Lower Austrian Industrial Society.

It is rather interesting to notice the similarity of cuts, even to the wrench shown.

Might I also call your attention to a slight misstatement in same issue. In reply to "*Nemo*," of Cleveland, you say, "All metals and all substances, solids or liquids, expand by heat,"

On tne authority of Sir Wm. Thomson, and Joule, India rubber contracts with application of heat, instead of expanding; vide Tyndall, "*Heat as a Mode of Motion.*"—American Ed., p. 82, etc.; *et seq.* (and following).

C. J. MATTISON.

AMES IRON WORKS,
OSWEGO, N. Y.

[We are always pleased to receive critical letters, and thank correspondents sincerely for their attention in this respect. We are quite as liable to be mistaken as other people, sometimes, but we endeavor to be absolutely correct, according to our light. In this instance—the India rubber—have we made an error? Rubber *shrivels* by heat, but is it larger or smaller? Is its bulk, for a given quantity, greater or less? And, at what degree of heat does it shrink, (shrivel)?

All that we know, personally, of the shrinkage of rubber by heat is derived from a crude experiment just made. We took a piece of velvet rubber, such as draughtsmen use, and laid it on a steam heater where it became quite warm; not actually hot so that it could not be handled. Measured with a Browne & Sharp Vernier gauge, it was sensibly larger hot than when it was originally measured cold. It is very certainly not smaller, but the change in dimension is so slight as to be unnoticeable by ordinary measures, and very ordinary eyes in this instance.

As a rule, substances increase in bulk with heat, but there are exceptions to all, and perhaps, our correspondents may find some others worth citing. Some alloys of metals expand in the act of cooling, but they also expand in melting first. Type metal is a case in point, it being a compound of tin, lead and antimony, and its expansion in cooling is a valuable feature, inasmuch as the metal fills all corners of the matrices.

Regarding the true inwardness of the shaper illustrated, we are under obligation for information as to its origin. It struck us that it was an old acquaintance, but, as the saying goes, "we could not place it."

We find our correspondent's letter of great interest and hope he will favor us again.—EDS].

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER.

The following are the names and number of members of the different associations that have applied to the *National Association* and been granted charters.

Chicago Broth'd Stationary Engineers,	250	members
Keystone Council, Phila., Pa., -	106	"
Broth'd Stat. Engineers, N. Y. City,	63	"
Ass'n of Stationary Eng's of Delaware,	18	"
Brooklyn Engineers Society, -	52	"
Eng's Soc. of Rhode Island, Prov. R. I.	72	"
Stationary Eng'rs Ass'n, Detroit, Mich.	30	"
Flour City Ass'n, Rochester, N. Y. -	54	"
Pioneer Brotherhood, St. Paul, Minn,	18	"
Stationary Eng'rs Ass'n, Canton, O.	16	"
Total, - - -	680	"

I have no report from the four Massachusetts societies. I will forward as soon as received. I expect an application from New Orleans, La., Houghton, Mich., and one or two places in New York, soon.

Detroit, Mich. A. M. DAVY. Sec'y.

[Hurrah boys! this is a good showing; 680 chartered members in four months is by no means a bad beginning, but there are other associations to hear from who will send the total up materially. Keep on! Overturn and overturn, until not one city, or town of any note, is without its contingent of the *National Association of Stationary Engineers.*—EDS.]

NOT NEW BUT GOOD.

Editors MECHANICAL ENGINEER:

I will send you my method of testing a boiler. I do not claim it as new, or original, but there are hundreds of your readers, no doubt, it will be new to. If it is of any benefit to one or two of them I will feel well repaid for writing it.

Fill the boiler full of water until it stands over the safety valve seat. Be sure the valve fits tight to its seat, and works free. Then calculate the area of the valve, and weight it to raise at the pressure you wish to test, start a moderate fire under the boiler and the expansion of the water will raise the valve when the pressure reaches the test point, that is if the boiler will stand it. If it will not it will give way slightly in the weakest place without doing any further damage, for if the test is properly done the water will not be near the boiling point.

To set the valve to test, say at 200 lbs per sq. in. proceed as follows:

Length of lever is 21″, distance of valve from fulcrum 3″, area of valve 4·9.″ Then $21 \div 3 = 7$, $200 \times 4{\cdot}9 = 980$ and $980 \div 7 = 140$ lbs. to be placed on the end of lever. From this, however, the weight of lever, valve and stem should be subtracted. W. R. G.

ATTICA, Ind.

LAP WELDED TUBE.

Editors MECHANICAL ENGINEER:

I notice in your issue of January 20, an article on Butt Welds and Lap Welds, by L. O. Danse. This gentleman says that it is better to test before threading them, as testing will develop all imperfections and save expense of threading. I do not see how pipe can be tested before threading, unless it passes through the threading machine to have the scrap-end of the pipe removed to make a tight joint in the testing bench. If it passes through the machine twice, once to remove the scrap or rough edge, then tested, and again put through the threading machine, he cannot save expense or labor, as the pipe is handled twice. If, however, he has a method by which he can make a tight joint between the rough edge of the pipe and the leather bush in the hands of the test-bench, without first removing the rough edge of the pipe as it leaves the tongs; I should like to hear of it. I am not aware that it can be done.

CHICAGO. JOHN ERWOOD.

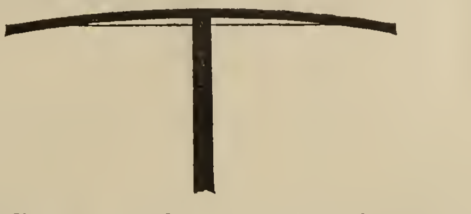
[Mr. Danse has the floor:—EDS.]

CROWN ON PULLEYS.

Editors MECHANICAL ENGINEER:

In the last issue you quote an article on this subject. Rankine's "Machinery and Millwork," page 184, says: "The swell usually allowed on the rims of pulleys is one twenty-fourth part of the breadth."

Portland, Me. W. H. OHLER.



[The diagram appended shows 1-24th of the width of the face.

To us it seems a good deal, even in this small pulley. A wheel 24″ face, crowned the 24th part of its face, would be exactly one inch higher in the center than the sides. How would that work? Not very well we fancy. It is sacrilegious to meddle with Rankine's formulas, but where did he get this one?—EDS]

ASPHALTUM, OR SMOKE-STACK VARNISH.

Editors MECHANICAL ENGINEER:

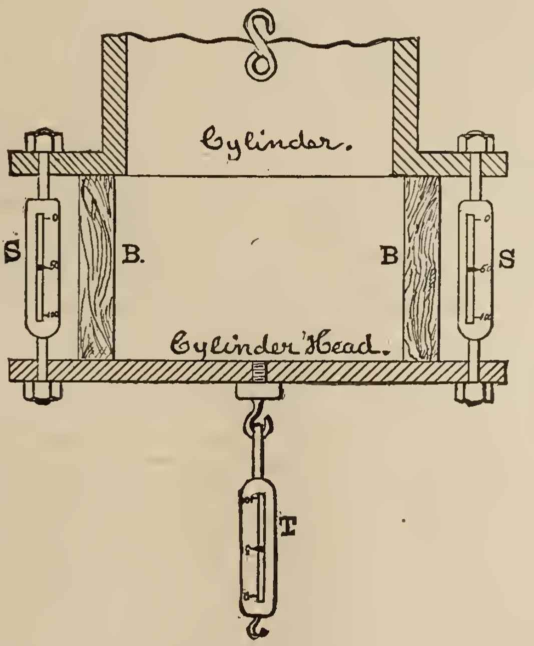
I would like to know what would be best for blacking hot and cold water pipes, which will not rub off?

Cleveland, O. LOUIS F. KUNZ.

STRESS ON CYLINDER HEAD BOLTS.

Editors of MECHANICAL ENGINEER.

When cylinder head bolts are set up so tight as to prevent leakage of steam from the joint at the flanges, there is no increase of stress on the bolts when steam is admitted to the cylinder; for the reason that when a steam cylinder is empty, all the stress on the bolts is resisted by the pressure of the cylinder head upon the cylinder flanges. When steam is admitted to the cylinder, it decreases the pressure of the cylinder head upon its flange by just as much as the total pressure of the steam on the cylinder head; but the stress on the bolts does not increase until the flange-joint leaks, because, until then, the whole pressure of the cylinder flange upon the cylinder head is not replaced by the pressure of the steam upon the cylinder head.



To prove this in an experimental way, take two sticks of wood to represent, respectively, the steam cylinder and the cylinder head. Place them between the blocks, *B*, *B*, and using the spring scales, *S*, *S*, in the place of the cylinder-head bolts, screw down nuts to tension of 50 lbs. each.

Take another spring scale, *T*, and pull on cylinder head until we reach 100 lbs., there will be no increase of tension observed on *S*, *S*. When we do reach 100 lbs., and just pass it, the blocks, *B*, *B*, will fall out at the moment that increased tensions are observed on *S*, *S*.

I trust that this will enable any person to demonstrate the fact experimentally who does not follow the explanation.

PHILA. JAN. 19, 1883. WM. D. MARKS.
UNIVERSITY OF PENNSYLVANIA.

SOOT.

There is one type of boiler which seems to have baffled every attempt to make it smokeless. namely, the modern marine boiler. A good deal of this is due to the work which such boilers have to do. They are, as a rule, hard fired, their grates are comparatively small, and there is no room for the hot gas to burn in. At sea, smoke is of little or no consequence, as far as nuisance is concerned, but it means a serious waste of coal—not, indeed, as is commonly supposed, because a great deal of the fuel goes unburned up the chimney, but because the tube-surfaces become coated with soot, which is an admirable non-conductor. Thus it will be found that after tubes are swept, a piece of zinc will hardly melt if hung in the smoke-box in front of the tube ends; but before twelve hours are over the zinc will not stand five minutes in the same place, and in a little time the smoke-box doors will become red hot.

We have heard it argued that the engineers ought to sweep oftener, and the answer is that half an hour after sweeping the tubes will be thickly coated with soot again. As an example of the evil effects of soot, we may cite the case of economisers, such as Green's. These are always fitted with scrapers, and it is well known that if from any cause the scrapers get out of order the economiser soon becomes useless, because of the deposit of soot on it. The relative efficiency of economisers can almost be expressed in terms of the efficiency of the scrapers in removing soot. It is far more easy to point out the difficulty that exists in the case of marine boilers than it is to suggest a remedy.—*London Engineer.*

Mr. George W. Barker, a well known engineer of Baton, has made an engagement to travel for Cotton, Wool, and Iron. We hope Mr. Barker will achieve high renown in his new calling. He has our best wishes for his success.

FIRE APPARATUS FREQUENTLY MET WITH.

Our keen witted contemporary, *The Tech*, published by the students of *the Boston Institute of Technology*, has the subjoined engraving of the fire apparatus used on its premises. It seems to us that it is the same old thing in use in many other localities!

A BIRD'S-EYE VIEW OF M. I. T. FIRE APPARATUS
("TECH." OFFICE FIRE ESCAPE, IN LOWER LEFT-HAND CORNER.)

BUSINESS CHANGES.

The business of manufacturing iron working machinery heretofore conducted by David W. Pond, Worcester, Mass., has been sold to the Pond Machine Tool Co., incorporated. The Pond Machine Tool Co., have purchased the business from Mr. Pond, and will continue under the same management, with careful attention to producing machinery combining latest designs with best construction. David W. Pond is President, and Albert C. Stebbins, Treasurer.

The Lambertville Iron Works, Lambertville, N. J., issue a very handsome illustrated catalogue of their automatic engine, with details and indicator diagrams; also various tables useful to engineers. They will send it to all engineers who furnish their address.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

PLEASE NOTE CHANGE OF STYLE.

Friends will please note change of style in our address, and use that form hereafter. Make all checks and money orders payable to The Egbert P. Watson Company.

THE MANAGEMENT OF A BOILER.

Elsewhere a frequent correspondent favors us with a thoughtful letter. In itself it is a source of great satisfaction to us, for the reason that it shows that a spirit of inquiry is aroused among engineers, and that they are studying common phenomena connected with their trades and endeavoring to apply the results of their observation in a useful way. From this nothing but good can result. Benefit is obtained in directions little thought of when the investigation is commenced. Aside from the possibility of making discoveries that may be valuable, commercially, there is the great gain of a habit of observation. When a man trains his mind to weigh cause and effect, he stands in much the same attitude as an athlete who educates his body to endurance, and all mental effort becomes easier to him. We repeat, therefore, that our correspondent's letter gives us pleasure, on account of its intrinsic evidence of an inquiring mind.

But what can we say in answer to the queries propounded to us? Not much, we fear, that is new, but possibly something that may be of value to others who have given no attention to the subject. In itself it is an intricate one, not to be solved by mere natural laws, or at all times subservient to them. Burning coal commercially, that is, burning it to produce the most steam with the least fuel in a given boiler, is not a matter which can be settled by formulas. And yet all that is known of combustion is derived from laboratory experiments. That is to say, the proportions in which certain gases unite to form one other, the heat given out by them, from the raw fuel from which the original gases were evolved—these are all determined from quantities of coal operated upon under conditions which are never obtained in actual work.

For example we know that for such and such rates of combustion so many cubic feet of air per minute should be supplied to the furnace. This, in order to obtain the oxygen in it to support combustion. Now how should this air be supplied? Our correspondent asks this very question, and our answer to it is, that we do not know. A given area of grate bar opening insures nothing, for the simple reason that the firing may be so poorly done that no air can pass through. The boiler may be improperly designed, and the firing may be well done, and then the combustion will be imperfect. Even the size of coal used enters into the problem. Our correspondent wishes to know why? and we join in his query for we cannot answer it. We fancy it is unanswerable. It is not answered by parading the proportions in which gases unite, the names of such gases, what will happen if certain things are not done, and how carbon is burned to carbonic acid, or carbonic oxide, under certain conditions. We say it will not advance our correspondent's knowledge of the subject for us to give him Favre and Silberman's results, or to tell him that they arrived at specific conclusions from fixed conditions. He wishes to know more than the bare facts, which he can find out from almost any hand book on the subject. Who can tell him the best method of firing? Only one master, and that is experience. He is serving under that tutor now, as his letter shows, and from his faculty for observation will undoubtedly gain. There are a half a dozen treatises on combustion under our hand at this moment, from which we could, after the manner of some, steal the body and blood, and clothing it in our own language, present it as an evidence of our familiarity with an abstruse subject. Whom would that benefit? Atoms of carbon and volumes of oxygen, the weight of them, and their relative volumes, are of no value whatever to our readers. If they were making experiments with gases under combustion perhaps, such information might be useful, but we have no desire to make a reputation as a cheap philosopher at the expense of those who look to us for positive facts. If our personal views are of any value we may say that in connection with the proportions under which known gases are evolved from burning coal, and used to advantage, the mechanical conditions attendant have a great influence. We mean by this a thorough union (mixing) of all the combustibles evolved. By whatever means this is done it is certainly of benefit, as the existence and prosperity of devices for the purpose indicated shows. Whether air should be admitted above or below a fire, and in what quantities, every man must judge for himself. According to the nature of his judgment, good, bad, or indifferent, will be the measure of his success.

The management of a boiler turns upon individual common sense and intelligence after all. We prove this by examples well known. Give two men the same boiler and apparatus, and let them each fire it for a week. A marked difference will be shown—unless both are equally stupid! This qualification somewhat detracts from the force of our example.

Under certain circumstances, admission of air over a fire is a decided advantage. We have observed this in a common parlor heater in our house, used for heating upper chambers in connection with the room it stands in. This is a magazine, base-burning device, and when it is charged—green coal upon incandescent coal—and its upper doors all closed and lower drafts open, the combustion of carbonic oxide commences at once. Now, if we open the upper doors slightly, instantly oxygen is supplied and the carbonic oxide is changed to carbonic acid, bursts into a blue flame and gives forth intense heat immediately. This continues for but a brief period—say three minutes, when the supply of air (oxygen) becomes too great, and combustion is checked again. If we keep up this process of opening and shutting doors alternately, we can obtain more heat from a given quantity of coal, but it is clearly impossible for any one to keep opening and closing stove doors to obtain the end named.

Practically we leave this subject as we approached it. We know but little of the laws of combustion, beyond the bare facts on record of laboratory experiments. These have nothing to do with every day management of steam boilers. If an engineer in charge of one, finds from the proportions of his boiler, his chimney, and the nature of his fuel that he gets better results all round, with his register partially open for a given length of time, that is the course for him to pursue. Let him read all he can on the subject from competent authorities and apply it as he best can, that is the only course we can advise.

THE NEW DISPENSATION.

Whereas in old time workingmen banded together and made common cause against their employers, asserting that they were hostile, natural antagonists, upon whom it was proper to declare war, in this day one class comes forward and assert to the contrary. This class is composed of the engineers—stationary and marine—of the United States, and they are the first, as they are one of the most important, to take this step.

Our friends have builded better than they knew, in some instances, in organizing for mutual benefit, for they have been met half way by manufacturers in their efforts to establish a better understanding, and to create a reciprocal interest in the business in hand. The movement of manufacturers has not been so general, however, as it will be in the future, for great changes are not made in a short time, but in Rhode Island, at any rate, and in Michigan, for another State, prominent men have taken a deep interest in the organization of these associations.

And why should they not? It is a common cause which brings the manufacturer and the employee together. There cannot be a division of interests. If both sides could see the matter in its true light all labor involved and all capital invested meet on common grounds. We have said it before in these columns, and we say it again, for it will bear repetition—no man works for wages in this country. He works for himself and if he gets the highest market value paid for the commodity he offers—work—he can get no more. Employers know this to a man, and few are so blind as not to see that it is to their direct advantage to encourage every man to do his best. The value of a good workman is far more than the mere sum paid weekly.

As we said in our caption, this is a new dispensation, and it is a matter of pride and pleasure to us that the trade we are so closely identified with should be the pioneers in it. At the last convention of the Marine Engineers in Detroit, an effort was made by some to fix a rate of wages for engineers everywhere within the Association, but it was promptly voted down and dismissed. This is also a standard principle with the Stationary Engineers Association, and in adopting and sticking to it they have shown great wisdom, and have fixed the status of each man belonging to it. This, for the simple reason that a good engineer need never be without a profitable engagement at the highest market price. A poor one who has to have the value of his services gauged by that of better men, held responsible for him, is not wanted and will not be accepted in any Engineer's Society.

Please note change of style.

CURIOUS FACT!

It is curious that in business, of whatever kind the average manufacturer cares the least for what costs the most, that is his steam. If he uses $1,000 worth of lumber and $2,000 worth of steam to work it up into goods, he will cut and carve in every direction to save waste, but he will throw money into his boiler with a shovel, and no man can convince him that he is boring holes in his own pocket. We say no man can convince him, and in this expression we allude to the average manufacturer, in wood or otherwise.

Every engineer knows that he can go through any considerable town where steam power is used and see money thrown away like water. He also knows that if he went into the counting room and said to its proprietor that he could stop the waste for twenty-five dollars, that is he would save $500 a year in fuel for a fee of $25, that he would be hardly noticed. Anyone who doubts this has only to take an indicator under his arm and go through a town with it. Let him take the first big brewery he comes to, or any place where fuel is bought and paid for at market prices, and interview its proprietor on the subject of testing his engine. He will find that he is looked upon in about the same light as a confidence man. Some manufacturers will not treat an engineer with ordinary courtesy when he proposes to apply the indicator! Others appear to think that an engineer will make power tests, and calculations involving two or three days time, for about five dollars.

We were witnesses not long since to this proposition: An engine builder said to a manufacturer that he would put an engine into his shop right along side of the old one. He would connect with the shafting and run the shop at his own expense for thirty days. If at the end of that time he did not show a certain economy mentioned, he would remove his engine and charge nothing. For all this he would give bonds.

The reader imagines, doubtless, that this proposal was accepted promptly! It was not, it was declined promptly, and to this day the manufacturer is losing something like $3,500 a year on cost of coal alone. Such instances as these are by no means uncommon, and can be paralleled in the experience of most professional engineers, but as the loss, in the first instance, comes upon the manufacturers themselves we do not think there will be any popular uprising to correct it.

As we said in our first paragraph the cost of steam is the last item considered by manufacturers, and in its cost we include the engineer as an expensive one. The idea prevails to a great extent that the machine shop builds the engine and agrees that it shall produce a horse power for any number of pounds of coal they choose to mention, after that it runs itself. That is to say if it is started and proven to run economically, it will forever after. Any man can take care of it and it is rather a courtesy to pay him living wages then otherwise. How false such assumptions are every engineer knows, but the average manufacturer does not, and cannot be induced to recognize them. Perhaps in time they will; when one generation passes away and another takes its place. The last should be wiser than its predecessor, and the constant iteration of this matter will have its effect. Engineers will have their true places as skilled members of an important business. Steam power will be found cheap through care, instead of costly through abuse, and our sons may reap the benefit of their father's services.

◆

WORCESTER ASSOCIATION OF STATIONARY ENGINEERS.

The Worcester Association of Stationary Engineers now number about forty members, which is certainly an excellent membership for the few weeks they have been in existence. Rally gentlemen; fall into line! It is an old and true saying, "who would be free, himself must strike the blow" and this applies here, in the sense that he who wishes to get on in life must put himself in the way of advancement, and there is no school so good as that of experience. We take a deep interest in stationary-engineers associations everywhere, for we have by no means forgotten how to fire with all sorts of fuel. It comes very near to us to hear of these societies and their successes, for in years gone by we have trained in the same company.

◆

TO THE TRADE AT LARGE.

We are happy to advise our friends that in making over THE MECHANICAL ENGINEER to the management of a company, we are thereby relieved of a very onerous portion of the business, and can hereafter give our undivided attention to the technical part of it.

We have found it very arduous to run both ends of a newspaper at one and the same time, and this task being now lightened, we think our connection will find it to their advantage.

◆

A BOTCHED JOB.

In our issue of January 20th we commented upon the continued troubles experienced by the American Steam Company with their "system" of pipes and the method of laying the same. These troubles still continue, and it is apparent to disinterested observers that a change is needed somewhere, whether in the pipes or those who direct the laying of the same, is a question for the future. There are rumors afloat that the latter course will be adopted.

In any event there seems but one remedy for the present difficulties, and that is in relaying the whole line on approved plans. The expense involved in this, to say nothing of the public inconvenience in having the streets again excavated, is very great, and we sincerely hope it will not have to be done.

◆

SOME DIMENSIONS OF THE HERRESHOFF ENGINES.

As our older readers know, the Herreshoff Mfg. Company, of Bristol, R. I., have made a world-wide reputation for high speed vessels. These are not large, in feet and inches, it is true, but they are great achievements none the less, for it is harder to get high speed out of a small craft than it is in a larger one. The reason of this is that high speed means, for one element, great power in boiler and engine. Great power is generally—that is in ordinary engines—the same thing as great weight, which is immediately fatal to high speed.

In vessels of this class everything is sacrificed to speed, and our professional readers will see, from the figures given, how great is the departure from conservative practice. For example: the piston of an eight-inch cylinder is only $\frac{7}{8}$ths of an inch deep, over all, at its outside edge. The cylinder is $\frac{7}{16}$ths in walls, the heads $\frac{3}{8}$ths, and pistons $\frac{5}{16}$ths thick, in body metal.

Principal dimensions are as follows: Cylinder 8″ diam; piston rod, $1\frac{1}{4}''$ diam.; steam ports, 7″ × $\frac{15}{16}$ths; exhaust, 7″ × 2″; clearance on end of piston, $\frac{1}{8}$th of an inch. This is a compound engine, and the low pressure cylinder is 14″ diam.; rod, $1\frac{3}{4}''$; steam ports, 12″ × $1\frac{1}{4}''$; exhaust, 12″ × $2\frac{1}{2}''$; area in square inches about $\frac{1}{10}$th the piston area. Diameter of air pump, single acting, $4\frac{1}{2}''$; stroke, $3\frac{1}{8}''$; depth of packing rings in both pistons, $\frac{3}{8}$ths of one inch; stroke of pistons, 9″; length of connecting rods between centers, $22\frac{1}{2}$ inches; breadth of neck of rod, $1\frac{3}{4}''$; width, $\frac{3}{4}$ths of an inch. The shaft is of steel, $2\frac{1}{2}$ inches diameter; journals, $2\frac{1}{2}''$ × 4″; crank pin journals, $3\frac{1}{2}''$ long × $2\frac{1}{2}''$ diameter. Total weight of engine and appurtenances (motive power) 2,100 pounds.

These engines drive a four-bladed screw $35\frac{1}{2}$ inches diameter, with 120lbs steam, 485 revolutions per minute; speed of the boat being $15\frac{3}{4}$ miles per hour; with 140 lbs. steam they made 530 revolutions per minute, the vessel making about $17\frac{1}{4}$ miles per hour, the engines developing, by the indicator, 169 H. P.

Thus it appears that a vessel 48 feet long, by 8 feet beam, having a mean draft of 2 feet, $5\frac{1}{2}$ inches, a total displacement in working order, with all loads of every kind on board, of $16{,}672\frac{1}{2}$ lbs. requires, in round numbers, 170 H. P. to run at 17 miles an hour.

In itself, this affords ample matter for reflection to those who intend building boats to make twenty miles an hour, upon the strength of some peculiar, fanciful, mechanical device, the consideration of power, and where it is to come from, being left out, as of slight importance.

◆

NEW BOOKS.

THE MATERIALS OF ENGINEERING.

In three parts. Part I.—Non-metallic materials, stone, timber, fuels, lubricants, etc., by Robert H. Thurston, C. E.
New York: John Wiley & Son, 15 Astor Place.

This volume contains a great deal of useful matter to constructing engineers, mechanical as well as others. Unfortunately, for its popularity among a large class, its calculations involve a knowledge of higher mathematics that is possessed by few. If the constructor, however, is willing to take dimensions as he finds them set down in tables in the work, he will have valuable data to work by. These tables include such matters as the load on yellow pine beams, which is given in tons for one square inch of section, upward; also, the co-efficient of friction of lubricants; values of fuels; rates of combustion, and the principles involved in it.

The engineer will find in the chapter upon stone-work voluminous data, which will afford him material assistance in building foundations for engines, pumping or other machinery, and in addition, the mortars and cements used for them.

We regard this as a most useful book for reference in its departments; and as a compendium of ascertained facts, derived from competent authorities, it should be in every engineer's library.

SAW FILING.

A practical treatise, in popular form, by Robert Grimshaw, illustrated.
New York: John Wiley & Sons.

In his preface to this little manual, the author says it is designed as a practical aid to all who use saws, while, as its title indicates, it treats principally of filing, it also touches on gumming and swaging. In the introduction, the author also says that there is no more sense in using a dull saw than there is in using a dull razor, and that it is easier to keep a saw sharp by constant attention, than it is to let it get so dull as to require long filing, and from this palpable truth he goes on to describe, in detail, the several processes needed to keep saws at their best estate. Saws of all sorts receive attention in turn, and we should think, from the rapid review we have given the work, that the class to whom it is addresssed would find it of great value.

BROWN'S BUILDING AND ESTIMATE BOOK.

By L. E. Brown.
New York: W. T. Comstock, 6 Astor Place.

This is a handy volume for contractors and builders who desire to know the quantities of timber needed for certain buildings of prescribed dimensions. The special object is to show the proper method of obtaining the cost of any contract, large or small, and to lessen the time and labor in making the calculations. The greater part of the book is unlike any other work, with a variety of full bills of timber, giving the number of feet of frame lumber, boarding, clapboarding, shingles, etc., in over two hundred buildings of various dimensions; commencing with the size of 8 by 10, and gradually increasing to 100 feet in length, with proportionate width. With such a variety, one can hardly fail of finding the desired size with the number of feet annexed.

The rules for measuring dimension lumber, wood and bark, will here be found the shortest and best methods for making such measurements, giving such examples and explanations as *cannot* be found in any arithmetic.

REPORT MADE TO THE BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT, AUGUST 9th, 1882, BY B. F. ISHERWOOD, CHIEF ENGINEER, U. S. N.

On the Vidette Boats, constructed for the British and French Navies, by Herreshoff Mfg. Co., Bristol, R. I.

We are indebted to the Bureau of Steam Engineering for a copy of this pamphlet, which embodies much useful information connected with the subject, and a great deal that is extremely interesting on the construction of small, high speed vessels. We shall make extracts from it at a later day.

THE PROFESSOR IN THE MACHINE SHOP.

No. XXVII.

Last week I received a letter from the Editor of The Mechanical Engineer, which rather surprised me. I sat reading it over in the office when Professor Rhombus came in on some business, which, having transacted, he remarked, casually: "You seem rather out of sorts, this morning;what is the matter with you?"

"Well, perhaps I take this a little too much to heart," I said, handing him the letter previously spoken of. "Read it, sir, and favor me with your advice. Should I take notice of it, or let it pass?"

Professor Rhombus made no answer, but sat down and read the letter. That the reader may know also what it was, I append it, by my own desire, and through the Professor's advice.

Editors Mechanical Engineer:

I would like to know who the writer of the articles, entitled: "*The Professor in the Machine Shop*" is? He certainly has a wide range of information on subjects of interest to men in general, but, allow me to say, that if he would deal less with boys in the shop, and their affairs he would strike a higher note, and find a much larger circle. Much of what he writes is trivial, and even foolish, beneath the evident capacity of the man. He does not do himself justice. If he would confine himself to machine shop matters, and let all and suudry outside of it severely alone, I think a majority of your readers would be better pleased.

Yours, etc.

The Professor laughed loud and long when he read this letter; indeed, till the tears stood in his eyes.

"Excuse me, sir," said I, "but I don't see where the fun comes in!"

The Professor took down his glasses, looked at me with his eyes still twinkling with mirth, and said: "You don't see where it comes in? Why it is ingrained in it; the fun lies in blocks in it; it is a placer!"

"In what way, sir?"

"In its unconscious egotism and conceit. In its complete acknowledgment of your most excelent popular dissertations on men and machine-shops, in one line, and its instant traverse in the next line; where the writer kindly volunteers his opinion of what you should write upon. He is evidently sincere and confident of his ability to advise, and he discharges himself of the responsibility he feels at once. It is very funny to me."

"It isn't so funny to me, sir," said I; "for I happen to know the writer of the letter; he is an engineer of many years experience and has been through the mill, as the saying is."

"That may be true; but if he has, he is not qualified as a critic on this subject. He looks at the matter from the wrong end of the spy glass, so to speak. He complains that "boys affairs" comprise too large a portion of your letter, and he thinks that more technical matter would be better suited to the paper. I do not agree with him, and I do not think a majority of the readers will. My reasons for saying this are that "the child is father of the man." In other words the boy of to-day is the man of the next generation. What he does, what he is doing, what he will do, is of the very greatest importance to the world at large. It is not a small matter by any means, and to see the future great man in the inconsequent, careless boy of to-day, requires discernment, judgment and tact possessed by few. The boy in the machine-shop to day, is the machinist of the future, and if we want good machinists, careful workman, good citizens, we should not disdain that which intimately concerns and interests them. As to the manner in which they should be interested, that seems plain enough. I recall that I was once a boy," said the Professor, "and when my elders pounced on me and read me long lectures upon my carelessness, and heedlessness, it went in at one ear and out of the other, but when I read in some tale that John lost his skating, because he had thrown his skates down somewhere when he came home the last time, and could not remember where, I immediately sympathized with John, and took good care to hang mine up where I could put my hands on them in the dark. Now all your details of shop life are akin to this. You set forth Lamb's impertinence, Miles's heedlessness, Paul's good work, Jacob's admirable patience and judgment, and Paul's views of prosperity as connected with the grocery trade—In a word, the affairs, great and small, of a machinists occupation. Is not his shop his world? Does he not spend his life in it? Is he not bound up in all that passes in it? All things that happen in the shop comprise the sum and substance of his existence. If any one thinks that a machinist wants to live and breathe lathes and planers constantly, screws and nuts, and never know anything else, I am sure he is mistaken. I am not a machinist," said the Professor, "but I think I know them much better than some who have lived among them all their lives, and for that very reason: I have not always lived among them."

Jacob had come in while the Professor was speaking, and heard the whole of this eulogium, and he came up and said, with his face as red as a boiled lobster, "Professor! you never spoke more truth in five minutes in your life. I'll stand to that. Suppose Moulton writes some foolishness, though I don't admit it, ain't that life, just as much as anything else? Did you never see any foolishness in real life? I'll say this much: there's more blamed fools outside of a machine shop than there is in it! It's to Moulton's great credit that he writes things as they are, and not as some, who don't know what they are talking about, imagine them to be. Ain't that so Professor Rhombus?"

"It is so," said the Professor, "but here we are, resolving ourselves into a committee to defend Mr. Moulton from a charge he is not guilty of. I should be sorry if he took it so much to heart as to break off, or be embarrassed by the letter in any way. With his versatility he can easily jump in another direction, if he thinks the boys have had attention enough for a while! How is it Moulton?"

"Well, Professor, it hit me a little hard at first, for this is the only letter I have had expressing dissatisfaction in any way, and it naturally set me back a trifle. I suppose I have had all of a hundred inquiries as to who I was, and why I didn't come forward and make my name public. Some wanted my services as superintendent, others wanted to sell us tools, etc., but I paid no attention to them, other than to feel gratified by the compliments. I never set up for a writer, and don't want to be known as one. I am a machinist, and if, in the intervals of business I amuse myself by these chronicles of machine-shop life, I fancy it does no great harm, and may 'help some lame dog over the stile,' as the saying is. That's about the size of it, Professor. May be if I was in a big shop, with a thousand or more men, I could see more, but this is a small shop and a small town."

"Oh, what's the matter with you!" said Jake, in his rough way. "Don't you mind what that lunatic says. You go on and do what you always did—write what you see—until you can't see any more, or the editors tell you to stop. Did they ever tell you that you were getting played out?"

"No," said I.

"Well, then you haven't got anything to say about it. May be one week a man sees something in one of your articles he don't like, or don't care much about. The next three weeks he thinks he never read such interesting matter anywhere. I wouldn't make an old woman of myself, bothering over the first letter of criticism I ever got," and out he went, slamming the door so that the glass jingled in it.

"Jacob is sterling," said the Professor, "and his advice is sound. Take it; you can't do better," and off he went.

I think I will be guided by what these two friends say, and continue a little longer, or until I have more proof that I have ceased to please. Perhaps the writer of the letter was half right after all!

PATTERN MAKING NO. VII.

BY A PATTERN MAKER.

The half-check joint being only available for pieces of square, or rectangular section, a sort of butt joint is employed for pieces that in section are curved, or irregular. I refer to what is known, in the shops, as the miter-joint, used so much by picture-frame makers. Among the workmen the term miter means 45 degrees; it is an ancient word brought into shop use long before the average mechanic knew there were any degrees in an angle.

In forming a bishop's crown, or miter, the material is so peculiarly (not to say mysteriously,) cut and folded, that the 45 degrees or thereabouts, shows in four different directions. Hence the word miter was taken to signify that particular angle which divides a square corner into two equal angles.

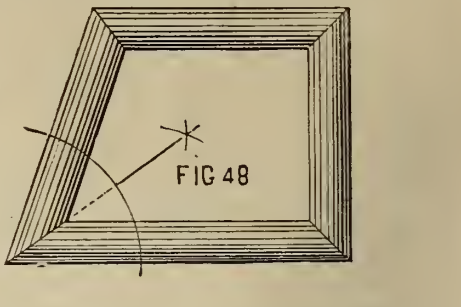


FIG 48

Fig. 48, represents a frame put together by mitering. It will be seen, that the joint line, always bisects the angle formed by two meeting sides of the frame. This bisection of the angle is the principle of mitering, hence the corners, *D* and *C*, are admitted to be miters, as *A* and *B* strictly are.

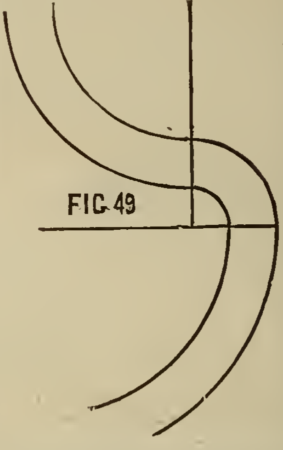


FIG. 49

Pieces that are curved in the direction of their length, and are also irregular in section, are butted together, as in fig. 49. The line of the joint must lie in the direction of the centers of the curves, as shown in the figure.

Miter joints seem very simple to make, and if the work does not need to be very exact, are not difficult; but if the frame is required to be perfectly square, and to size, it is a nice matter to get all the joints close and even.

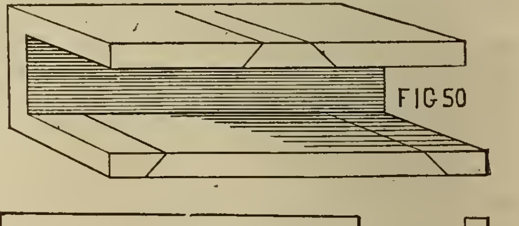


FIG 50

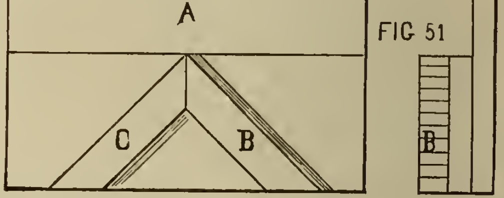


FIG 51

The ordinary appliances for cutting miters are shown in figs. 50 and 51, that is a miter box for sawing the miters and a miter board for planing them. The box so called, consists of three planed pieces of wood, fastened together to form a kind of trough, in the sides of which two saw cuts are made as near as possible to the correct angle. These cuts act as guides for the saw in cutting the stuff placed in the box. The miter board is made by fixing a piece of board, about 18″ long, 6″ wide and ⅞″ thick, upon another of the same length about 9″ wide. The plane runs on the margin, *A*, guided by the edge of the top board. The work is held in the right direction by being pressed against the pieces, *B* and *C*, nailed to the top board. The plane is either thrust from the workman or reversed and pulled towards him; depending on the direction of the miter

Joints of the above description may be much strengthened if, after the glue is dry, one or more saw cuts are made well into the joint, as shown in fig. 52; thin wood being afterwards fitted and glued in; the grain of the filling-in piece to lie in the direction of the arrow.

Suppose a man should come into the shop where I work, and ask me for a piece of board 12 inches square and an inch thick! I could cut off a piece from a planed board of that thickness, and, after smoothing it, hand it to him considering the job done. Time, two minutes.

He will probably then ask if the board will keep straight? to which I would reply:

"No; not unless you have a batten on it."

I put on a batten.

He may then demand if it will keep square.

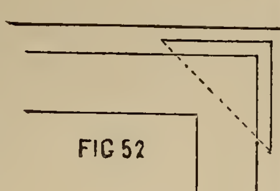


FIG 52

"No; it will keep 12 inches long, but not 12 inches wide; it may not take it a week to get to 11⅞. The batten will keep it straight, but will not be able to resist the force with which it will shrink."

He might then say that he desired above all things that it should keep to size. I should then have recourse to *paneling*, which is performed as follows:

Take four pieces one inch thick, about 1½ inches wide, and 12 inches long, with ends cut to a miter. Plough a groove on the inside of each piece. These four pieces, when joined, will form a frame. A filling for the center must now be got out and tongued to fit the grooves it is to be put in, before the last piece of the frame is fixed in its place. In large work, the panel, or center filling, is made up of several pieces, so that the whole shrinkage is divided among them. Otherwise the panel may shrink quite out of the grooves. The method of paneling circular work will be alluded to later.

BUILDING.

It is often required to form cylindrical, or conical patterns, whose length is short as compared with their diameters. These, when it is necessary they should be strong, and preserve their shapes, are not made from a solid piece of wood, but are built up in layers of quadrants and segments. The pattern maker uses his own discretion, generally, as to the number of segments he will take to complete the round of the circle. For small rings, say of 6 or 8 inches diameter, he will divide the circle into four parts. For larger diameters up to 4 or 5 feet he will use six segments. Above that size eight to the circle. The thickness of the ring he is about to build, has also to be considered in determining the number of segments, for the reason that the fewer the segments the more cross-grain, and a thin ring will not bear so much cross-grain as a thick one. Generally speaking six segments to the circle serve all purposes, down to the sizes I have named.

The thickness of the segments is another item to be considered, within reasonable limits. The thinner the segments the stronger the work. Why? Because the shrinkage is less in a thin segment than in a thick one. Also, it may be because a thin segment will allow itself to be brought down to a joint, by nails or cramps, if its surface is not very truly planed, while a thick segment, under the same circumstances, would perhaps resist that effort. Again, should the segments shrink, in the direction of their width, then the pattern with the thin segments will still be nearer to a circular form than the pattern with the thick ones. Of course it is understood that with thick segments the work is run up quicker, and therefore cheaper, a matter, often nowadays having considerable weight.

For thick rings one inch is the usual thickness for segments, up to about 2 feet diameter. Above that, from 1¼ to 1½ inches. Irrespective of this, a thin ring demands a thin segment; because on such work, only a moderate amount of force can be applied to bring, and to hold the segments to a joint. Therefore, I should make my segments about the same thickness as that of the ring. For example: suppose I had to make a ring ¼ inch thick, finished. I should build my ring ½ inch and use segments of that thickness.

In all quadrants or segments, the grain of the wood must run at right angles to a radial line, supposed to be drawn at the middle of the curve.

Solid cylinders, or cones, are sometimes built up wholly of quadrants. If sufficiently strong, only the two top and bottom courses, or layers, are quadrants, the intermediate courses being segments.

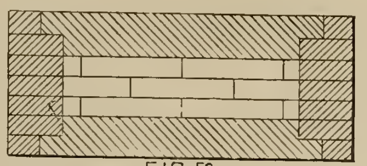


FIG 53

Another method, always used on heavy work, is shown in fig. 53, in which the ends of a ring are shown counter-bored, to receive panels or heads turned to fit; the fit in this case is always a very easy one, to allow for a possible swelling of the panel. As an additional precaution, if of large size, the panels are slit by the saw, into two or more pieces.

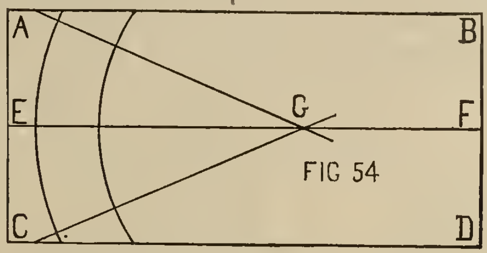


FIG 54

Rapid building consists in the facile production of segments, and in laying them on quickly. To produce segments the following is the best method I know of:

Cross-cut from a board of the right thickness, a sufficient number of pieces to contain all the segments required. Let *A B D C*, Fig. 54, represent one of these pieces, the grain of the wood running in the direction, *A C*. Draw the centre line, *E F*, square with the edge, *A C*, of the board, which edge must previously have been planed.

From a center, *G*, taken on the line, *E F*, lay off one segment. Let a pile of 6 be made of the pieces, each piece held fairly in place by two nails driven in slantwise, somewhere along the edge, *B D*. Let the piece which has the planed edge, and upon which a segment has been drawn, be upon the top of one pile. Commence by cutting out, with the band saw, a segment the full length of the board, taking no notice of the radial lines; preserve the pieces, *A C*. Using the segment for a template, scribe off the rest of the segments on the piles; having all sawed out proceed to cross-cut circular-saw table.

Set the cross-cutting fence to 60° with the line of the saw. Attach to the fence the piece, *A C*, in such a position that the saw may cut truly to the radial line, *C G*. Against this backing place a segment; saw off one end. Reverse the segment, placing the end sawed true to the radial line, *A G*, saw off the other end, and so proceed with all the segments. Note: One segment, in every six, should be left unsawed at one end.

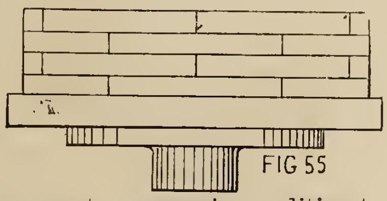


FIG 55

Our segments are now in condition to be laid on, without any further planing, either on the sides or ends.

Having selected a wooden chuck, of the size, or a little larger, than the work to be built, strike a circle upon it, of exactly the same diameter as the segments were scribed to; unless this is attended to the segments will require jointing on the ends.

Remove the chuck (with iron-face plate attached) from the lathe and place it on the bench, supported by a ring or other packing to clear the face-plate, so that the chuck may lie firm and solid. Take up the first segment, glue each end, set it to the line, and secure it by small nails partially driven in a slanting direction, into the inner and outer edges of the segment; it takes but little to hold it. Having glued each end of the second segment, set it to the line and butt it against the first; drive in a dog or square staple across the joint, to draw it close and nail as before. So proceed until the fifth segment, or last but one, has been laid. Now take one of the segments which was left long and fit it to its place.

Place the work in the lathe and face off the first course. The courses to follow are laid in the same manner, with the exception that nails will be driven through the body of each segment. Each course should be faced in the lathe. After three courses have been laid, insert screws through the chuck to hold the work, and withdraw the nails.

The above is the method, most commonly practised, for building up work; but in some cases nails would be objectionable. When this is so proceed as follows:

Having the chuck upon the bench, preparatory to laying the first course, glue strips of paper to it where the joints are to come, and others between, if the work is large, for there must not be an interval between the strips of more than three or four inches, or the pressure of the cramps, afterwards to be used, may spring the segments.

Take the first segment, glue each end, and on the side which goes next the chuck put a few spots of glue. Set it to the line and cramp it down; the next in a similar manner, dogging the joint before the cramps are applied. When a course is complete, it must have time to dry, perhaps an hour or more. This is very inconvenient, so that it is necessary to have some other work going while this process is being carried out; unless the insertion of wooden pegs be permitted. In such a case the cramp may be removed, and the work faced off immediately in the lathe.

Wooden pegs are made by sawing off blocks the required length of the pegs and cutting them with a chisel, into pieces about one-eighth of an inch square; making them in this manner insures their being straight in the grain; those not well formed must be rejected. Pare points on the pegs and let round holes to receive them be bored of the same size as the pegs are square. The same kind of wood used in the pattern serves also for the pegs.

In connection with this kind of work, I will narrate the following:

A friend of mine, having worked some time in a shop, without its having fallen to his lot to build anything, had, neverthless, observed the methods practised by others in that shop. Being himself one day required to build a ring, about two feet diameter and five inches high, it occurred to him that then was his time to have a little fun with a shopmate and "astonish the natives."

Having trued up a chuck and stuck it on a post that fitted the thread of the iron face-plate tightly, prepared his segments and got everything in good shape, he approached a fellow-workman with these words:

"George, according to you, now, how long do you think a man ought to take to build a ring like that?"

"Oh, I don't know; about three and a half or four hours."

"I can do it quicker than that."

"Well, come to look at it, perhaps you might do it in three hours."

"I'll bet you the cigars, I will build it in two hours and a half."

"You may have got hold of some fresh wrinkle that will enable you to put it through in that time; but in the way I have always seen them done, a man must look lively to build that ring in three hours!"

"I'll bet you I'll build it in two hours!"

"Well, as I said before, you may have some wrinkle, so, though I do not think you can do it, I will not bet."

"George, I will bet you cigars, that I get that ring built up in an hour! There now! If I have got a wrinkle you will learn it and that, if it enables you to build that ring in an hour, will be worth the cigars to you; so you will lose nothing."

"I am opposed to betting, gambling, and all such bad practices."

"By this time," said my friend, "I felt a little mad. There was a man who thought the job would take four hours, and had not the courage to bet it could not be done in one hour; so, said I: George, you don't seem to have a bit of sand; but, as I have gone so far with this thing, I am determined to have a bet out of you if I rush myself to death over the job. Will you bet me I can't build it in half an hour?"

"In half an hour? Done; go ahead."

My friend went severely ahead, over in his corner, men's arms, hand screws, glue brushes and segments, seemed to dance before the confused vision. In twenty minutes, from the time he started, he had laid his last segment.

A little while afterwards, George crossed over to another shopmate: "Say, Bob! did you see how he built that ring?"

"Well, I didn't take any particular notice, though I thought he seemed to be dancing and flying around queerly."

"Why, land! He's built a ring, 24 inches by 5 inches, in 20 minutes! Never saw anything like it!"

"How did he manage it?"

"It took twelve cramps to do it. No nails, and no paper on his chuck! He just dabbed his first course right on the chuck with little spots of glue to hold them, two cramps all the time on every segment; no jointing the ends, no facing the courses. He just kept right on, twirling the whole thing round on that post till he got to the top. Never saw anything like it. You'll take a cigar I suppose." VERNI NOIR.

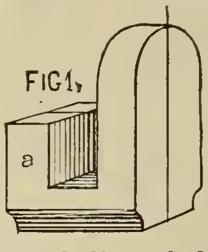
DIES AND DIE-SINKING—No. V.

BY A DIE SINKER.

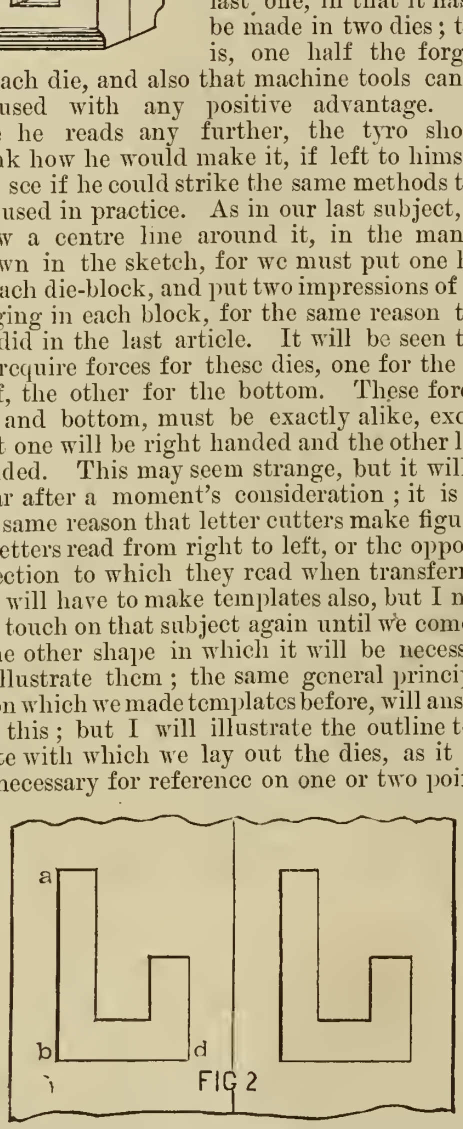
The reader, by this time, can form some idea, of the care and skill required in this work; he will see also how necessary are all the preliminaries, such as making templates, etc., and how the slightest error at the commencement, will run all through the job, and infallibly lead to disastrous results. It will be well to impress upon his mind, that he cannot be too careful and particularly with the smallest detail. He should neither hurry, nor say to himself, "that's good enough;" but he must be positive he is right before he begins, and at every step he takes towards the end in view. If there are doubts about a template, or force, it must not be used, but either alter or make others which can be depended upon; it will be quickest in the end to do so. It will be evident, too, that skillfulness with tools is not all that is necessary. There must also be an ability to design or invent, ways and means of accomplishing the ends desired. There is often more ingenuity and skill displayed in planning how a job should be done, than is required to carry out the plans when made. Sometimes in thinking how to do a job, several different ways will present themselves to the mechanic, all equally good to accomplish his purpose. In such cases, he should think each way carefully over, consider every detail necessary for each method and select that one which would give the best results for the least work. After he has once decided upon a certain method of working, he should forget all the other plans he has been considering, and put all his energy into the one he is pursuing. These remarks apply equally well to all other branches of the machine business.

There are a great many mechanics who think we should not talk these things over out of the shop. They never read papers touching on trade matters, and shudder at the mention of the grimy workshop. I think they are wrong. Our lives, for the most part, are spent in the workshop; the vast majority of us have no other prospect, and we should make the shop interest us as much as possible, and make ourselves happy in it. Thus will our labor become lighter and life more bearable.

Some one has said, "Every man should have a hobby." What hobby can be more interesting than the study of mechanical operations? Others say, also, you cannot learn anything from papers; at least nothing in their own particular lines that they do not know themselves. This may be true, in part, but the machine and engineering trades cover an immense range, and it is impossible for any one man to work at all the branches! Life is too short; but it must be, and is, advantageous, to have a good general knowledge of all branches of the business. It is as true now as ever, that "knowledge is power." Circumstances over which he has no control often change the whole course of a mechanic's life, and he is pretty sure to find himself sometime in a position in which a little knowledge outside of his own specialty would do him a deal of good. The machinist who has traveled, knows that foremen of machine shops, like most other people, go a good deal by appearances. If you go into a shop and show yourself strange to the work done there, you will feel it in your pocket when the pay day comes round! Most men are sure to be a little awkward among strange surroundings, and on work that is new to them, but they should be able to hide this feeling, and make it appear that it is just the sort of work they have been always used to. This they can do easily, if they have read up trade matters judiciously, for they cannot then be entirely ignorant of any class of work. After they get used to the shop, they can show what they really are. This is a long digression from the subject we are engaged on, [A very sensible one, though—EDS.] but I think I am justified in making it, as this die work may be a little tedious to some readers.

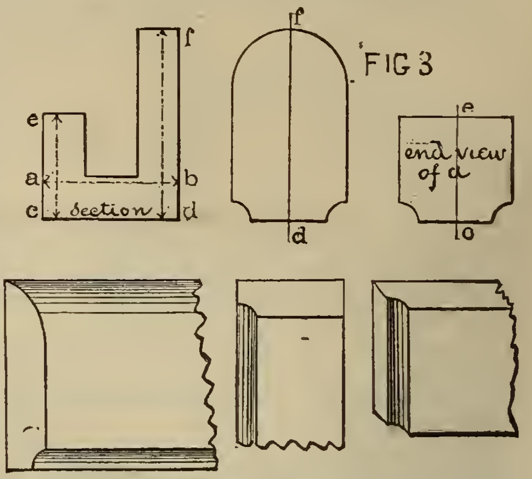


The next forging we will make is a tension stand for an Elias Howe sewing machine, see sketch. This is a very difficult one to sink. It is of the same class as our last one, in that it has to be made in two dies; that is, one half the forging in each die, and also that machine tools cannot be used with any positive advantage. Before he reads any further, the tyro should think how he would make it, if left to himself, and see if he could strike the same methods that are used in practice. As in our last subject, we draw a centre line around it, in the manner shown in the sketch, for we must put one half in each die-block, and put two impressions of the forging in each block, for the same reason that we did in the last article. It will be seen that we require forces for these dies, one for the top half, the other for the bottom. These forces, top and bottom, must be exactly alike, except that one will be right handed and the other left-handed. This may seem strange, but it will be clear after a moment's consideration; it is for the same reason that letter cutters make figures, or letters read from right to left, or the opposite direction to which they read when transferred. We will have to make templates also, but I need not touch on that subject again until we come to some other shape in which it will be necessary to illustrate them; the same general principles upon which we made templates before, will answer for this; but I will illustrate the outline template with which we lay out the dies, as it will be necessary for reference on one or two points.

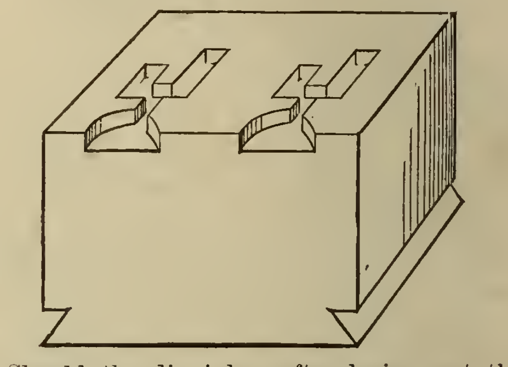


OUTLINE TEMPLATE; SOLID FORCES ARE MADE FROM THIS.

Here it is in this sketch, the two outlines on it must be at the same distance from the centre, as I pointed out in the last article. I have said we will use two forces, but there is another way (it is not the right one for this forging, but it is good to know sometimes how a job should *not* be done), which works well in some cases when there is a forging to be made for which there will not be sufficient demand to justify the expense of making proper forces. This way is to make the force in three pieces, as shown in fig. 3, where the letters indicate the parts the forces are used upon; one for the long side, one for the short side; the third represents the bottom of the forging, fig. 1, and has the fillet shown there, made on it. It should be clear that these can be used in either the top or bottom die, and doing away with the necessity of making right and left hand forces. The method is not reliable. I do not advocate its use except in combination with solid forces, when they are of great advantage, especially the one that has the fillet on it. There are some shapes of forgings, in which it is absolutely necessary to have the forces made in pieces, but this is not one of them. We will come to them by and bye.



We will suppose we have our die-blocks planed up ready for sinking; we then draw center lines across them as usual, then place the template on the bottom die first (there should be center lines on each side of this template), with the center line coinciding with the line on the block, scribe round the outline as usual, then put the template on the top die, but place it upside down, have the center line in proper position and scribe the outlines; this will reverse the outlines; see sketches.



Should the die-sinker after laying out the bottom die, inadvertently place the template on the top die with the same side up, the dies would of course be laid out the same way, and he might go on working, get interested in sinking them (the dies) and never discover his error until they were finished; then it would be a hard matter to find words strong enough to express his feelings. This has often occurred, but, strange to say, not with beginners; they are generally warned and are careful at first, but with old hands that have great confidence in themselves and know all about it. It never happens to the same man twice.

Now we put the die in the cutting block, and mark round the scribed outline with keen chisels, holding them perfectly upright, and tapping lightly with a hammer; then cut out that part of the die marked on the template *a*, *b*, *d*. This can best be done by taking a narrow cape chisel, about $\frac{1}{8}$th, or even less, and cutting two grooves from *a*, *b*, *d*. Then take a flat chisel of suitable width, and remove the piece that will be left between the first two cuts. Keep repeating this process, alternately using the capes and flats, and you will make rapid progress. After a while, as you go deeper, it will become more difficult to sink. When we bear in mind that this forging is only one inch at its longest part (which is the part we are cutting), and that it is $\frac{3}{4}$ in. thick, each die to be $\frac{3}{8}$ in deep, and that it is only $\frac{3}{8}$th wide at this place, narrowed down to $\frac{3}{16}$ths near the bottom, by the fillet on the forging, it will be seen that we have a confined space to work in, so we must be careful not to injure the edges of the die by letting any part of the chisel strike them. As we get deeper there is more danger of this, so we must modify the shapes of our chisels to accommodate the work. As we are getting near the end of this article, it will be better not to dwell upon this subject. In another article I will describe and illustrate a few simple shapes, which I found of great advantage in practice. There may not be anything novel about them to some, but as I have seen many good die-sinkers that did not know them, or if they did, did not use them, I am inclined to think some of them are original.

THE HAVOC OF A SINGLE "GREEN SEA".

The last voyage of the *Alaska* S.S., was a memorable one; the havoc caused by a single sea that came on board is graphically narrated by an officer as follows:—

"By Wednesday afternoon a terrific gale had set in from the west, and the ship's engines were slowed up, so that we had only just enough power keep to us head on to the sea. Wave after wave rolled over the deck as night set in; everything was made ready for the worst kind of a tempest. At midnight the storm became perfectly awful in its wildness. The climax occurred about two o'clock Thursday morning. The ship was ploughing through the water heavily, when suddenly a cross sea struck us on the starboard side. It lasted only about a minute; but, what a minute! The great wave split in two, and one section of it carried away the oaken door of the purser's room. as though it were made of paper. The purser lay in bed asleep. Before he could realize what was the matter he found himself struggling in the icy sea which filled his room to the ceiling. As the water receded he was thrown violently against the jamb of the door and sucked across the deck against the ship's railing. This alone saved his life. Being in his night dress he was chilled to the bone, and when he crept into his room again. he found that the sea had broken into the locker and desk and washed everything movable out of the apartment. Strangely enough, the door of the steward's room, which was immediately adjoining, escaped harm. The baker was asleep in his room at the time and had a similar experience. His door was demolished, and he was churned about by the water, until he was almost unconscious.

A section of the wave broke through the door of the butcher's berthroom, and the poor fellow was lifted out of bed in his night clothes by the water, and, with a single movement, washed through the entrance against the iron railing opposite with sufficient force to bruise him severely about the body and limbs. He was stunned but had sufficient presence of mind to seize the railing and hold on for dear life. At one time he was almost smothered. When the water ran off the deck, the butcher found that the interior of his sleeping room was ravaged terribly, most of the movables being gone or torn into splinters.

An examination showed that the wave which caused so much damage, had actually stripped heavy panels out of the wall of the deck house and broken articles of enormous strength."

The appearance of the Alaska showed that the officer's statement was not exaggerated. The woodwork of the starboard side was destroyed in a number of places, and the three doors of unpainted wood, which had been hastily improvised gave the vessel the appearance of a combatant in a naval battle.

PUMPING ENGINES.

The best Cornish engines give a duty of 80 millions. It is said that one engine attained a duty of 112 millions, but this is problematical; and the engine split its cylinder after being a few months at work, and the experiment of working a Cornish engine with a five-fold expansion was never repeated. A duty of 80 millions represents 714,285 lb. raised 1 ft. high by a pound of coal, and is equivalent to about 3lb. of coal per horsepower per hour indicated. This performance has only been excelled by a few exceptionally fine rotative engines, and the average performance of such machines does not exceed by much that of the Cornish engine. A duty of 90 millions will represent the best that has been done by all but a very few rotative and differential engines.

The hyperbolic logarithm of the number which represents a given ratio of expansion may be taken to represent the extra work got out of a pound of steam by expanding it instead of working at full stroke. Now, the hyperbolic log. of the ratio of expansion in the most economical Cornish engine is ·6931—that is to say, if the steam were worked without expansion its efficiency would be 1, but expanded three times its efficiency becomes 1·693; but the hyperbolic logarithm of the ratio of expansion in the best rotative engines is 2·0794. Thus, the performance of 1 lb. of steam unexpanded being 1, if it is expanded eight-fold its performance becomes 3.0794. Thus if the duty of the Cornish engine was 80 millions that of the rotative engine should be 160 millions, whereas it is nothing of the kind.

Because of cylinder condensation the full advantage can never be obtained from expansion; but in the Cornish engine there is less cylinder condensation than in any other engine, * * * * * * In the Cornish engine one side of the piston and one end of the cylinder never have any communication with the condenser, and so its cooling influence is cut off. It is worth considering whether a considerable advantage might not be obtained from making a compound engine, say, of the differential type, with three cylinders, one high-pressure, the other two low-pressure, these last being single-acting Cornish engines in the full sense of the word. No doubt, a very considerable advantage might be gained by compounding ordinary Cornish engines.—*London Engineer.*

FRICTION OF PARTS.

An eminent English physicist, says: "It appears that the amount of friction which has to be overcome in maintaining the motion of reciprocation of a particular piece of a machine controlled, as by a crank, is not, as in the case of rotation, a quantity depending merely on the weight, manner of support, and motion of the reciprocating piece, but depends essentially on the forces which the reciprocating part is transmitting during its motion; and in general diminishes as these forces increase up to a certain point, when it vanishes.

"To take an illustration—in an ordinary steam engine doing full work it can be shown that the friction resulting purely from the motion being reciprocating is zero; but if the load be taken off the engine and the governors act so as to control the speed, the friction due to reciprocation will rise, and will reach a maximum when the engine is doing no work except driving itself.

The same would be to a certain extent the case in a crank-driven reciprocating dynamo. When moving unexcited, *i. e.*, with the circuit open or doing no work, the resistance from the friction entailed by the reciprocating motion would be a maximum. When, by closing the circuit, resistance was thrown on to the machine, the work spent in friction from reciprocation would diminish, but it could not altogether vanish. In order that it might vanish altogether, the resistances encountered towards the end of the stroke must bear a certain relation to the weight and velocity, or more correctly, to the energy of motion, of the reciprocating part, and this relation cannot be reached under the circumstances of the practical dynamo, in which the energy of motion of the reciprocating piece bears a much greater proportion to the work done than in the steam engine, and in which the resistances fall off at the end of the stroke. Thus, while in the steam engine the lightness of the piston compared to the pressure which the steam exerts upon it at the commencement of the stroke, allows of its being driven at convenient speeds without entailing—when doing work—any extra friction from the reciprocation; in the dynamo, owing to the smallness of the resistance at the ends of the stroke compared with the weight of the reciprocating piece and the high speed required to develop the power, the friction entailed by reciprocation would be large.

In this comparison both machines are supposed to be controlled by the crank. The friction under such circumstances is not at all the same as when the reciprocating piece is controlled in other ways, as by a spring."

WHY MAN CANNOT FLY.

It is generally assumed that because birds can fly men ought to be able to fly. The operations effected by the bird are just as mechanical as those of the man who walks on dry land or swims in the sea. If only we could perceive precisely what it is a bird's wings do, then we could fly. Now this seems to us to be a very specious and shallow argument. It is not probable that there is anything occult, or mysterious, about the action of a bird's wing.

If there is nothing mysterious about wing motion, and a simple up and down flapping will at least suffice to raise a bird in the air, why should not men fly? The answer is that they are not strong enough. If we consider birds as machines, we see that they are all comparatively small. There is no bird of flight which weighs as much as a very light man; but there are many birds which are far stronger than men. The albatross, is, we believe, the largest—not the heaviest—bird of flight in existence. Its wings measure sometimes as much as 13ft. from tip to tip, but the total weight of the bird seldom if ever exceeds 28 lb., or one-sixth that of a powerful man. But the albatross can keep its wings in motion for a whole day, while the strongest man would be exhausted if he had to keep beating the air with them for half an hour. There are many birds with limited or no powers of flying which weigh much more; but we shall not be far wrong if we say that the maximum weight of any natural flying machine, which can fly well, does not exceed, say, 30 lb. Now this is a very important truth, because it goes to show that that is about the limit of weight beyond which the air cannot be utilized for bird flight.

We may rest certain that the roc of Eastern story is a mechanically impossible creature. The reason why huge birds do not exist is this: It is well known that the strength of every machine rapidly decreases as it increases in dimensions. Thus, for example, the crank-shaft and other parts of a model steam engine, if all made to scale, are immensely stronger than would be those of a similar engine made with the same proportions, and, say, twelve times the size. Let us apply this to the albatross. and suppose that its wing, instead of being some 6ft. long, was 12ft. long. All the bones being doubled in length would be doubled in weight; but they would also have to be at least doubled in strength, which represents another duplication; so that an albatross with a spread of wing of 26ft. instead of 13ft. must weigh, not 28 lb., but four times as much, or 112 lb. at the very least. Nor would the augmentation stop here, for the area of the wing would have to be altered. Merely to double its length would not suffice; its breadth must, *cæteris paribus*, also be doubled, and thus we have four times the area; but this would again double the strength or weight of the bones, and a very little calculation will suffice to show that a bird with a spread of wing of 28ft. could not weigh less than 2 cwt., instead of 28 lb. Next comes the question, is it possible to get as much power in proportion out of 2 cwt. as we can out of 28 lb?

A great deal has been written from time to time about the effect of the wind on inclined planes in keeping birds afloat in the air. Those who have a knowledge of the laws of dynamics are, however, aware that the inclined plane action cannot alone keep a bird from falling to the ground. The action is at best just that of the wind on a kite; and the equivalent of the string must be provided or the bird will be carried away, just as a kite is when the string breaks. Birds, when sailing, are either going with the wind or are using up momentum acquired by previous rapid motion. The work done by the bird will vary continually; but it is strictly analogous to that of a swimmer, who, carrying a load, has to keep himself afloat by his own exertions. There is no way out of this. Nothing is got from the air in the way of help, save when upward currents strike the flying bird; and that such currents exist, every engineer who has seen the decking of a bridge lifted in a gale well knows. Returning then to our albatross, the work it does is equivalent to continually lifting 28 lb. The idea that the bird is buoyant in the air is a delusion. If it weighs dead 28 lb., it will weigh living 28 lb., and the variation in the displacement of the dead and living bird cannot represent more, at the most, than an ounce. In round numbers, 13 cubic feet of air weigh 1 lb. The albatross therefore represents no less than 13 × 28=364 cubic feet of air, while its entire displacement is probably at most 4 cubic feet. An increase in dimensions of one-fourth when alive, as compared with the same bird dead would represent about $\frac{1}{360}$ of its weight saved by extra buoyancy, which is nothing. The weight of the bird then may be regarded in exactly the same light as the weight on a brake driven by a portable engine. The brake-wheel is always trying to lift it up. The power expended is measured by the distance passed over by any point in the rim of the brake wheel in one minute, multiplied by the weight and divided by 33,000 per horse-power. Now, if we could tell the distance passed over by the bird's wings at each stroke, and the number of them, we should, knowing its weight, be able to estimate the power expended. We cannot do this in the case of the condor or albatross; but bearing in mind the small specific gravity of air, we shall not be very far wide of the mark if we say that an albatross probably possesses as much muscular energy as a man.

The utmost load that a man working at a crane cradle can put forth for a day's work is 20 lb. at a crank handle making about 3ft. per second; and nearly all the muscles of the body are engaged in this work. It will be seen that if even half this work is got out of the very much smaller muscles of the albatross, the energy of the muscles—on whatever it depends—must be very much greater than it is in man. The pectoral muscles of the swallow weigh much more than all the other muscles in its body put together, and in all birds which fly well, it will be found that the muscles actuating the wings are relatively enormous in dimensions. But not only is this the case; the bird works at a higher pressure, if we may use the words, than any other animal. Its temperature is considerably above 98°, that of man and the mammalia generally; and all the swift birds live on food capable of giving out much energy while concentrated as to dimensions. In other words, we have in the bird a machine burning concentrated fuel in a large grate at a tremendous rate, and developing a very large power in a small space. There is no engine in existence, certainly no steam engine and boiler combined, which weight for weight, gives out anything like the mechanical power exhibited by the albatross.

It is simply for lack of muscular power that man can never fly. Whether he can produce a machine to supplement his own want of force remains to be seen. Such a motor cannot, we think, be driven by steam. It is, however, not impossible that a machine might be made which would be caused to fly by means of a small electric motor run at a very high speed and worked by the aid of a couple of wires from the ground. This, however, would hardly be flying in the true sense of the word. When a machine can be made, each pound of which will develop as much energy as each pound of a bird, flying may be possible—not till then.—*London Engineer.*

FINE SHELLAC VARNISH.

Shellac in one of its many shapes forms the foundation upon which the varnish is built. Shellac, under its various names, indicative of its color, is only another form of the so-called "seed lac," and also of stick lac. Some recipes give most absurd instructions as to the proportion of the various forms of resin to be used.

Stick lac is simply the twig incrusted by the lac insect with the peculiar substance it produces.

Seed lac is the incrustation removed, in which state it presents the appearance of small seed; and shellac is the purified seed lac melted, strained, and placed on large cylinders or slabs to harden, from which the resin is chipped or shelled off as "shel-lac."

Shellac is found in a variety of shades of brown, from pale "orange," to deep garnet or ruby. For our purpose the finest "pale orange" shellac should be purchased, and when varnish is likely to be made in quantity, samples must be obtained so as to purchase where the palest sample came from. Another consideration is to see that the pieces are as clean as possible.

A solution of a shellac in methylated spirit forms the basis of our varnish, and a simple varnish so made will answer for all rough work, but where delicate results are wanted it must be paler in color, and for this purpose we use "bleached shellac."

Bleached shellac dissolved in spirit also makes an excellent varnish; but it is not nearly so hard and tenacious as that from the orange shellac.

White shellac is made by dissolving ordinary shellac in caustic alkali, and then treating the solution with chlorine, which at one and the same time decolorizes and precipitates it. This process, though it produces a pale resin of great value for many economical purposes, causes the resin to lose many of those properties that specially fit orange lac for use in photograph varnish. One of the peculiarities of white lac varnish is the frequency with which it dries into a multitude of fine ridges, which no rocking of the work to and fro, during draining and drying, will prevent. But for paleness of color in the coating nothing can be better; and in a mixture of the two resins—that is, the bleached and the unbleached—the objectionable qualities of either seem either covered or greatly reduced.

Experimenters with "bleached," or, as it is often called, "white lac," must know that unless it be properly stored it practically loses its solubility in spirit of wine. We know of many cases of failure in varnish-making caused through the purchaser being supplied with a sample that had become insoluble. In the case of white lac, where the experimenter is ignorant of the appearance it should present, he can easily test a small quantity, if he have any doubt. It should be crushed or pounded into small pieces before adding to the spirit, as even in the best samples a large proportion entirely insoluble, always exists, and a clear solution must not be expected. Its solubility or the reverse is soon discovered by noticing whether the small particles begin to disintegrate, as it were, or retain their sharp outlines. A good indication of insolubility is the outer layer of the round pieces, or sticks, turning semi-transparent. The plan usually adopted to prevent this change taking place is to keep the bleached lac in the dark and covered with water, when, if it remain so covered, it will retain its solubility in spirit for a lengthened period.

The third and last ingredient in this varnish, is "sandarac gum." It is well known by varnish makers that when gums and resins are mixed and "blended" by solution, the character of this solution, or varnish, is not an average of the characters of the gums taken separately, and such is the case with sandarac.

This gum by itself gives a varnish that is useless from its brittleness, but when added to shellac varnish it confers a portion of its own quality of brightness of surface, which it possesses in a high degree, but does not, in moderate quantity, tend to make it "rotten."

The formula for a varnish devised on the principles above enunciated is as follows:

Palest orange shellac	2¾ ounces.
Bleached lac	5½ "
Gum sandarac	½ ounce.
Methylated spirit	1 quart.

Bruise the bleached lac till reduced to small pieces. Powder the sandarac, and then add the whole to the spirit, putting in a few small pieces of glass to prevent the shellac caking at the bottom of the jar; stir or shake the whole from time to time, till it is evident that the solution is complete. All that is then necessary is to set it aside to clear, pour off the clear fluid, and filter the rest. It is best to allow a month or two for subsidence, for the insoluble part occupies so large a space that much waste, through evaporation, is caused if an unnecessary large quantity be passed through the filter.—*British Journal of Photography,*

It is a fact not generally known that stamped envelopes, when spoiled through misdirection or other causes, can be exchanged for a postage stamp of the same denomination at the nearest post office.

NATIONAL EXPOSITION OF RAILWAY APPLIANCES.

At the moment of going to press, we receive advices that an exposition will be held in Chicago, May 24 to June 23. Among the other features will be a full collection of all articles pertaining to railway building, which shall represent, by contrast, the improvements made in the past fifty years. Some railways could come out strong in this line!

The most ardent co-operation has been manifested, and we have no doubt but that the exposition will be a great success. Persons needing information as to space, and all other details, should write to E. H. Talbot, Esq., Sec., Nat. Railway Appliances, Grand Pacific Hotel, Chicago, Ill.

AMERICAN CHILLED ROLLS THE BEST.

A correspondent writes to a foreign contemporary: "It is quite true that English paper-makers are compelled to go to America for the best chilled rolls, although this course involves a greater expenditure of time and money than the purchase of English rolls. Some Scotch and Lancashire firms profess to supply first-class chilled rolls, but experience has not yet gained them sufficient confidence to supersede those from the United States, when and where the greatest economy is required. 'Cheap and nasty' spells ruination in the paper trade."

English milling engineers are introducing square rope belts, which are said to be very suitable for transferring power. They are made in strips with "step" joints, screwed together; the sides of the rope leaving the pulley groove without loss of power.

It is stated that a 1½ inch rope, at 4,000 feet a minute, has driven over 100 horse-power.

OUR CLUB LIST.

To new subscribers who wish to take THE MECHANICAL ENGINEER in connection with other papers, we are enabled to offer the following publications; the publishers of which also make reductions from their regular rates.

The rates named cover both publications for one year:

THE MECHANICAL ENGINEER and *Scientific American*, together one year	$4.36
Railroad Gazette, together one year	5 30
American Miller, " "	2.25
North-Western Miller, " "	3.00
Railway Review, " "	3.90
Builder and Woodworker	2.25

MARKET REPORTS.

By request of many manufacturers in various parts of the country, we renew our publication of market reports of metals and engineers' goods, which was dropped some months ago, it being found a great convenience.

These quotations are made by the houses represented, who alone are responsible for the statements. While every effort will be made to insure strict accuracy, we disclaim any liability that may arise from changes without notice or typographic errors.

John W. Quincy & Co. quote, Jan. 30th, Commercial Pig Iron:

Number 1x	$25@$26	
Number 2x	$23@$24	
English Foundry	$22 @	
Scotch Number 1	$22 @$25	
Lake Copper	18¼@18½	cts.
Arizona Copper	17½@	"
Baltimore	17 @18⅜	"
Tin	21½@	"
Spelter	5 @ 6½	"
Antimony	10⅝@	"
Babbitt Metal	8 @25	"

American Tube Works quote:

BRASS TUBES (solid drawn).

Per pound, $\frac{3}{8}$, 50c.; $\frac{9}{16}$, 45c.; $\frac{11}{16}$, 40c.; $\frac{13}{16}$, 40.; $1\frac{1}{1}$, 35c.; $1\frac{5}{16}$, 30c. Same price to $3\frac{1}{2}$ diam. Copper tubes for above sizes respectively, 63c., 58c., 53c. 48c., 43c , 38c., for $1\frac{5}{8}$, and same price up to $3\frac{1}{2}''$ diam. Special price for large orders.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, etc., engraved in a superior manner. Finished castings at reasonable prices. JOHN BECKER, 28 Oliver Street, Boston, Mass.

PATTERN LETTERS FOR MOULDERS, Brand Letters, etc. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets. New York. Send for price-list and catalogue.

"HOW TO KEEP BOILERS CLEAN," and other valuable information for Engineers and Steam Users. Book of sixty-four pages published by James F. Hotchkiss, 84 John Street, New York. Mailed free to any address.

A THOROUGHLY CAPABLE mechanical engineer, understanding the use of the dynamometer and indicator, and expert tests of all kinds, is open to an engagment, remote or near by. Has been and is now, in charge of large Works, but desires change. Address: Siphon Gauge, care Mechanical Engineer, 150 Nassau Street, N. Y.

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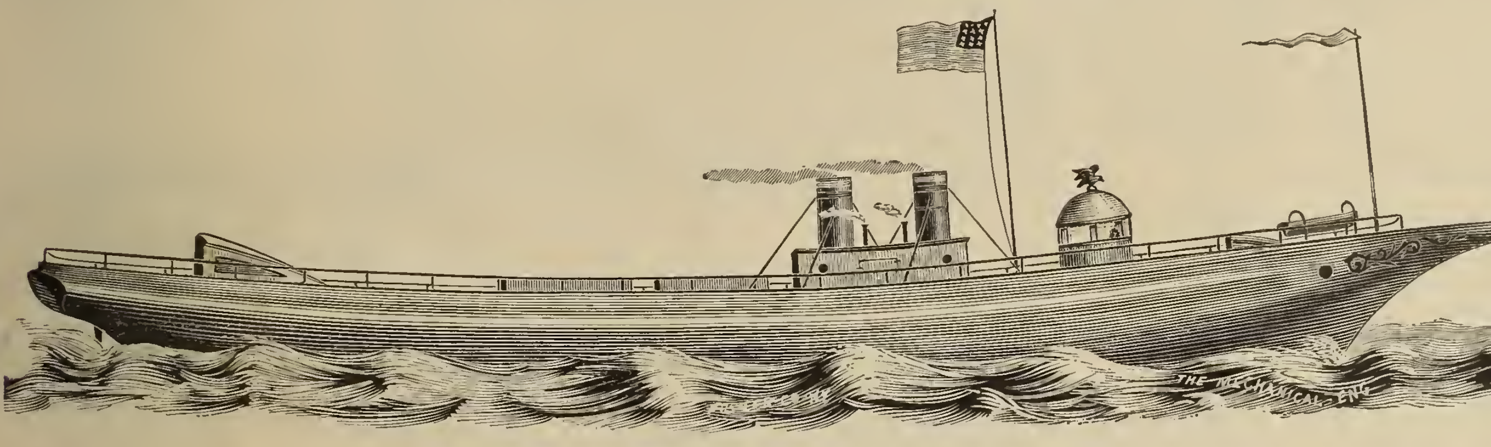
New York: J. W. Weekes & Co., Printers, 25 Beekman St,

THE MECHANICAL ENGINEER.

New Series. Vol. V.—No. 5. Enlarged, 1883.
New York, March 3, 1883.
Single Copies, 8 Cents
$2.00 per Annum.

THE METEOR—THE STEAMER INTENDED TO GO TO EUROPE IN FIVE DAYS.

We are pleased to be the first to lay before our readers, and the public in general, an engraving of this vessel, and also a sketch of the engines, as they appear at the present writing. In explanation of the want of more exact details in the engine we have to say that positive information, or indeed any information whatever, was repeatedly refused by the proprietors. Feeling that our readers would be pleased to know something of the vessel, and her motive power, we took our own measures for obtaining the facts in the case. So far as they go they are correct.

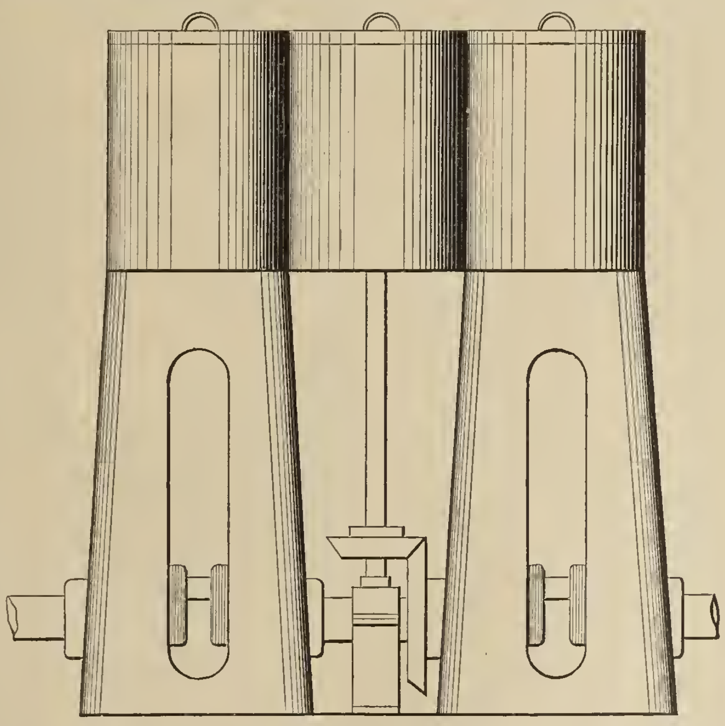


THE METEOR—THE STEAMER INTENDED TO GO TO EUROPE IN FIVE DAYS.

The *Meteor* is a wooden vessel, very handsomely modeled, and externally, as shown in the engraving, she has very fine lines and her top sides "tumble home" in a marked degree, and to an extent that cannot be shown in so small an engraving. She has a flush deck fore and aft, and no structures rise above it save the smoke-stacks, boiler casing, and pilot house. A sea might sweep her from end to end without damage. She is in fact a steam life-boat, so far as stability and staunchness is concerned.

In dimensions the *Meteor* is 156 feet in length, 19 feet 6 inches on the water line, in breadth, and depth—not stated. She carries two flag-staffs only, no other rigging being above deck.

The pilot-house is a circular structure of mahogany, very strongly built, with the upper portion glazed all round except the extreme apex of the dome. The funnels are two in number, fore and aft the vessel, and surmounted by red, white, and blue bands, alternating. The engines are not yet completed, parts of them being still in the shop. The cylinders and frames are in place, however, and the general design is well shown in the sketch. There are two engines, fore and aft, compounded, with the high pressure cylinder inside the low pressure. The latter is twenty inches diameter, and the high pressure nine and a half inches, by twenty inches stroke. This plan of construction makes the low pressure piston a ring only, with two piston rods on opposite sides; the high pressure piston rod, and connecting rod, being in the middle, as usual; the low pressure piston having two connecting rods.



The valve gearing is peculiar, the valve making a complete revolution in the chest or receiver, between the two cylinders. It is driven by bevel-gears, as shown, and apparently serves both cylinders at the same time. We judge this to be the case, for the reason that there are sixteen steam openings in the chest, which would hardly be needed unless all four cylinders were supplied from the same chest. We regret that our information as to these details is so limited, but as there were no drawings at hand and no information was vouchsafed, we took what we could see.

The boilers are peculiar, and these we can give no description of, except that they are made of four-inch lap-welded tube, something on the plan of a coil boiler, the arrangement is so complicated that a mere verbal explanation would be of no value. Water circulates through these tubes or coils, the working pressure being about 300 pounds to the square inch.

The propeller wheel is 10 feet diameter by 10 feet pitch, and it is intended to drive it at about 300 revolutions per minute.

We hope the *Meteor* will achieve all that her designers and projectors expect.

By an error of the draughtsman the gears are of different diameters. They should be the same.

The Brotherhood of Locomotive Engineers has now 205 divisions and 12,000 members, against 150 divisions and 7,000 members in 1877; 32 new divisions were organized in 1882, and 10 this year. The organization now extends from Sprague, W. T., down to the coast through the entire region of California and Arizona. There are two lodges in Arizona and one in New Mexico. Last season in Nova Scotia the railway officials endeavored to crush the brotherhood by discharging all engineers who joined. When this fact was brought to the attention of the Prime Minister, and Minister of Railroads, the company was immediately ordered to reinstate the discharged men, and pay them for the time they had lost by reason of the removal.

What is perhaps the largest engine lathe ever built, to turn work between centres, has recently been completed in England. The height of the centres above the bed is 5 feet, so that 10 feet diameter can be turned with the lathe. The face-plate is 10 feet 4 inches in diameter. The bed is 9 feet wide, and is 34 feet between the centres. There are two saddles, each with compound slide-rests, back and front, and having self-acting motions in all directions. The total weight is about 90 tons.

"I predict that the day is not far distant when locomotive boiler pressures will be common at 200 pounds per square inch, and independent cut-off valves will be in general use. The results will be that the consumption of fuel per train per mile will not exceed 25 pounds, in place of 50 pounds, as now used in our fast express locomotives."

Mr. Le Van, the writer of the above, is quite safe in his prediction, for, so far as fuel is concerned, the quantity named has been reached some time ago in England.

Under any circumstances, says the *Photographic News*, it is a difficult business to photograph a machine effectively; and little success is likely to ensue, unless the whole is first covered with a grey paint or wash. One of the best in use by photographers is the following: Dry white lead, 5lb.; lamp-black, 2oz. to 5oz.; gold size, 1 pint; turpentine, 1½ pints. The amount of lamp-black is varied according as a light grey or dark grey is best suited to the machine or the lighting. The paint is quite harmless, and is easily removed with turpentine rubbed on with a handful of cotton waste.

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THE MECHANICAL ENGINEER begins the new year with substantial evidence of prosperity. Its recent enlargement, together with its handsome typography, well edited reading matter and numerous illustrations makes it one of the most attractive publications of its class. It should be in the hands of all practical mechanics.—*National Car Builder.*

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American cider is largely exported to England.

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HARD BRONZE OF THE ANCIENTS.

Ludwig has made a number of analyses of ancient bronze implements, of great hardness, with the following results:—

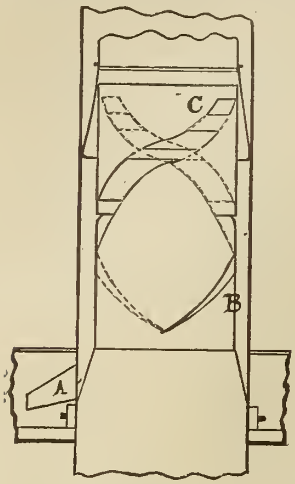
	Copper.	Tin.	Nickel.	Iron.	Phosphorus.
(1.)	87·25	13·08	0·38	trace	0·250
(2.)	83·65	15·99	0·63	"	0·540
(3.)	85·05	14·38	trace	"	0·106
(4.)	88·06	11·76	"	"	0·027

Specimen No. 1 was a fragment of an axe from Maiersdorf. The metal was tenacious, and bright yellow; hardness equal to that of apatite (5). No. 2, an axe from Linburg; reddish golden-yellow; tenacious, and hardly scratched by feldspar (6). No. 3, fragment of a sword from Steier; the metal was reddish-yellow, solid and tenacious, and not easily scratched by quartz (7). No. 4, a chisel from Peschiera; deep yellow, and containing a trace of cobalt; hardness, 5. Neither zinc nor lead were found in any of the specimens.

A PECULIAR SMOKE STACK.

Our sketch shows a plan for a smoke stack recently introduced in England. It is simply the ordinary stack with scrolls inside, as shown at *C*. These it appears are so efficient that a boiler of comparatively small size, for a given engine answers. That is to say, the efficiency of any given boiler is improved by having scrolls inside, a proposition to which, individually, we do not subscribe. It is reasonable to assume that the velocity of the gases through a smoke pipe is comparatively low. In other words the pressure is light; anything, therefore, that creates an obstruction to the flue, and tends to drive the smoke in tortuous channels seems to us a mistake.

A good certificate, or recommendation to the contrary, however, sometimes has its effect.



SOME THINGS ABOUT SAWS.

When one not acquainted with the business stands in a mill and sees a large sixty-inch saw go tearing through a great pine log, and cut after cut is made seemingly without the least trouble as the logs are rolled on to the carriage and the boards or timber is taken away from the tail end, he says to himself, "What a simple thing it is to run a saw, and what a small amount of care there is to do what a sawyer does." But let him change places with the man that has the care of either the great bright sixty-inch saw, or the twelve-inch one that goes with little noise through small work, or the more common saw that cuts the less particular work, for molding machine or matcher, and before he has been there long he finds lots of trouble and many hard places. Yet, after all, there is one general rule that governs the whole of saws and sawing.

First of all is a perfectly straight plate. That is the foundation of all good work with any kind of a saw. If the plate is crooked or sprung in the least, there is trouble sooner or later, and no setting or filing can ever remedy the defect of a warped saw plate. Taking it for granted that the plate *is* perfectly true, the next thing is to have a saw as near round as possible, for a saw that is not round will buckle if it is driven hard, because one side does not cut and the other side takes the whole strain, and, unless it is thicker than it ought to be, will buckle from the unequal strain that is put on it. This acts the same on both large and small saws, but especially so on large thin saws. A saw from 20 to 28 inches running in a table without guide pins is apt to get out of round, and sometimes will run both ways, or one piece will bind in the gauge and the very next one, perhaps, will draw away from it. A great many are puzzled to see a saw bind in one cut and run free in another, but if they would joint their saw round, and square across, everything else being right, a saw will run easy every time alike, unless it gets a little too warm in the centre. Great care should be taken to joint a saw perfectly square across, so it will draw both sides alike, for if one side is longer than the other it will draw off on the longest side. No matter how perfect everthing else may be, no filing will make a saw run well if it is not jointed square across, and no saw will run well if it is not filed well.

Every tooth should be filed just alike, and whether filed fleaming or square, every tooth should be just alike. This applies to saws of all sizes, for the conditions govern the whole of sawing. Every different user of small saws has a very decided opinion of his own about his ways of filing, but there is only one opinion about having every tooth alike. No one can ever make a good smooth cut with any saw if one tooth is filed straight up and the next one to it is very hooking, and the next one to that is half way between the two others, no two teeth being filed alike. The custom in a great many places is to keep the saw sharp, and many think that if a saw is only sharp, no matter what the shape of the tooth may be, it is bound to cut. I am not fully convinced in my own mind which is the *very best* way of filing small saws for light *clean* work, for I see every day saws from 10 to 18 inches in diameter filed very fleaming, and cutting almost as smooth as can be planed; and I also see saws from 18 to 60 inches filed as square as possible, and still cutting very nicely. One thing I am very sure of, however, and that is, a rip saw will cut very much easier filed perfectly square. If any one doubts this, let him take saws filed both ways, and use them in a machine run by hand-power.

In filing a saw begin at the bottom of the tooth and work up to the point, so the pitch of the tooth shall always be kept the same. There is no use to sharpen the point of the tooth and work down to the base, for if you do your teeth will be out of shape in no time, and then your saw will go anywhere only right. I find the great trouble with many using bench saws is, if they bind in the gauge, to drive the piece through, if possible. Nothing can be more foolish, for the very best saw made may be spoiled in just one cut, for it bends it right over on the collar, and it works just like spinning a piece of metal. The saw is hot just above the collar, and consequently a trifle softer, and it stretches from this point out to the rim, not making it dishing to the eye, but only to the collar. There are but very few men that run bench saws that ever ought to see a saw from this very fact that they use no kind of reason. If a saw goes well, all right, but if there is any trouble they call it hard names, instead of fixing it as they ought to do, when it would work well without calling it any hard names. More saws are spoiled from carelessness than from hard work.—*J. T. L., in Builder and Woodworker.*

BRAZING BAND SAWS.

Mr. Thomas Fletcher says in *Engineering:* "There appears to be a growing fashion for brazing band saws with gas blow-pipes, and as a maker I am continually being asked for apparatus for this purpose. If gas is once used to braze a band saw its use is continued as a matter of convenience, and after a short time breakages gradually increase in number. As these do not occur exactly at the joint, no blame is attached to the use of gas, and the cause of continual failures is rarely if ever discovered.

It is well known that a gas flame not only scales steel deeply, but also destroys the nature by burning the carbon out, and this occurs especially at the edges of the flame. Band saws brazed by gas almost invariably break again at a point some little distance from the previous fracture, at a point where the outer edge of the flame has damaged the metal. A large proportion of band saw users seem to be puzzled as to the method of repairing easily. The only satisfactory way is to make a thick heavy pair of tongs bright red hot and clamp the joint with them. The heat melts the spelter instantly and makes a good joint without scaling or damaging the steel. For a joint which has to stand constant heavy strains and bending, it is better to use an alloy of equal parts of coin silver and copper, melted together and rolled out thin. This alloy never burns, cannot be overheated, and makes first-rate joints, which will stand hammering and bending to almost any extent.

BRACKET SAWS.

The first bracket saw made in this country was manufactured in 1874, in Massachusetts. The hardware manufacturers made them of wood to the extent of at least 100,000, and then of steel frames, at least 100,000 more. At the opening of the Centennial year foot-power saws were introduced. These consisted of a three-legged frame supporting a table, a drill and a saw working through the table, set in long arms, the lower one of which is in connection with a wheel revolved by the belt of the driving wheel. At first these frames were of wood; but iron castings took their place, and the manufacturers put a good all-iron machine in the market at $2.

As one trade calls into existence and supports another, so the manufacture of the scroll saw has created a demand for saw blades, some of which are less than an ordinary needle in thickness, and with teeth invisible to the eye, and perceptible only to the touch. As a dozen blades are supposed to accompany each of the 200,000 machines already in existence, that would have called for the manufacture of over 200,000,000 blades, and as each sawyer requires them by the dozen, if not gross, owing to their liability to break, the number manufactured is simply amazing. The low price at which they are produced is, however, still more astonishing, considering the work required of them.—*Unknown Exchange.*

NIGHT WATCHMEN AS ENGINEERS.

A Babcock & Wilcox water tube boiler, of 100 horse power, recently had a severe test at the works of the Fuller & Johnson Manufacturing Company, Madison, Wis. Their night watchman was left in charge of the boiler; he allowed the water to run down, and as he found the steam going down increased the fire, and continued to fire with no water in the boiler for about six hours.

The result was the bending of several of the water tubes, three cracked "headers," and a leaky drum. The boiler was repaired in a few days, at an entire cost for material and labor of $130. Although the tubes were bent, none had to be removed, and the only new material needed was three headers to replace those that were cracked. There was no coroner's inquest, with a verdict of "nobody to blame," as there probably would have been if the boiler had been an ordinary flue, or cylinder boiler.—*American Manufacturer.*

GOOD ADVICE.

F. B. Allen in *The Locomotive* gives some good advice, which is worth remembering. He says: "The great advantage of properly located man, and hand-hole openings is their utility. This we think is not always appreciated; sometimes they are regarded as ornamental appendages. We know of exceptional cases in which they had not been removed for a number of years; meanwhile scale had accumulated to a dangerous extent and nearly ruined the boiler, the excuse offered by those in charge being that the joints of the plates were tight and they were afraid to take them off for fear they would leak when put back. With proper care in scraping off the old material from the face of the joint before it is remade, that is when the old gasket cannot be used over again, there should be no trouble.

Do not try excessive screwing up to stop any leak; that is a very dangerous plan, in which many inexperienced or reckless men have lost their lives. Tightening a joint under steam pressure is attended with great danger under any circumstances. When the joint is about the boiler it is doubly so. Under proper conditions ordinary screwing up should give a tight joint; when it does not something is wrong, and what that something is must be determined by examination.

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Artificially seasoned wood, that is, kiln-dried timber, is regarded with disfavor by some.

There is a belief entertained that wood subjected to even less than 250 degrees of heat loses its life. For this reason certain manufacturers will not use kiln-dried lumber, but insist that every piece of wood shall be seasoned in the open air. This opinion, however, is mostly entertained regarding wood that is to endure strain. Whether such heat will injure wood for furniture and finishing purposes is a question of itself.

◆

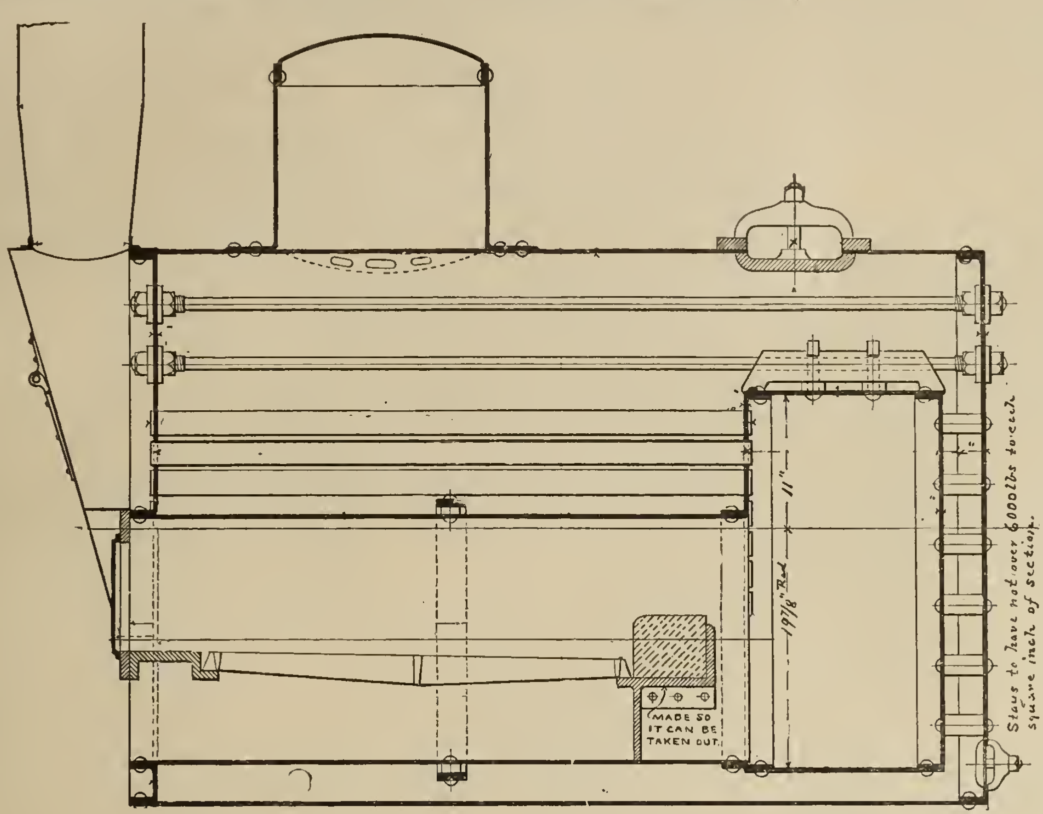
Obviously, the value of patents depends entirely upon the intelligence, care and strictness of their issue; failing as far as they fail in this, they not only defraud those who buy them and invest capital on them as foundation, but stir up litigation.

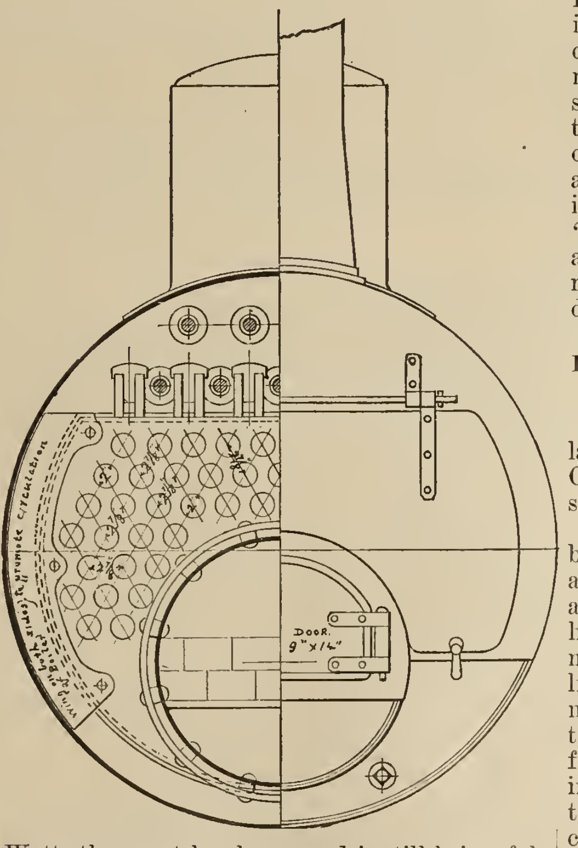
A patent is only the personal certificate of an examiner that the claim possesses patentable novelty, and is new, as far as his knowledge goes.

MARINE BOILER, WITH CIRCULATION DEVICE, BY THE BABCOCK AND WILCOX COMPANY.

An excellent form of boiler which steams well and is uniformly heated is here illustrated. Its efficiency is largely increased by the device for creating circulation of the water. This is shown in the end view, on the left hand side of it, and is merely a plate, projecting at right angles to the shell, as shown, attached to the back connection. This answers so well that no difference in times of heating, is observed between the water on top and that at the bottom.

We are not permitted to give any dimensions of parts of this boiler, and have therefore cut off all dimension marks. The attachment for circulation is not patented.


11"
19 7/8" Rad
Stays to have not over 6000 lbs to each square inch of section.
MADE SO IT CAN BE TAKEN OUT.



SMOKE "BURNING."

It is remarkable that the problems presented have hitherto practically baffled engineers, most probably, because they have tried to do two things at once, namely, save fuel and prevent smoke. It is a mischievous delusion, the propagation of which has done much harm and caused much disappointment, that if only smoke is prevented economy of fuel must follow.

The truth is very nearly the reverse. The mere coal contained in smoke, that is to say, the black dust and soot, is so small in quantity that it does not require a moment's consideration whether it is, or is not, to be burned. The waste is really carbonic oxide, and this may be freely given off from a nearly smokeless fire. As a rule the prevention of smoke is secured by the admission of a great deal of air, and this air all subsequently escapes at a high temperature, representing so much loss of heat. Thus, under proper arrangements about 18 lb. of air will suffice to burn a pound of coal. Some of the smoke consumers admit as much as 30 lb.; say that they admit 10 lb. too much, taking the specific heat of air at 0·23, it follows that the 10 lb. of air, if it escapes at 600 deg., carries off as much heat as would have raised 2·3 lb. of water through 600 deg., or in round numbers, it represents the conversion of considerably over 1 lb. of water into steam. Thus a boiler which was evaporating 7½ lb. of water per pound of coal, may have its furnace so far improved that heat enough will be developed in it to evaporate 8 lb. of water; but inasmuch as extra heat equivalent to the evaporation of 1 lb. of water is absorbed and carried off by the extra air admitted, the boiler will, after the improvements (?) have been effected, and after smoke has been prevented, evaporate but 7 lb. of water per pound of coal. These truths ought to be generally known, but we regret to say that they are persistently overlooked.—*London Engineer.*

RECIPROCATING, VERSUS ROTARY ENGINES.

In the steam engine, although reciprocation has the best of it, the battle has never been given up. This is a case in which simplicity of construction is apparently, at all events, at variance with adaptability to its operation. In some cases, as in pumping engines, the operation involves or admits of reciprocation, and, as is well known, it was to such operations only that the steam engine was confined for about a hundred years after its invention. For these purposes it would naturally seem that the reciprocating motion was most applicable. But so little applicable to move revolving machinery did it appear, that when, after a lapse of a century, Watt improved the engine and saw the importance of applying it to revolving machinery, he kept his improvements waiting for something like ten years while he was attempting to find a revolving substitute for the reciprocating piston. At last he gave up the quest, and found in the crank, or his bastard form of it, a means of applying the reciprocating engine to purposes requiring revolution. But although abandoned by Watt, the quest has been, and is still being followed by others. The apparently obvious advantage of a revolving engine, and the apparent simplicity of the problem, offer so tempting a field for invention, that probably nine out of ten of those who commence practical mechanics engage in it until they find how thoroughly others have been over the ground before them. So the reciprocating engine holds its own in the long practical test. This may be said to be on account of its simplicity of construction, and the adaptability of the reciprocating piston to the operation of taking the work out of the steam; still, nothing approaching to a satisfactory theoretical or scientific explanation of its advantage has been given. Thus the advantage of the reciprocating over the rotary steam engine stands almost entirely as an empirical fact, without explanation, and somewhat in opposition to what has been thought probable, from scientific consideration.—

Prof. Osborne Reynolds.

TEMPEST IN A TEA POT.

Recently some cadets at the Naval academy, Annapolis, undertook to criticise orders posted by the authorities for their observance, on the ground that they were too severe, and not appropriate for "gentlemen" of their calibre.

They say, for instance, that one of Captain Ramsey's first orders was to establish so-called "conduct grades," and these "boys," as Secretary Chandler very properly calls them, have the impudence and arrogance to add:

> "This might answer very well were it applied to blue jackets and marines, but cadets are a different class, being young men possessed of honor and intelligence, and it hardly seems fair that they should be placed on a level with ignorant blue jackets and worthless marines."

If this fairly represents the intelligence of the cadets, the Secretary of the Navy ought to dismiss them from the Academy. Allowance may be made for the silliness of young men who lose their heads because they are allowed to wear a uniform and are paid by the government for going to a good school, but it concerns the discipline of the navy, and its efficiency, that young men whom the government trains for officers should be taught, no matter by what severity, that they are in no way beings of a superior order, who may speak with contempt of "ignorant blue jackets and worthless marines." An intelligent officer respects his men; and these "boys" have a good deal to learn from "ignorant blue jackets" before they are fit to command a ship, or even to do very subordinate duties in one.—*Herald.*

ENGLISH MACHINE-TOOLS FOR AMERICAN RAILROAD SHOPS.

Messrs. Craven & Co., of Manchester, England, have just completed a large order for the Chicago, Milwaukee and St. Paul Railroad, consisting of the following tools:

"A great variety of lathes for turning and boring cranks, eccentrics, and for turning axles at both ends at the same time, crank axle lathes, and quartering machines for boring crank pin holes in the wheel-boss when on the axle. A machine for boring connecting rods and coupling rods at both ends at the same time, drilling machines for tube-plates, and for drilling and tapping the stay holes in the locomotive fire-box frames. A special planing machine for connecting and coupling rods, and another for planing two locomotive cylinders at the same time. A crank axle planing machine for planing the side of the crank sweeps with three tools, a crank axle grooving machine, for grooving both keybeds at the same time, a horizontal face-plate tire and wheel-boring machine, several wheel lathes of large size up to 8 feet, machines for sawing iron cold, a profile milling machine for locomotive motion work. Among slotting machines were several with special arrangements for slotting the steam ports of cylinders, with a special machine for slotting the arms of the reversing shafts."

Our foreign contemporary, from whom we copy this item, must have got things mixed up on some tools. What the C. M. and St. P. R. R. wants of a machine to plane "crank sweeps" is a mystery to us.

* * *

Demarcy found that metals can be volatilized in a vacuum at a low temperature.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

We regret that the late arrival of correspondence renders it impossible to get it in this issue, An exceedingly interesting letter from Prof. J. Burkitt Webb, of Cornell, on "*Stress on Cylinder-Head-Bolts*," will appear in our next, together with very many favors from everywhere in the United States.

FROM AN ENGINE ROOM.

Editors Mechanical Engineer :

I receive The Mechanical Engineer regularly, and read it with great interest, especially the correspondent's department, which I find very instructive, as it gives engineers a chance to ventilate their opinions, and brings up matters for discussion of interest to all of us.

I am a young engineer myself, trying to gain all the knowledge I can. I am at present running a 100 H. P. Corliss engine, and am a member of the Brotherhood of Engineers in this city. Before taking your paper I was a regular subscriber of the ——, but since I began taking your paper I have dropped the other entirely, as yours proved to be just the paper an engineer wants. Without any doubt yours is the best paper of the kind ever published, and all engineers of my acquaintance think the same as I do, and subscribe for it. The enlargement is quite an improvement, as well as the articles on Mechanical Drawing and Pattern-making, in which I am greatly interested

So far you have kept all your promises, and I am sure you will in the future; you are certainly deserving of success, and it will be yours as long as you keep on as you have commenced.

Now, Mr. Editor, don't publish this letter, as I am such a poor writer, and cannot put my thoughts on paper as I want to. I can handle a shovel a great deal better than I can a pen. I wish I could write as some of your correspondents do, but I content myself with reading their letters; and feeling as I did—that some words of praise were due you from me—I took occasion to write this letter.

Mr. Editor, in conclusion, I would say that we engineers in Chicago number a great many men (and good ones too), and I hope the time is not far distant when we may see them all enrolled as members of the Brotherhood.

With kind wishes I remain, C. L. H.
Chicago, Ill.

[Our correspondent has no occasion to apologize for either his writing, or his letter, or his spelling. If the former were left to the opinion of our printer (and Brother Ponsonby of Chicago!) both would say our correspondent's writing is better than our own. We have changed just one word in it; otherwise it is as it was written.

We have disregarded our correspondent's request (but suppressed his name) for the reason that we want all our engine-room friends enrolled as correspondents.

We want the "literature of the engine-room" in our paper; not only for its technical value, but also as a means of encouraging engineers to put their ideas on paper. When a man has anything to say we notice he has no trouble in saying it; he only fancies his writings have no interest for others. Therein he errs, as witness this letter; it interests all of us.

All matters connected with engines and boilers interest those of us who earn our living with them. How much coal is burned for a given engine, what condition the valves are in as to lead, surface, point of cut off, etc., etc.; these, and a thousand other things, if duly chronicled are of positive benefit.

Don't say you can't write when you can; that is telling a wrong story!—Eds.]

THE UNBALANCED SLIDE VALVE.

Editors Mechanical Engineer:

That "Unbalanced Slide Valve," in your issue of February 17th, it seems to me, is balanced under certain conditions. As I understand it, the valve and steam chest are all solid, in one piece, The steam pressing on the valve-seat through the openings at the ends of the valve, will tend to lift the whole thing from the seat.

Now there is only one condition under which the valve will hold down, and that is, when the engine is working with a condenser.

It is true there is pressure on the back of the valve, as in ordinary valves, but there is also pressure opposite the valve on the steam chest, which will exactly counterbalance that on the valve, so there is nothing to hold the valve and chest down, unless there is a vacuum under the valve.

By proportioning the size of the openings through the chest at the ends of the valve, and the steam pressure to the vacuum, I believe you might have a very good balanced slide valve, that is, if a balanced slide valve is one in which the steam is prevented from pressing the valve upon the seat.

Fred. Olin.
Perry, N Y.

[Our comments were made upon the valve as shown, not as it might be made. Moreover, we did not understand it to be cast in one piece, valve and chest, but separately, for, it is expressly stated in the specification to be like an ordinary valve, with the exception of balancing the steam chest! Further, unless the ports were equal to the back area of the valve, which is manifestly impossible, there would still be a superior presssure of the valve against the valve seat.—Eds.]

BURNING SCREENINGS.

Editors Mechanical Engineer:

I have been reading Mr. Burdekin's letter on firing. So far as my experience has taught me, I can endorse his ideas. I believe air should not be admitted above the fire. I have tried it both ways, and am now running a blower and burning screenings, which can be bought for one half the cost of hard coal—and if burning the smoke is any evidence of perfect combustion, I think I am right, for I have watched closely and have never seen any smoke since I put in the blower.

Like Mr. Burdekin, I run with the damper nearly closed, just leaving it open enough to obviate any danger of a gas explosion, which I suppose is liable to occur after new coal is thrown on, if the damper is closed too much. My employers are highly pleased in the difference in the coal bills, and I'm not disappointed, as it is for my interest to burn cheap fuel. Very few changes have to be made in an ordinary furnace to burn screenings, and the first cost of a blower can be saved in two months. Please excuse finger marks, as this is written in my engine room.

"Blower."
Westboro, Mass.

[Write again from your engine room, we like that kind of finger mark.—Eds.]

BURNING BEGASSE.

Editors Mechanical Engineer.

I have just received from Cuba, under date of January 30th, '83, the following letter:

Ingenio San Claudio, Island of Cuba.

James Mahony, Esq.

I commenced grinding "Sugar Cane" on the 15th of this month, that is on the "San Augustine." The "Mahony Furnace" works splendidly, and gives great satisfaction. M. Aguirro, owner of the plantation is very much pleased with the result,

Yours, truly,
Joshua Priest, Engineer.

The furnace herein mentioned was specially designed for burning wet "Begasse" as it comes from the "sugar mill;" it is the fibrous matter of the cane.

James Mahony.

A COMRADE ENDORSES "THE PROFESSOR."

Editors Mechanical Engineer:

In your last issue is a piece called "The Professor in the Machine Shop," and it reminds me of a story of two missionaries to the Indians: One of them was very successful in his efforts with the red skins; they always went to hear him, his hearers increased in numbers, and everything went on lovely. The Indians, however, soon began to listen to the "other man," but soon they all left him;—didn't want to hear him at all. When he asked one of the red skins why he didn't come to hear him any more, as well as the other man, the Indian's answer was that "he had a silver bowl, and he put it way up high where poor Indians couldn't get at it, but the other man had a great, big wooden bowl, right down among poor Indians, and all full of succotash!"

You may tell the writer of "The Professor in the Machine Shop" to keep on with his bowl of succotash, for nine hundred and ninety-nine of every thousand readers would not be able to climb up to the silver bowl.

I do not wish him to think that we disparage his efforts by likening them to a wooden bowl, for I think they are very good indeed, and I should be exceedingly sorry to see them discontinued.

I like your paper very much indeed. I buy it of our local newsdealer, who is, by the way an ex-mechanic who while out of a job began a little variety store, and by attention to business has built up quite a trade and is doing well, though I would not recommend any mechanic who is at work and has good wages to try it!

S. D. Hill,
Draughtsman and Pattern Maker for Chapman Valve M'f'g Co.
Indian Orchard, Mass.

[Mr. Moulton wishes us to thank this comrade for his kind appreciation.—Eds.]

KEEPING BRASS WORK BRIGHT.

Editors Mechanical Engineer:

I have seen some brass work in stores that never tarnished or grew dull looking with time, and suppose it is owing to something that is put on it to keep the air off. Do you know what it is, and whether it would answer on cylinder head covers of a locomotive, and its brass work generally?

Cleveland, O. Elbow Grease.

[Brass work of an ornamental character is lacquered to prevent it from tarnishing. Lacquer is nothing more than a transparent varnish made from shellac, alcohol and a little coloring matter (also transparent) to give it tone and prevent cloudiness. It would not answer on locomotive work for heat, dirt and rough usage would soon destroy it. There is nothing that will answer so well to keep brass work bright as our correspondent's signature and a little tripoli—Eds.]

REPORT OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

I send herewith lists of the secretaries of the several societies chartered by the National Association :

Henry D. Cozens, Providence, R. I.; M. J. McNelly, 1006 Poplar st., Wilmington, Del.; Jno. F. A. Cullinan, 23 Exchange st., Rochester, N. Y.; Jas. Sweeny, care Forepagh & Tarbox, St. Paul, Min.; Geo. F. Peifer, corner Johnson avenue and 20th street, Philadelphia, Pa.; R. D. Bradley, 104 South Walnut street, Canton, O.; Wm. Conroy, 239 Broadway, N. Y.; Jno. J. Hughes, 57 Wyckoff st., Brooklyn, N. Y.; Chas. W. Gillen, Box 532, Carthage, Mo.; Wm. Ponsonby, 361 Hubbard st., Chicago, Ill.

I have not the addresses of the four societies in Massachusetts yet, but add A. M. Davy, Detroit. A charter was granted February 2 to the society at Carthage, Mo.

There are now sixteen societies working under charters from the National Association, with a membership of about 816. There are societies formed in some fifteen cities, from whom I expect applications for charters soon. Now we want to get the *Aid Society* established and working by March 1st. Already some societies have taken action upon it. We think that the "Aid" will be a great help to us. It will be the means of uniting the stationary engineers of this country as nothing else will. The small assessments we will have to pay will not be felt by us, but the good they will do, when put together will amount to a great deal.

Already one member of the New York society has been found dead in his crank pit, leaving a widow and small children to be cared for by a heartless world! Stationary engineers of the country, I beg of you, lay aside the feeling of apathy that exists in some sections! Join our societies. Assist us in aiding the bereaved, and you will enjoy life better. Who knows but that you may be called away, as our brother has been? With us your family, that you love, will not be left destitute!

I ask the editors of The Mechanical Engineer to send this issue to the various Secretaries of societies, and I ask them to subscribe for it, and keep it on file at their halls, for, from time to time, it will be used as a means of general communication to them.

Detroit, Mich. A. M. Davy.

PRESIDENT REID'S DOINGS.—MARINE ENGINEER'S ASSOCIATION.

Editors Mechanical Engineer :

Knowing you take a great interest in the M. E. A., I write to say that I visited Bay City, in company with the M. W. secretary, J. H. Harris, after the adjournment of the Convention, and found the brothers of Number 27 ready to receive us, which they did in a hearty manner. We met with them in their hall in the evening and it was well filled with the members. They are going to rent a new hall, where they can have a reading-room in which they can meet one another in the day time and talk about the steam engine. They are the right kind of men.

Before the association started in Bay City, when the boats were laid up for the winter, the engineers used to congregate in saloons, but you might now look for a long time in such places and not find an engineer. I was told by one of the owners of boats that he never saw such a change as has taken place in the character of engineers there. He said they must have all joined a temperance association!

I leave here to-day to visit Chicago, and go from there to Milwaukee to see if I cannot revive the association there or start a new one. Everything looks bright now. I will write you on my return.

J. H. Reid,
M. W. P. N. M. E. A.

[President Reid is correct in his assumption that his doings, and the brotherhood, have interest for us and the craft at large, and we hope to have frequent advices this winter.—Eds.]

THE COST OF PRODUCTION.

Twenty years ago the motive plant of most manufactories consisted of a slide valve engine, flue, or cylinder boiler, plunger-pump and heater. In many cases no steam gauges were attached, or oil supplied to the steam cylinders. Automatic, or sight-feed, oil cups were unknown. Usually no attention was paid to condensation. Naked steam pipes and cylinders were the rule, rather than the exception, yet we jogged along comfortably with long stroke and slow speed, and evaporated as much water with a pound of combustible as we do now.

If it required fifty or sixty pounds of steam to develope a H. P. per hour no one seemed to be the wiser for it; no attempts to devise ways or means to retrench this waste were made. The automatic cut-off engine seemed to be considered simply an ornamental engine, designe was pressly for high-toned establishments. d examount of coal burned per horse-power The considered an item that had no direct connection with the products turned out. The manufacturer purchased a steam engine to furnish the power to run his establishment, and if it would develope the necessary power, with a certain boiler pressure per square inch, it was deemed all that was required in that direction.

Of late years, however, competition has opened the eyes of manufacturers, and circumstances have obliged them to see and acknowledge the discrepancy between a sixty and a thirty pound engine, and that to procure reasonable returns from capital invested, a diminution is necessary in the running expenses, and to this end all the details need attention.

The old methods and machines must succumb to make room for modern methods and equipments. Manufacturers find that they must keep pace with the times or go backwards; that others with improved machinery can produce cheaper than they. They are compelled to look at the costs of production from a different basis, and all that affects the cost of goods turned out needs attention.

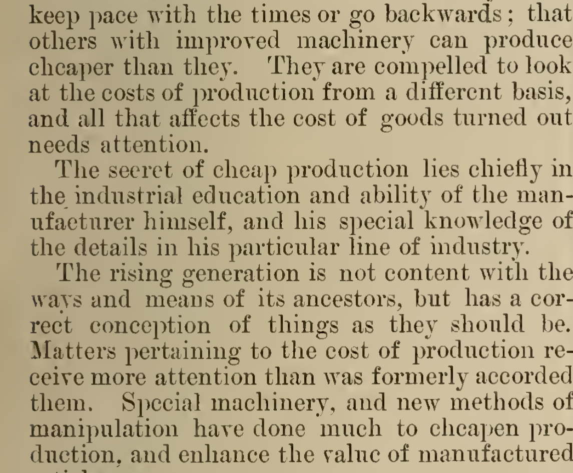
The secret of cheap production lies chiefly in the industrial education and ability of the manufacturer himself, and his special knowledge of the details in his particular line of industry.

The rising generation is not content with the ways and means of its ancestors, but has a correct conception of things as they should be. Matters pertaining to the cost of production receive more attention than was formerly accorded them. Special machinery, and new methods of manipulation have done much to cheapen production, and enhance the value of manufactured articles.

Evidently, there are yet broad fields for the mechanical engineer of the future to bring out new devices as well as to modify existing evils in present systems; bringing them into closer conformity with correct principles. Through closer inquiry and more accurate observation they discover deficiencies existing in old methods and machines, thus decreasing the cost of production.

SMOKE ARCH.

BEVERLY, MASS.



"FREE HAND DRAWING."

Recently a locomotive on the "Mansfield Tap" R. R., a short local road in Missouri, broke down and needed some repairs. The "President" of this railroad made a survey, and the appended sketch of the disaster, with written instructions to the mechanics as to what they should do.

The *Age of Steel*, wherein we find this sketch, says:

"The explanation written on this drawing, alluded to the figure on the left as 'representing half circle,' and as being the 'collar that the yoke works on;' the projection on the back of the 'collar' as the part that is 'fastened to yoke,' and the further information that 'the yoke is not broken, but the band around the axle that the yoke works on.' 'Axle inside' explains itself.

"Of course the meaning of the matter is that the eccentric was broken and it was desired to replace it."

The locomotive subsequently exploded, not in consequence of the above drawing, however, but by reason of the state of things described below; also from the same source as the drawing.

Some trouble occurred with the locomotive, and an engineer was sent to find out the cause.

"He found that the packing rings required expanding, and that the engineer in charge confessed his ignorance of how it should be done. The man stated that he had never driven an engine before, except one in a saw mill for a while, and that he knew nothing about the requirements of a locomotive. The tender was supplied by the use of a common hand lift pump, taking the water from a spring by the roadside. On examining the gauge cocks he found that one of them was entirely closed, the man explaining that he could get along with two gauges as well as with three! On being asked when the boiler had last been washed out, he replied that it never had been washed out. It had been in operation some four or five months. The water was clear, but very strongly impregnated with minerals, apparently salt and sulphur. The man did not know that there were plugs in the bottom of the fire box for the purpose of enabling the boiler to be thoroughly washed and cleaned—he had never examined or looked for them, or knew what they were there for.

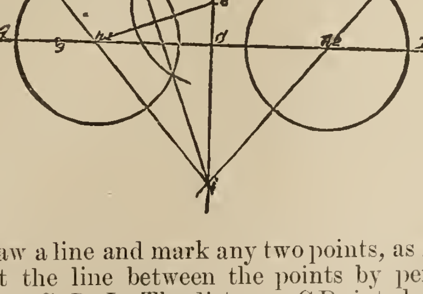
"He warned the men that unless the boiler was kept clean and better care taken that an accident would surely occur sooner or later. This warning was repeated in the hearing of all the persons he saw about, who were connected with the road.

"Mr. Noble learned from the men whom he found on the road that their wages were: Engineer, $35 per month; fireman, colored, $6; brakeman, $10 per month. The only surprise is that the boiler did not explode sooner. Mr. Noble said that the engine and boiler were of first class workmanship and material in every respect—as good a job as was ever sent out of a shop."

Why *will* boilers persist in exploding?

TO STRIKE AN OVAL WITH DIVIDERS.

The subjoined method of constructing an ellipse, or an oval figure, is taken from the California *Architect*:



Draw a line and mark any two points, as *A B*. Bisect the line between the points by perpendicular, *C*, *D*, *L*. The distance, C D, is to be one-half the width of the required ellipse. Divide *C D* into 3 equal parts. Measure off from *A* and *B* the length of 2 of these parts as points, *h* and *z*. Join *h* and *e*. Bisect line, *g e*, and continue the line until it intersects with the line, *D C L*. At *L*. is the center from which to describe the sides of the ellipse, and the points, *h* and *z*, are the centers from which to describe the ends.

PERSONAL NOTES.

At the Holyoke Machine Company's new shop at Worcester, Mass., A. C. Rice, is superintendent, John Reid, foreman, and E. O. Cross, engineer.

C. M. White, for 18 years foreman at Lombard's shop, Worcester, Mass., has taken charge of the engine at the new shop of the Worcester Barbed Fence Co. Jno. E. Brown succeeds him in the engine room at Lombard's.

The Osborne Engine and Manufacturing Company, East Boston, have for its officers: Geo. Plaisted, President; Geo. C. Morrill, Treasurer; J. O. Cheever, General Manager, and W. E. Pearson, Superintendent.

ECHOES FROM THE WORKSHOPS.

BY OUR OWN REPORTERS.

A. M. Powell & Co., Worcester, are getting out patterns for a new 16 inch lathe, extra heavy.

Boynton & Plummer, makers of patent drills, presses, etc., Worcester, will soon occupy a new building erected for them near the South Worcester depot. It will give them about one-third more room.

Edw. S. Matthews, A. A. Barker, Edw. H. Marble, and Austin W. Matthews, Worcester, are teachers of evening classes in mechanical drawing. The classes number 125 members, and have four sessions each week, the course embracing thirty lessons. It is aimed to make the instruction not too abstract, but thoroughly practical.

A. & S. F. Burlingame, engine builders and machine jobbers, Worcester, will move to new quarters in the Edwards building on Cypress Street.

W. A. Pentacost, Worcester, has placed one of his new pattern engines in a mill at Millsbury, Mass. The peculiar feature of this engine is that the cylinder is between the cross head and crank. This plan has been tried before, but in this new application of the idea, Mr. Pentacost believes it is thoroughly practical and advantageous.

H. C. Young & Co., light machine tools, Worcester, are getting out a new pattern, 13 inch, friction-feed lathe, heavier than former patterns, with steel, apron and feed gears, in head.

F. A. Humphrey & Co., Worcester, have gotten out a new "cavity planer" for pattern makers, etc., which possesses several advantages.

The shop of the Lockwood Manufacturing Company, East Boston, built a year or more ago, is now in full operation. It contains some very fine tools and special machinery, mostly built by Pond Tool Co., and Pratt & Whitney. Their principal work is building leather splitting machines, and steam engines. They are now building a compound engine for the propeller "*Independence.*" High pressure cylinder is 24"; low pressure 41", 26 inch stroke.

The Osborne Engine & Manufacturing Co., East Boston, formerly Lewis Osborne & Co., are manufacturing the new patent Pearson's safety valve. This is a pop valve in which a piston, in connection with the valve, affords increased area; by which it is claimed the valve is opened and closed in a shorter space of time than any other in the market. The spring is so inclosed that the steam does not come in contact with it.

E. Hodge & Co., East Boston, are building a 52 ton boiler for the S S "*Star of the East,*" and two 20 ton boilers for the new steamer to run between Boston and Provincetown.

Webb & Watson, East Boston, are building a compound engine for the Boston and Bangor Steamship Company.

W. H. Craig & Co., Lawrence, Mass., are getting out a new steam engine governor to be much simpler and cheaper than their hydraulic governor.

The Fairhaven Grate Bar Co., Boston, have engaged Mr. A. Macbren to establish and supervise agencies for their grate bar in various parts of the United States.

Useful Hints on Steam, by E. E. Roberts, 107 Liberty street, New York, is a hand book on the steam engine, compiled for steam users who are not engineers. It is chiefly a concise explanation of the details of engines and boilers, with their uses, and will be of great assistance to all who contemplate purchasing machinery of this class. It is advertised elsewhere.

A pet way for lumbermen to advertise this year, seems to be by means of calendars. The number of them received at this office, providing they were for the proper years, would lay a time track from now to the millennium.—*Northwestern Lumberman.*

You might have included the whole civilized manufacturing world on this side of the globe, and not have told a story.

The articles upon "*Dies and Die sinking,*" and "*Pattern Making*" are well received by our readers, as constant demand for them from the beginning attests.

Higgins American Drawing Ink is a standard preparation, well known to the trade. From an extended use of it we can endorse its excellent qualities. It is liquid, intensely black, flows easily and dries rapidly, The only genuine is that sold by G. S. Woolman, 116 Fulton Street, N. Y., sole agent.

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☞Papers will be discontinued at the expiration of the time contracted for, with due notice of same by postal card.

Entered at the New York Post Office as Second-Class Matter.

We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

THE MECHANICAL ENGINEER TO BE PUBLISHED WEEKLY.

With the close of this current volume, THE MECHANICAL ENGINEER will be issued as a weekly paper. This will occur in the issue for July 1st, No. 1, Vol. 6. No change will be made in the subscription price, or advertising rates, until that time, and persons desirous of availing themselves of the opportunity, can secure the next volume weekly at the price of the fortnightly edition.

ANOTHER ONE.

Of new locomotives there is no end, but somehow, all these new fangled devices come to naught. At all events the standard locomotive still holds its own, and is likely to for many years to come. The reason why is plain: the present engine is the product of the experience of the whole world, for with a few changes in details, and arrangement of them, the locomotive is the same everywhere.

What with the hydrogen locomotive, the Shaw locomotive, the Strong locomotive, the Fontaine locomotive, and now the Mallet locomotive, there would seem to be plenty of competitors against the standard locomotive, but we have not heard of any large orders for these improved engines as yet. The latest locomotive is one without any smoke stack. That sometimes useful appendage is now supplanted by an exhaust fan, driven by a small engine in the smoke box! This charmingly simple device has great attractions for an engineer, for as he has ordinarily nothing to do after the train leaves the depot but sit on a seat, look out of the cab window, and enjoy the scenery, he can now amuse himself by wondering how the little engine in the smoke box is getting along, and whether it is having a good time or not! If the little engine should happen to break down, or knock off work at any time through a freak, all the engineer has to do is to tell the passengers what has happened, and sit still, and wait until some old-fashioned locomotive, without a little engine in the smoke box, comes to his aid and tows him home!

What starts the little engine aforesaid when there is no steam in the locomotive is a conundrum we cannot answer, or how the smoke is to be consumed when there is no consumer at work we are too stupid to discover, but we suppose it all happens somehow, or else it wouldn't be patented and be backed up by strong capitalists.

The device itself is thus described:

> "A new device for consuming smoke is soon to be tried on the Erie. The smoke-stack disappears entirely, and in its place is a man-hole merely. The gases produced by the complete combustion will escape about the periphery of the extended boiler casing. The fan is worked by a small engine in the smoke box, and a powerful draft maintained when the locomotive is at rest. The exhaust steam passes along the side of the locomotive to the tender, which is divided into three compartments. The upper one is for fresh water, the middle one contains copper tubes connecting with the external air in front and with a suction-fan in the rear. The exhaust steam circulates around the copper tubes and becomes in part condensed, the resulting hot water falling into the lower compartments. The uncondensed steam, comes in contact with a spray of water falling from the upper compartment, and the condensed water enters the lower department, whence hot water is pumped into the boiler. The air used to condense the steam is employed for heating and ventilating cars, being delivered through a conduit which, with coupling ends, passes along beneath the cars. This system does away with coal stoves or heaters, and supplies the cars with fresh air, and warm air, without danger of fire in the case of a smash-up."

Gases produced by complete combustion! We had an idea that no gas was produced by complete combustion; rather consumed! We also object to air which has passed through a condenser, for heating and ventilating cars!

Not to put too fine a point upon it, we object to the affair, all and sundry, as a first-class piece of foolishness!

THE OBJECT OF ENGINEERS' ASSOCIATIONS,

What are the objects of engineers' associations? For what do men assemble in session? Do they meet to discuss theories, wages, or matters of general interest to them in their daily occupation? We think an affirmative answer to the latter is correct.

Discussion of theories, in certain premises, is not out of place in such meetings, provided they are clearly stated and derived from authorities—and when we say authorities in connection with theories, we mean views held by persons best fitted, through association and trained observation, to give opinions.

The main object of engineers' associations, to our thinking, is to diffuse a better general knowledge of curious action in machinery. That is to say, a member finds that, under certain circumstances of wind, weather, and barometer, he makes more steam, or his boiler steams easier, than under certain other conditions. This naturally excites inquiry, and having clearly established the fact, he states it in open meeting, and asks if other members have had a similar experience. This arouses discussion among others to the gain of all, and to the gain of the craft at large, if the discussions are made public.

Professional argument upon curious action in steam using, is of the greatest benefit, and should be encouraged in all engineers' associations. It is by interchange of experiences that information is gained.

Will not our friends in this line favor us with some reports of their meetings and debates on technical matters? We shall be glad to publish them.

THE PUBLIC STEAM SERVICE.

The troubles of the Steam Heating Companies in this city are many, and by no means ended. Introducing steam for public service, upon the scale projected, is a comparatively new field of engineering, in which few precedents exist as guides. Protecting pipes four inches in diameter from loss by radiation, and pipes twelve inches diameter, are two different things, as shown in practice. It is asserted by the public in the vicinity of the under ground steam service that the water mains are heated, as to their contents, by the radiation from the steam pipes, and the gas companies say that their lines of pipe are injured in the joints from the same cause, that is, heating, and cause great expansion of the pipes. This breaks the lead joints and allows gas to escape. Two explosions of a serious character have already occurred from the alleged overheating of gas mains, by the steam mains, through insufficient protection from radiation.

The latter sentence explains the source of some of the difficulties which have arisen, and the solution of them is not easily arrived at. The magnitude of the undertaking introduces new elements, in a sense, and it is not to be wondered at that the public complain.

It would have been wisdom on the part of the steam companies, if they had laid down an experimental line of, say 1,000 feet, and operated it for one year before going into more extended transactions. This line would have revealed the weaknesses of some parts of the system, saved the public from annoyance and the companies from loss. It would have greatly aided the rapid adoption and introduction of public steam, so to speak, into places where it will now be slow in finding its way.

The constant explosions, interruptions of service, and annoyances, known and unknown, will deter the public at large from the use of the companies' steam, and make its introduction slow and tedious. What promised to be a great advantage has been turned into a public nuisance by mismanagement.

SQUATTING.

A screw propeller is said to "squat" when the stern drops while under way. That is, the draft aft is increased while that forward is decreased. This brings the vessel to bear on very different lines while under way, from those on the model viewed in its natural position.

Taken altogether it is an interesting problem, as to the resistances set up. Whether they are lessened, or augmented, is shown by the speed attained from the power put forth.

Chief Engineer Isherwood has made an interesting analysis of the point in question, which may be found upon another page under the head of *Alteration of Trim with relation to Speed.* It will repay careful perusal.

SWINDLES PRACTICED UPON ENGINEERING STUDENTS.

We have had several complaints from engineers who have been humbugged by a party who advertises to procure situations and teach "engineering" in a few lessons, for a consideration. One of the latest victims thus describes his experience:

> "Seven months ago I commenced to take lessons in engineering from a party who proved to be a fraud, that is he got my time and money, in return for which he gave me promises. He promised to put me through so I could get a license as stationary engineer, after that I would have big wages and could pay for a full course in mechanical engineering. He wanted $100 in advance for the "course" and $15 for the stationary engineer business, and furnishing a situation. I went to him three nights in the week and paid him for instructions; but he kept putting off, and putting off, in regard to a situation, and gave me only promises in return, until I got tired and left, in company with six others."

There is a remedy for this sort of thing and our correspondent should not have submitted to robbery quietly. He should have complained to the nearest police justice and had the swindler brought to book.

EXPLANATION OF THE HAIR MARK ON THE FORGING, BY THE IRON AGE.

> "One of the most difficult things to make an ordinary mechanic understand is that two things cannot occupy the same place at the same time. It is consequently a never-ending source of wonderment to him when he finds that lace, a gelatine film or a pressed flower can be made to give an impression in lead, or even in soft steel, when passed between the rollers of a transferring press. That the soft substance can indent the hard one taxes his credulity to the utmost, and when he sees the work done he is ready to disbelieve his own eyes. When such a man finds the print of a hair on his cold forging, or a thousand and one other instances illustrating this fact that two substances cannot occupy the same space at the same time, his wonderment exceeds all bounds, and yet, though slow to believe such a demonstration as this, it is easy to accept the fact that a little water on a piston may be sufficient to smash the cylinder or blow off the head, which is only another illustration of the same fact."

One of the most difficult things to make a person, who is not a mechanic, understand is that he does not possess a monopoly of information on any given subject. Our contemporary's complacency amuses us; it either knows too little or too much. True, two "things" cannot occupy the same place at the same time theoretically, but practically they can, and they do.

Tallow is a substance, but if a filament of cold tallow had been interposed between the forging and the die, as in the case of the hair, it would have been spread out infinitely. Why not the hair? The hair was not compelled to occupy the place of any other substance at the same time!

We have had occasion heretofore to remark our contemporary's puerility in mechanical matters, but we hardly expected it to sneer at "ordinary mechanics." It seems to be an extraordinary mechanic when it speaks of "a little water" knocking out a cylinder head. Water goes over into cylinders daily without knocking out heads, or doing any damage whatever.

THE PROFESSOR IN THE MACHINE SHOP.

No. XXVIII.

A manufacturer from a neighboring town (perhaps I ought to say city) came in last week to see about some changes in his motive power. He said he had been reading so much about waste of power, and one thing and another in that line, that he began to suspect that possibly it might mean him, as one of the parties interested, and this more particularly as his engine and boiler were not of the newest. For that matter he was old-fashioned all through; himself, his shop, his machines, and his men, but he was not averse to keeping up with the times if he could make a dollar by it.

This was the gist of an hour's talk; details of which, with the "said he's," and "said I's," I spare the reader. I could not help thinking to myself, during the confession of the manufacturer, that he had been a long time finding out that he was losing money, and, in the time he had been using his old-fashioned machines, he could have saved enough to have bought, really, about two shops out and out. It is a fact, he could have.

If I digress here, and preach a sermon on the astounding shortsightedness of some as regards wasting power, which means throwing away money, I wonder if I shall tread on any one's toes! Perhaps I may pass it over and let the conversation I had with our friend convey its own lesson.

"How much will it cost, Mr. Moulton, to put some kind of cut-off gear on my engine?"

"Mr. Blank, I don't know." Now let us begin at the beginning, if you please. You have an old-fashioned shop and set of machines all through, and you want to modernize it. Is that correct?"

"It is."

"Well, now, do you want to go clear through the place and rip it all out at once, and put in new, or do you want to go through by degrees, taking out one machine after another; replacing it by a better one?"

"We can't stop; we must go through the shop one machine at a time."

"That is the best plan," said I, "for the new machines will be at work, saving money and helping to pay for themselves and others. When do you want to begin?"

"I want a new cut-off rig, of some kind, put on my engine right off."

"Why don't you buy a new engine out and out?"

"Because I can't afford to. Ain't there some kind of a jim-crack I can put on the old cylinder, that will work more economically than a common slide valve?" "Some device that I can put in between Saturday night and Monday morning?"

"Plenty of them," said I, "but how do you know you want anything of the sort?"

"I don't know, and that is the reason I came here for advice."

"Well, now, Mr. Blank, whether you can save your old engine or not, depends entirely upon circumstances. Have you power enough?"

"Why, no; that's just what I have been talking about?"

"Then you can't afford to cut any of it off. If your cylinder is too small now, it won't make it any larger to put on a cut-off, unless your boiler is plenty large enough. How is it about that?"

"It's large enough in the summer when we don't use steam to heat the shop; then we don't want much boiler for we haven't much work. In the winter we are full of work, but heating up the shop takes it away from the engine."

"We can soon stop that leak, by using the exhaust for heating the shop; so if there is boiler enough, as you seem to think, and it will stand higher pressure, we may be able to see you through. How much pressure do you carry now?"

"Sixty pounds."

"Will the boiler stand seventy-five?"

"I don't know whether it will or not."

"If it will, we can get along. One other question: Is your work regular?"

"How do you mean, regular; in quantity, or on the engine?"

"I mean, is it all on the engine at once, or is it 'steady by fits and starts' as the boys say"

"I let out power to a neighbor who runs a wood working place, and he uses all kinds of power at all times. Our own work is regular."

"I would get rid of that neighbor, and his wood working business, if I were you. Unless he pays a round sum for power you are paying part of his expenses!"

"How is that?"

"That's a long story; let us stick to business in hand. One thing at a time will take us through quicker, and to come to the point at once, and save your time and mine, I will tell you just what we can do, and what, if I were in your place, I would do. If my engine was large enough, with increased pressure, to do my work, I should put lap enough on the valve to cut off at three-fifths of the stroke, that would save two-fifths to begin with, for you now work full stroke. If I could cut off shorter eventually I would, but I would do that first."

"I thought a self regulating device was the best?"

"So it is, when the power is variable, but don't you see if you put on an automatic cut-off it would only do just what you can by lap on the valve! It would find the most economical point of cut-off and stay there. It wouldn't keep bobbing around all the while, snipping off steam every five minutes through the day. An automatic cut off is only useful where the work is changing constantly. If you are intending to rent out power to the man with the wood shop you should have an automatic engine."

"Then your advice is for us to speed up the engine, carry more steam, and cut off shorter. Is that it, in a nut shell?"

"Yes, sir, it is. Mind, I give you this advice without seeing the patient. I prescribe only from symptoms as given to me. I know nothing of the shop, or its work, but if you have correctly described it, my plan is a good one, on the face of it; and conservative practice."

"Suppose you come over, and make a survey at the earliest moment! When can you come, and what will it cost?"

"I can come, or rather my partner, Mr. Hess, will come, at any time you mention. He will apply an indicator, find out what your engine is doing, and he will put on a dynamometer and weigh your power. If we make the repairs there will be no direct charge for this work. If you take our estimate, and then go figuring around among other shops to get the work done we plan and devise, at less cost, we shall charge you $100 for the estimate and advice."

"How long will it take to find out about the power and the steam?"

"I can't say; it depends upon the surroundings. As there has never been any indicator applied, it will take some time to rig up for it. That is included in the bill. It may take two, or at the outside, three days for a survey."

"One hundred dollars for three days work! Just a little figuring!"

"Yes, sir; if you can do it yourself it won't cost you a cent; but as I understand the matter you can't, and so you came to us. We charge for brains in our business, just the same as you do in yours. We certainly cannot afford to spend two or three days time in your interest without the assurance of being paid for it."

Mr. Blank agreed to this proposition for it struck him as a fair one. As he was going out, after having engaged us to make a survey, I called after him: "I suppose you know that speeding up the engine means a change in pulleys on the jack shaft"?

"How is that?" said Mr. Blank, returning.

"Why, if you speed up the engine the line shaft runs faster, don't it, in the same proportion?"

"Yes."

"Well, your line-shaft must run at a certain speed, so you must put a smaller pulley on the engine-shaft, or a larger one on the jack shaft."

"Well, that's curious! First I must speed up the engine to get more power, then I must reduce the speed to where it was at first to get less velocity on the line-shaft! What better am I off?"

"You are this much better off: that there are more pounds of steam going through your engine than there were before. That means more power. You get more foot-pounds of power, per minute, than you did at less engine speed."

Mr. Blank looked confused, and finally said, "Well, I leave it to you. I suppose you know your business. Any way, I hear you do."

"If you leave it to us," said I, "we will satisfy you."

I expect there will be some curious developments in clearing out this old place, and if there are, I will give the readers of THE MECHANICAL ENGINEER the benefit of them.

A GRACEFUL RECOGNITION.

Regarding the status of locomotive engineers, in his address to the *American Society of Mechanical Engineers*, Prof. Thurston said:

"All the enormous accumulation of capital in the form of rolling stock is the product of mechanical engineering, and the thousands of trains daily speeding across the land, each representing in value $30,000 to $150,000 and carrying hundreds of human beings or property worth from $20,000 to a half million dollars, depend for their safety upon the thoroughness of the builders' work, and upon the coolness, skill and judgment of the man who handles throttle, brake and reversing lever—an obvious and forcible reminder of the importance of a profession, one of the humblest and least considered members of which is laden with such enormous responsibility.

ABOUT GAS.

> A drop of sulphuric acid upon an iron surface, which has been eaten by sulphuric acid, will liberate carburetted hydrogen so unmistakably that a man who has once smelled it will never forget the odor.—*American Machinist.*

Oh, no; carburetted hydrogen is illuminating gas. You must mean *sulphuretted* hydrogen.

PATTERN MAKING NO. VIII.

BY A PATTERN MAKER.

To produce a circular disc, that will retain its size and shape: Let a strong margin be built, with two courses of segments glued and screwed together, and bored out in the lathe to the form shown in fig. 56. Turn a panel, or filling for the centre, and fix it in place with screws. The centre filling, if large, should be composed of several pieces, whose meeting edges have been grooved to receive a strip of wood, called a tongue, which runs the whole length of the joint. The joints should be left a little open.

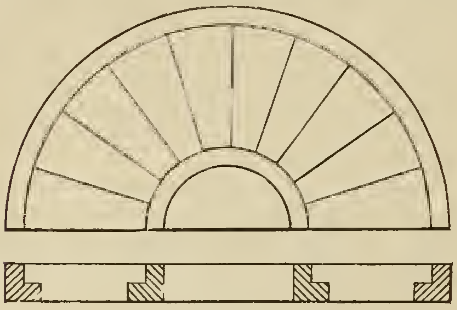


Figure 56.

If the disc is too thin to admit of the above method being adopted, the following stands very well, but is liable to become "dished"; that is hollow on one side and round on the other.

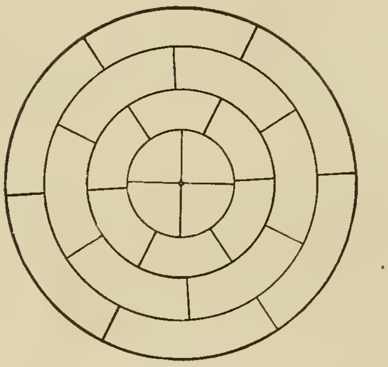


Figure 57.

Bore and turn a series of rings, each composed of one course of segments. Lastly turn a centre-filling, composed of quadrants. Take the segments composing the first ring and glue them, one by one, by their inner edge, to the centre. Glue on the other rings in the same manner, until large enough. The segments must break joint, and the meeting ends of the quadrants and segments must be tongued. For a disc four feet in diameter, I would make the centre about 12 inches, and the segments about 4 inches wide, I might lessen these sizes for a smaller job, but would not be disposed to increase them for a larger. Thin wide rings are also made in this manner by leaving out the quadrants.

For a wide ring, of sufficient thickness to admit of screws, or nails, being used, say one inch or upwards, the following I believe to be the method, which gives the best results for good stock patterns:

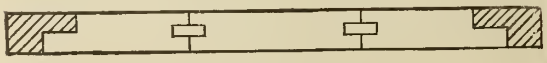


Figure 58.

Lay down a plan of half the ring, natural size, as in fig. 58, below it draw the ring in section, as shown in the figure. On the sectional drawing mark the width of the inner and outer margins, which are to be built with two courses of segments in each. Carry up these widths to the plan, and draw circular arcs to represent them.

Divide these arcs into any number of equal parts, but so as to have about 4 inches between the divisions on the larger circle. From each divisional point draw radial lines, as in the figure. The spaces thus formed will represent the pieces of which the annular panel is to be composed. Cut out a template to this form, and trace from it the pieces on a board of the proper thickness. As the pieces, when finished, are to be the size of the drawing, they must be sawed out a little longer, to allow for turning.

Let the panel-pieces be now arranged on a face-plate and temporarily fastened by nails, then turn down the inner and outer rabbets as shown in the section. Number the pieces and detach them from the face-plate. Proceed at the same time to build the two marginal rings. Take any one of the panel pieces and turn out the space between the rings to fit it. One by one fasten in place by nails, and glue at the margins, each of the panel pieces; rearranging them by the numbers. The pieces need not be glued to each other, nor is it necessary to plane the joints, as liberty must be allowed for a probable swelling when brought into contact with the damp sand of the foundry.

DRAFT.—Generally speaking, all patterns should be "drafted," that is, tapered from the top, or part which is to be uppermost in the mold, towards the bottom. Here we see the necessity of deciding how the pattern is to be molded before commencing to make it, so as to have the draft in the right direction. When the question is asked, how much? "Give plenty," will be the reply of the molder; but the machinist, who has perhaps to finish the casting perfectly parallel, will naturally find "plenty" very obnoxious to him.

Between these two conflicting interests it seems to be generally decided that one-sixteenth of an inch, on all sides, for one foot of depth shall be the amount allowed, but though this may be taken as the rule, deviations are frequently made on both sides of it. For instance: the hubs and rims of wheels are always shown parallel on a drawing, but are always made with a good deal of taper. So, likewise, the ribs on machine framing. In fact, where draft does not interfere with the designs, about an eighth of an inch in three inches is a fair allowance. On the other hand, the teeth of spur wheels and pinions are made almost square; the draft being so little that it cannot be detected in the castings, as the pressure of iron is greater at the bottom of the mold than at the top. This causes a slight expansion of the mold, thereby neutralising the draft. Sometimes, to our dismay, the teeth in the casting are found to be larger on the bottom side than the pattern teeth were on the top side!

Close core-boxes, that is those that cannot be taken apart, require at least $\frac{1}{32}$ inch all round for every three inches of depth. If less be given the core cannot be relied upon to shake cleanly out of the box. If there are narrow or intricate places in the box, more draft must be allowed in those parts. I have named the least that the core-maker can get along with, it being understood that in cases where draft does not act in any way detrimental, it is well to give more, even if possible as much as $\frac{3}{16}$ inch on all sides, for every 3 inches of depth.

Consideration on this matter is of great importance, as it may effect a great saving of time in the molding shop, without interfering with the designs of the engineer, or throwing any additional labor on the machinist.

Before passing this matter I must add another consideration, viz: an extra amount of taper must be given to all projections on a pattern (not detachable from the same) that rise into the upper part of the mold, called the cope. The same is true of any cavity in a pattern into which the cope descends.

The reason of this extra taper, sometimes called "cope-draft," being necessary, is because there is no opportunity to rap or loosen the pattern in the mold before the cope is lifted off. Gravity is likewise against us, which, with the natural adhesion of the sand to the pattern, causes portions of the cope to become detached from the rest and stay down, involving much time, trouble, and uncertainty in restoring the mold to its proper condition.

SHRINKAGE.—Cast-iron contracts in cooling, from the molten state in which it enters the mold, $\frac{1}{8}$th of an inch for every foot of dimension. Patterns have therefore to be made larger by this amount than the castings are intended to be. In order to make this allowance always, the pattern maker uses a rule, which, though assumed to be two feet, is actually 24¼ inches long. I need scarcely say, such a rule should never be applied to a drawing, for then we should fail in making the allowance necessary; mistakes, however, are sometimes made through doing this. I remember a young man breaking a new shrinkage-rule because he had, inadvertantly, measured his drawing with it and made his pattern too short!

Some men are opposed to shrinkage rules! I think I must have been some five years in the trade before ever availing myself of them. We seemed to get along very well without them. Upon a small wooden set-square, about three inches was laid off; each inch divided carefully into tenths, for, I should say, one-tenth of an inch per foot was the amount of shrinkage we allowed in those days. Of this more anon. Well, we measured off the length the drawing called for, then added as many tenths as there were feet in that length.

I believe in a shrinkage-rule, but men who do not, have some reason on their side. They will tell you (and it is fact), that different kinds of iron do not contract the same amount; that hard, or white iron, will contract more, and scrap iron less, than soft grey iron. Another point they will make, is, that heavy, massive castings, will strain the mold to such a degree as to nullify the shrinkage to a great extent.

As an example of this, I remember a pipe, or long cylinder, about 8 feet in length, 1¾ inches thick, with flanges of the same thickness which, when cast, was found to be of the exact length of the pattern. Luckily we had anticipated this result, somewhat, though not to the extent it turned out to be.

I believe, for machine castings, $\frac{1}{10}$th inch per foot of shrinkage, is nearer the truth than $\frac{1}{8}$th inch. I have compared many long columns, pipes, &c., with their patterns, and found, always, that $\frac{1}{10}$th was enough, and sometimes more than enough. I have also found that I could not guarantee, within a quarter of an inch, how long a 10 or 12 foot column would turn out, observing it frequently to happen, that two columns, cast from the same pattern would vary that amount in their lengths.

On a measurement of four inches and under shrinkage is not allowed, as the rapping of the pattern will provide the amount necessary. Broad, heavy castings, I have found, invariably turn out thicker than their patterns; $1\frac{15}{16}$ths inches of pattern will surely give 2 inches thickness of casting; $2\frac{7}{8}$th inch pattern will appear as 3 inches in casting. I cannot say how the proportion may run in higher dimensions.

Brass castings require an allowance of $\frac{3}{16}$ inch per foot.

I have little doubt but that the majority of my readers are desirous to pass on real pattern construction, and are as the weary farmer who waits and watches for the harvest. Confessing to a little impatience that way myself, I enter upon the culminating division of this series, the working out of various examples illustrative of what has gone before.

Just here I believe is the best place to insert a few lines containing certain warnings in such shape as to be easily borne in mind.

When a pattern you start on, be not over bold!
Take time, and consider; ere you make, you must mold.
'Twill conduce to your comfort, gain time in the end;
If you decide, in commencing, the top, side, and end,
Have plenty of taper, put on the right way,
To help the poor molder, with ten flasks a day.
Don't forget shrinkage, and for facing allow;
Or the machinist will grumble, and perhaps, raise a row.
Allow not too much, for some like it cut fine;
The material costs money, its removal costs time.
Have the sizes all right, and to make it look nice,
Sandpaper it well, and varnish it twice.
Though not for looks only, is varnish applied;
It protects from damp sand, and wet swabs beside,
Let the thing be made *right* and, (I don't come it too strong),
Make it so molder can*not* make it *wrong*.
If a print is cast on, or a loose piece misplaced,
For lack of third peg, or line duly traced,
If haply a batten's not stopp'd off in the cope,
Your casting's gone up! it's all wrong, by the Pope!

VERNI NOIR.

* * *

The turbine, introduced in an effective form by Fourneyon, a half century ago, and especially in the late forms of Fontaine, Henschel, Jonval, Schiele and others abroad, and by Boydon and his successors in the United States, has become the only water-motor in general use.

DIES AND DIE-SINKING.—NO. VII.

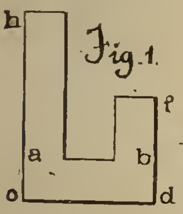
BY A DIE SINKER.

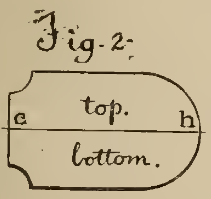
We have now come to a part of our operations in which I said we would pass a few remarks on chisels. To many this may seem unnecessary, as the chisel is a rough tool at the best, they think, and there is growing less occasion for its use daily. This may perhaps be a sufficient reason for a little talk about it to keep us from forgetting its use altogether. Again, some first-class machinists think it is a tool that is only used for cutting the ends off bolts, snags and gates off castings, etc.! I have known men of undoubted ability to have that idea, and lamentably deficient in the use of this tool.

My readers must at some time have seen men chipping some inaccessible place (for the shop tools), that is, where the tool could not reach. They would have seen, perhaps, one man expert enough, to all appearances, with the hammer, but woefully ignorant of how to grind his chisels, exerting himself to the utmost trying to keep up with the other man, who would be taking things very easy and getting away from him, without using one half the muscular force; every blow of the hammer being well defined, and the surface of the work smooth, against the other fellow's botch-work. In sinking dies there is always necessity for the chisel, and the reader must be aware that in working below the surface it is impossible to use the file to any advantage, the only approach to it being the riffler. This is a very unsatisfactory tool, as in confined spaces you cannot take any metal off with it. To use it for smoothing is not much better, as it rides over and follows the irregularities of the chisel, if you leave any. Scrapers of a variety of shapes are much better, as are also gravers, and if you cut at right angles to the direction in which you chipped, and keep changing and crossing after that, you get good results. This applies only to finishing the work.

If there is much stock to take off, they are too slow. The sole reliance therefore must be placed upon making a good job with the chisel, and this can be done. After a little practice it is surprising how smooth a job, and what thin, light chips can be taken off with it. As a rule for this work, the chisels should be very hard and ground to as acute an angle as they will stand and do the work. Light cuts must always be taken. Some men are careless about these simple things and never grind a chisel to the same angle twice, and don't seem to understand why they don't always work so well. Others always grind them too obtuse, but after a little while the mechanic who studies will be able to tell, by his eye, when they are ground to a good cutting angle. Another thing: the chisel should be kept always well up to the cut, not drawn back every blow, after the manner of a stone-cutter.

I will here try to show some of the difficulties met with in cutting such a die as the one we are engaged on, and how to overcome them, and again illustrate the outline of the last forging and the different views of it, as it is cut in the die-block.





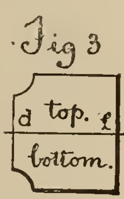


Fig. 1 is the outline, fig. 2 is the end view, *g*, *h*, showing it as it will be when finished, one half in each die, top and bottom. The dotted line represents the line, *a b*, in fig 1.

Fig. 3 shows the other end, *e*, *f*.

In the last article we left off at cutting out the part marked, *a*, *b*, *d*, on fig. 1. This is comparatively easy at the first, but as we get down a little we find our chisels will strike the edges of the die, as in fig. 4, and destroy it. This must be avoided, so we work from *a* to *b*, and from *b* to *a*.

By this means we get along very well, but as we go still deeper we find there will be a high place left in the middle, as in fig. 5, which we can not get at with the ordinary chisels, for they must be held at the proper angle to make them cut. If you attempt to cut this high spot out by holding the chisel more erect, you will only dig a hole, the dotted line as shown in fig. 5, showing the direction the chisel will take. To overcome this, we take a chisel rather thicker at the point than usual, and grind it like a side cutting chisel; but we do not use it in the same manner, but rather reverse its action. That is, we place the ground part down, as in fig. 6, the ground part of the chisel impinging on the bottom, every blow forces the chisel along sideways. Thus, the direction the chisel will take will be at a greater angle than would appear at first sight. By working this way, it will be observed that we can hold the chisel more erect and thus save the corners of our die and be able to remove the metal in the most difficult place, no matter how deep the die is.

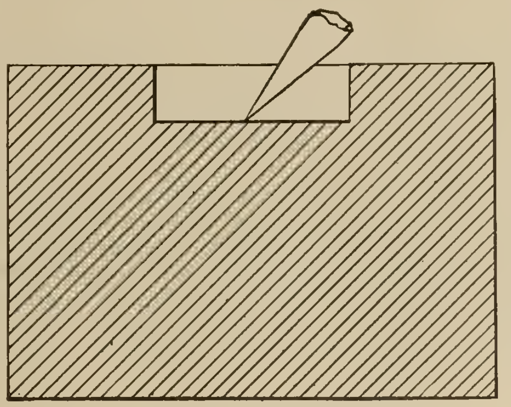


FIGURE 4—DIE BLOCK.

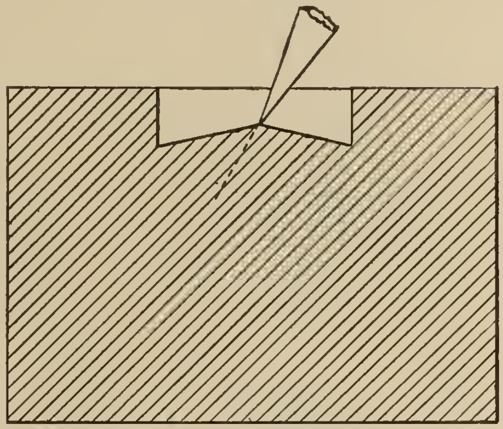


FIGURE 5—SHOWING THE DIRECTION THE CHISEL WILL TAKE.

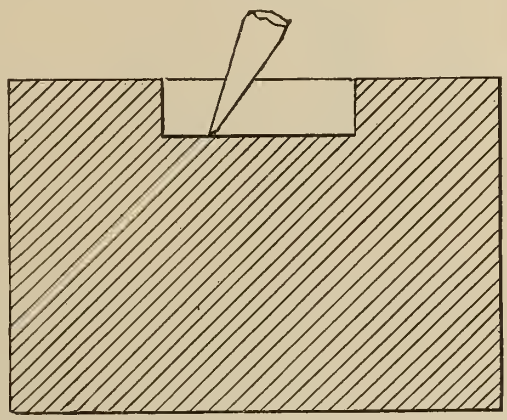


FIGURE 6—SHOWING CHANGE IN DIRECTION OF THE CUT.

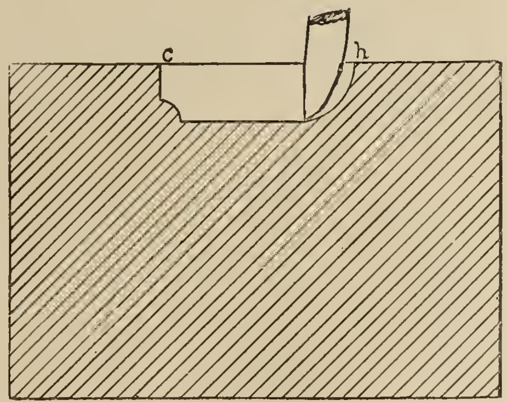


FIGURE 7—SHOWING DIFFICULTY OF MAKING THE CURVE IN BOTTOM, ON END.

Another awkward place to cut is the rounded part in fig. 7, at *h*, the chisel having a tendency to dig into the metal and make it square. This can be avoided in a similar manner to that just shown, but instead of grinding the chisel flat, make it the same contour as the figure you desire to cut. This is a good way to cut out any place that has to be of a rounded form.

Assuming that the reader is now thoroughly conversant with the different uses to which a chisel can be put, we will go on cutting the dies. Supposing that we have roughed out the part, *a*, *b*, *d*, we now cut out the parts, *e*, *f* and *g*, *h*. When this is done the force is applied in the same manner as explained in previous articles, but the outline template must be continually placed on the die-block to see that we are keeping the impressions in the proper positions in regard to each other.

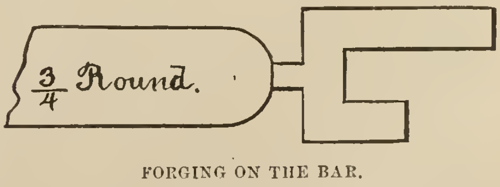
A good way to do this is to finish one impression completely before the other is touched, then we have the scribed outline of the untouched one for a guide to place the template, and when we are cutting the second impression, the first serves as a guide the same way. When the bottom block is done, of course the top one is made in the same way, except that the impressions are placed left-handed, as mentioned before.

Great care is necessary in sinking dies with double impressions, to see that both impressions are the right depth. If one should be too deep it would be necessary to plane a little off the face; then of course the other would be too shallow and would have to be sunk again. The same care is necessary to prevent any of the impressions from getting twisted, or out of the right position in the slightest degree. If this occurs it will be evident that we would not only lose the labor expended on the one so twisted, but also on the one that was finished. A good thing to do in cutting, is to run melted lead in, and hammer it into the dies. This will give you an idea of how you are getting along, and show up any holes or bad spots, if there are any.

In the last article I mentioned about making right handed and left handed forces for these dies. Also for the forces made in parts, the right hand is for the bottom die, the left hand for the top one. Forces that are made in pieces are very useful in such dies as this, in preparing the way for the solid forces, and are a great saving on them. This is of interest, as these forces are very expensive to make.

This forging we are now on, is a very difficult one to make dies for, because there are four impressions, (two top, and two bottom), but a good die-sinker can make them in four days, and there is some little recompense for the care bestowed on them as they stand well in the drop hammer. I have seen thirty thousand forgings taken out of one pair of these dies, and they were very little the worse, but we stopped using them as we considered that was enough. It is calculated that when dies get about five or six thousand forgings out, that is taking the average, they pay for themselves. A great deal depends on the shape of the forging as to how dies stand. Any one that is compact in form will be easier on the dies than more intricate ones. This forging is one of that class, although so hard to make. On the other hand some more intricate forgings to look at, will be easier to make dies for, but will not stand so well for forgings. These points will be fully illustrated in future articles.

In making these forgings they get one blow in one of the impressions, are then trimmed in hot trimming dies, (made for them,) then another blow in the second impression, which is reserved for finishing. Strange as it may appear these forgings are made of $\frac{3}{4}$ round iron. Here is a sketch of one on the bar. But it can be made of almost any shape iron that is large enough.



FORGING ON THE BAR.

It is in these points that drop forging differs so much from ordinary forging. It is astonishing, sometimes, what results can be obtained by it, getting out shapes that an outsider would think impossible with the iron used. Of course, the iron is worked very hot, almost at welding heat, and when it receives the blow it flows around to all parts of the die, as cast iron does in a mould. This drop forging is a mechanical operation that is ahead of the times, not being so fully known and appreciated as it should be, but I venture to predict a great future for it. It is now chiefly confined to small forgings, but there is no reason why it should not be used for larger ones, and put away forever from sight, the hideous, so called, forgings that disgrace the floors of every machine shop in the country. This can be, and is done, to some extent, by substituting the hydraulic press for the drop hammer. The great drawback to this would be the expense of making the dies, and the difficulty of obtaining skilled mechanics in this line, but the last would be soon overcome. The first objection is more apparent than real, as the subsequent saving in machinist's time, and the wear and tear of tools, would fully compensate for it.

As things are at present, in most machine shop work, it is customary for the sake of saving an hour of the blacksmith's time to give the machinists (and machinery worth thousands of dollars,) four or five hours work. An attempt has been made in some locomotive shops to remedy this, by getting dies cast. It never was throughly tested, but done in a half hearted way and gave no results worth speaking of. Some might object by saying it would take heavy masses of steel to make dies for large work. This could be overcome by using cast iron blocks with steel faces for the impressions.

It certainly is strange, that, in this age of mechanical progress, the blacksmith shop, with some exceptions, should be in almost the same condition as in the days of Tubal Cain, who first turned swords into ploughshares!

MECHANICAL DRAWING—No. VII.

BY EDWIN H. MARBLE.

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[By an oversight, the last article on this subject was numbered incorrectly; it should have been No. VI.—EDS.]

Our study of projection so far, has been confined to solids, having plane surfaces for the boundaries. In them we have several principles that will apply with great force to solids, having other than plane-surface boundaries. The next object that we will examine is the cone. This, it will be remembered, is a solid, having a circle for its base, and its boundary a curved surface terminating in a point. Or another definition may be given: It is a solid formed by revolving a right angled triangle about one of its sides, the perpendicular side giving us the height; the horizontal side the radius of the base, and the hypothenuse the slant height or length of the side, as shown in our drawing. In drawing it is best to consider the cone as in our original definition, that is composed of an innumerable number of sides. Bearing this in mind it is easy to apply the same principle to this object that we did to the pyramid in a former lesson.

We will use the cone and cylinder as representations of solids, bounded by curved surfaces as we did the prism and pyramid as examples of plane solids. Assuming for our dimensions $6\frac{3}{4}''$ as the height, and $2\frac{1}{2}''$ for the radius of the base, we will proceed to draw a plan and elevation of the cone. We find that all that is required is a circle to represent the base or plan, and a triangle for the elevation. So far our drawing is correct. But having been unable to see anything of great note in the object, as yet, we will cut the figure by a plane perpendicular to the vertical, and inclined to the horizontal plane of projection. Such plane being represented in the elevation by the line, *h k*. Wishing now to obtain the shape of this section, as shown in the plan, we must proceed by the same method as in fig. 8. The point, *K′* will be found at *K*, the point, *h′* at *h*. Where the plane cuts the cone at *m′*, or at its center line, it is very evident that the distance across the section is equal to the diameter of the cone at that point, and we would therefore lay off on the projection of this line a distance equal to this diameter.

It will be well to divide the circumference of the base of the cone, as shown in the plan, into 24 equal parts, and, finding the projection of the same, we can work with the same method as in our other figures, the 24 parts or sides, being enough to properly construct the curve which we shall find.

These points will be readily connected by a curve.

It must be borne in mind that these sections should be cross lined, or hatched, but this has been omitted to better show the drawing, avoiding a number of lines which would tend to confuse the student. The hard lines will greatly aid the student in defining the object. In connection with this model we will cut the cone by a plane nearly parallel to one side of the lines shown in elevation, Fig. 10. This being shown by lines 8″ *S″ T‴*. In obtaining the view as shown in side elevation we will also introduce another method of obtaining the section of a cone, using the same principle that we did at first, viz: That sections cut by planes parallel to the base are circles of the diameter of the cone at the cutting point. Constructing the figure with this point in mind we will cut, by imaginary planes, at the points, 1″ 2″ 3″ 4″ 5″ etc., parallel to the base.

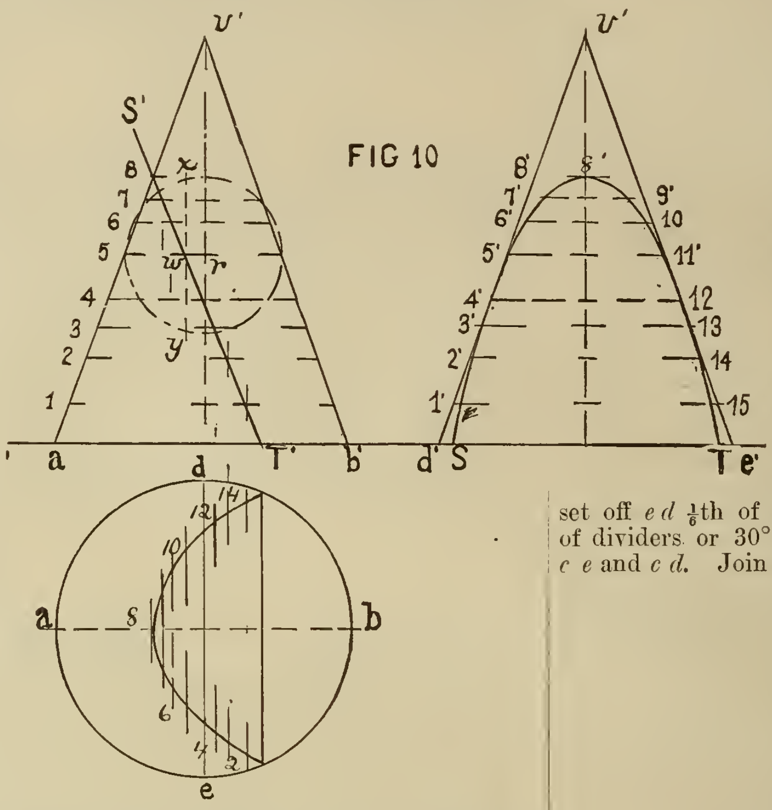
FIG 10

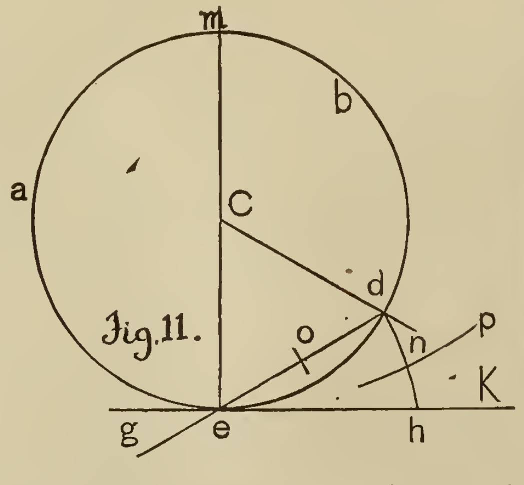
Fig. 11.

The complete operation of finding the distance we will draw for one set of points, but will show distance only for the others, as many lines confuse the reader. Taking the plane 4″12″ for our example, we will show in detail the various steps. This plane cuts the cone at a point at which the diameter is shown by plan drawing of circle, *v w x y*. This circle is cut by our plane 8″ *S″ T″* at the line, *y w x*, and the width of the section at that point will be this line, or *u y* on each side of the center line. This length we will transfer to the side elevation, and set off on the corresponding line, 5′ 11″. The distance that this cut is from the center line is *r, u*, or, as shown in the plan of second cut, by *v u*. In like manner we can find the other points in both side elevation and second plan, the lengths of the lines, 4, 12, etc. being of course easily found by projecting the points 4′ 12′.

The development of this object gives us a common figure in a boys' ordinary wide collar, as seen in store windows, the space left for the neck being that part represented by our first section. For the sake of clearness we will reproduce our figure with section properly marked, and will divide our circular base into 24 parts, representing side, and find the projections of the same. We will apply the same method of finding the true lengths of these sides that we did in finding the true lengths of the sides of a pyramid, and, remembering that the cone is but a pyramid with a circular base, we have the whole story represented by Figs. 12 and 13.

The length of the circular arc representing the unrolled base can be found by computation, though a graphic method will give it practically correct. Let *a b d e* be a circular, which, it is desirous to develop, first set off *e d* $\frac{1}{6}$th of the circumference by means of dividers or 30° triangle and draw the lines, *c e* and *c d*. Join the points, *d e*, and continue

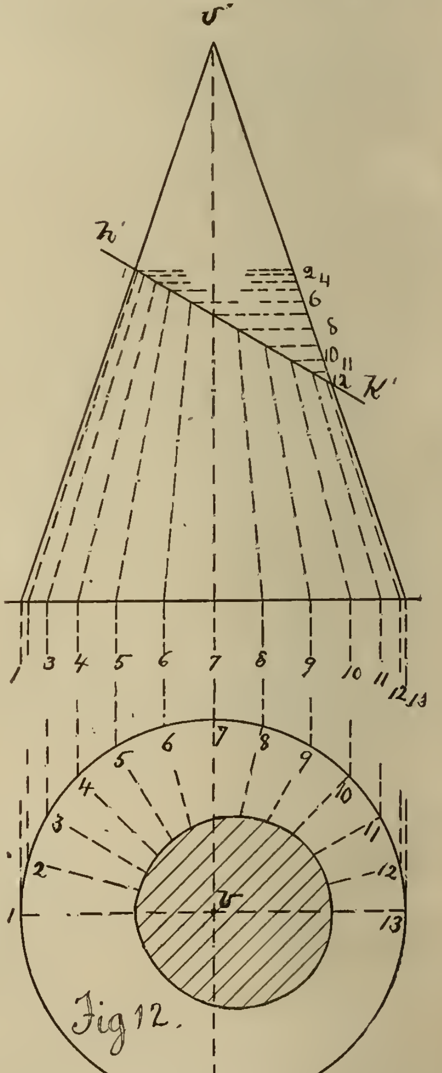
Fig 12.

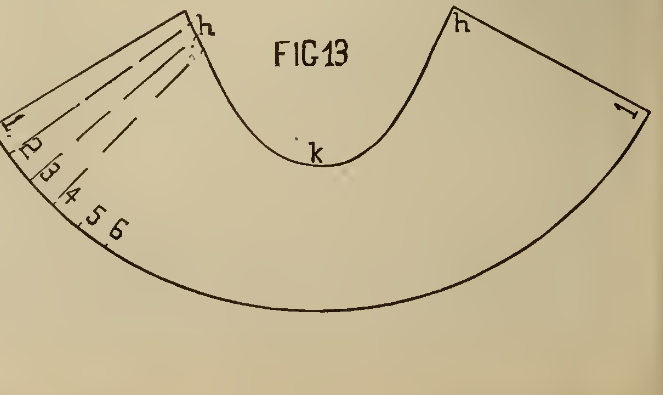
FIG 13

the line beyond *e*, bisect the line, *d e*, at *o*. Set off *E g*, equal to *d o*, and with *g* as a center and a radius equal to *g d* draw the arc *d h*. Should we desire to run out the circle upon a straight line, draw the tangent line, *e k*, and the distance from *e* to the arc, *d h*, will be one sixth of the developed circle. If, however, as in the case of a cone, the base of which when developed forms a circular arc of a radius *e m*, equal to the length of the face, or side of the cone, or the slant height, the length of the circular arc, *e d*, is wanted in a corresponding arc, *e n p*, of the given radius. The length must be taken upon that arc as *e n*, such a method gives us the length of the circular arc, 1, 5, 11, 16, 24. The length of the sides 2 and 24, 3 and 23, etc., are equal, so the figures will be uniform on each side of the center. The lengths of the cutting points may be also used to construct a figure which will fit into the "neck" of our pattern.

Before leaving this figure we will examine the structure a little more carefully, especially the different figures that are produced by cutting it with planes variously situated. Five important figures are to be obtained by planes, which are situated perpendicular to the vertical plane of projection. Of these figures we have shown three or rather four, though this fourth was hardly a cut. This was when the cone was cut by a plane perpendicular to the horizontal plane of projection, and through the axis of the cone, giving us a triangle for our cross section. When the cutting plane is parallel to the horizontal plane of projection we have a circle. When oblique to this same plane we have an ellipse, These are all familiar figures. We come to two new ones, now, which are used to a considerable extent. When the cutting plane is parallel to one of the sides, as in fig. 12, we have a parabola. This we define as a plane curve, every point of which is equally distant from a fixed point and a given straight line. The last figure we shall find is the *hyperbola*. This we obtain when the plane cuts the cone perpendicular to the base, but not through the axis, and we would define this as a plane curve, in which the difference of the distances of each point from two fixed points is equal to a given line.

From this it will be seen that this apparently simple figure, the cone, furnishes us with some of the most important curves used by draughtsmen in construction.

It must not be thought that this work, now studied, is mere boy's play. It is the fundamental principles upon which mechanical drawing is based.

The objects or models selected are not taken because handy or easy of access, but that the first principles may be studied from those bodies which are most familiar to each one of us, and those which will show to the best advantage the exact points it is desired to impress upon the student. Were I to take some complicated object as a pillow block, or lathe tail-stock, it would be like giving a primary school scholar the Greek Testament to commence on.

We will try and get our *A B C*, perfect, and our a-b, ab, and from them try longer and more difficult words.

From the study of projection as we have found it, when examining objects, which, so far, have been used in our lessons, we see that when the base of the object is resting upon the horizontal plane, the plane is very easily obtained without any projecting, or revolving of objects, and that it is always shown in its true size. We now wish to go a step beyond, examining objects, when in other than this position. Returning to the hexagonal pyramid, we will place the same with the base at an angle to the horizontal, and shown in its longest position, while the pyramid still remains perpendicular to the vertical plane of projection. It is very evident that with the exception of the inclined position of the base we have here a similarly situated pyramid to the one first studied.

Having found the angle made by the base with the ground line, and set off its correct length at that angle, we draw through its central point a perpendicular, and upon that set off the height of the pyramid. For convenience we have constructed a view of the object as seen by looking, not directly down, but in the line of its center. From this view we construct the pyramid as seen in elevation. The plan as seen, is shown in the drawing. Without going into minute details, we will only say that the width of the hexagon at *b f* in the plan is the same as in the view referred to at *b f*. The same with *d g*, since the object, being seen from the direction of the arrow above, is the same in width as that shown by view. The construction being based on principles already spoken of will need, we trust, but little explanation additional.

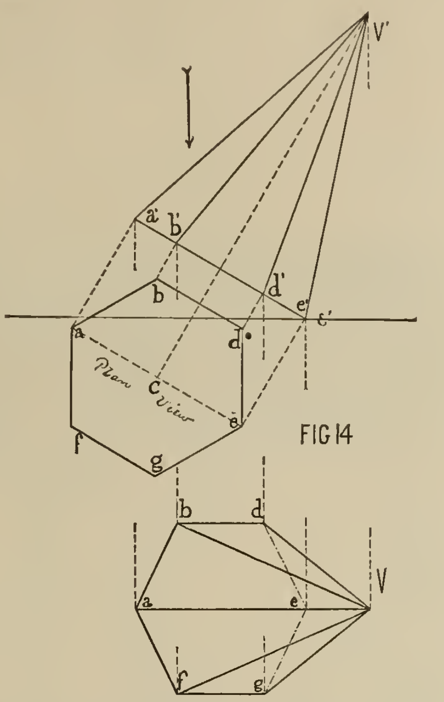

FIG 14

And we will add, that if proper attention is paid to the central lines, and the projections of the same, but little trouble is anticipated.

It would be well for the student to try this object in different angles of inclination.

In this, as in the other figures preceeding it, will be noticed, that the lines hidden from sight are represented by lines composed of dots and dashes—-—-—-—-—. While the lines used to indicate the projections, and constructions, are in plain dash or broken lines — — — — —.

In Fig. 14, the lines, *d e*, and *e g*, are hidden from sight by the remainder of the figure.

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NICKEL AND NEW ALLOYS.

Chemistry and mechanical skill are making rapid advances in the field of metallic alloys. An instance is afforded in nickel and its alloys, which have been carried to a point which causes that metal to be preferred, in numerous articles, to silver, as in watches, ornaments, furnishing hardware, superseding in the latter silver plating and brass. The difficulty caused by the porousness of the nickel, causing oxide or rust to form by the access of the oxygen of air, or sulphurous and other fumes, to the inferior metals with which it is combined, has been successfully overcome, solid alloys being produced which maintain the native brightness of the metal.

One important advance is in the purification of nickel carried to a point which secures its malleability, and this, by the elimination of the gases absorbed by it in the molten state.

Alloys are now produced free from cloudiness, and from liability to tarnish, to which silverware, solid and plated, is subject. These new alloys are much less affected than silver by organic acids, or the presence of sulphur or coal gas, "nickeline" or "platinine" silver not being eaten into by them. Pedometers, watches, and other fine pocket instruments made of alloys having nickel for their base wear clean and bright. The discovered malleability of nickel allows of its being chased similarly to silver and gold, and with the result of greater luster, while the qualities of brilliancy, hardness, and durability, whether used solidly or in electro-plating, commend it for table-ware service.—*Unknown Source.*

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Voluminous correspondence on the subject of *Stress on Bolts on a Cylinder Head*, will appear in our next issue.

ALTERATION OF TRIM WITH RELATION TO SPEED.

When the bow of a moving vessel is flaring or V-shaped beneath the water, the reaction of the latter tends to lift it with a force or pressure, other things equal, proportional to the square of the speed of the vessel. To counteract this lifting tendency there is only the constant force of the weight of the bow, which is unaffected by the speed. Now, it is evident that, let this weight be as great as it may, as it does no increase with the speed, while the lifting force increases as the square of the speed, there will be a speed when the bow will be lifted, and the less the weight of the bow the less speed will be required to lift it. When that speed is reached and the bow lifts, its *acting* weight in consequence of that lifting will be increased, less and less of it being supported by the water as it becomes more and more emersed, so that the lifting will be less than what is due to the upward reaction of the water with constancy of acting weight of bow. The effect of the lifting of the bow is to lessen the wetted surface, and the displacement of the vessel, and therefore to lessen proportionally its resistance.

Again, as the velocity of the ascending column of water, refilling the void left by the advance of the vessel, is due to gravity, and therefore constant for given conditions at all speeds of vessel, the greater that speed the further abaft the stern will the head of the ascending column appear, and the greater will be the dropping or depression of the stern, the result of which dropping is that the bottom of the vessel presents an inclined surface to the water, whose reaction tends to lift it with a force in the ratio of the square of the speed of the vessel. To counteract this force there is only the constant weight of the vessel, so that when the speed becomes sufficiently great the vessel will be bodily lifted. In this manner the vertical reaction of the water against the bow and the inclined surface of the bottom of the vessel lessens the wetted surface and the displacement, and proportionally reduces the resistance of the vessel.

In the case of Vedette boats, the alteration of trim commenced as soon as the very moderate speed of 7 geographical miles per hour was attained, and continued increasing with increased speeds, the resistance increasing in higher and higher ratio than the square of the speeds as the speed became greater and greater. When the speed of 12 geographical miles per hour was attained the vessel began to lift notably, and the ratio of its resistance in function of speed remained about constant up to the speed of 14 geographical miles per hour, when the vessel began to lift in a very marked manner, so that at the speed of 15 geographical miles per hour its resistance in function of speed had greatly lessened. The slip of the screw at this speed was about the same as at the speed of 10 geographical miles per hour. It is entirely owing to the lessened resistance of the vessel, due to her lifting, that the high speeds could be attained with the power developed by the engine. Had the resistance of the vessel in function of speed continued to be the same at high speeds that it was at medium speeds, the former would have been unattainable by the power actually applied. The alteration of trim may be appreciated from the fact that at the speed of 14 geographical miles per hour, the bow was 22 inches higher above the stern than when the vessel was at rest. Now, the draft of water forward from the lower edge of the rabbet of the keel was only 24 inches when the vessel was at rest.—*Isherwood.*

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A sensational paragraph says: "The recent discovery of a new and cheaper process of manufacturing aluminum, bids fair to revolutionize all work requiring the use of steel and iron. It has a greater resisting power than either of these, and is very ductile and tenacious. There is no doubt it will before long be very largely used for the erection of buildings in this country, and for the construction of bridges, railroads, and other engineering work."

It will be a good many years before aluminum bridges are very common in any country!

THE DRAUGHT OF CHIMNEYS.

Many chimneys smoke from positive ill-construction, having a narrow part, an ugly bend, or a downward portion in their conduit, which the normal draught is not strong enough to overcome. Others smoke because they form the shortest channel by which air can enter the house to supply the draught of the loftier chimneys. Where there are two chimneys in one room, and the doors and windows are closed, lighting a fire in one chimney will ordinarily cause down-draught in the other, as the readiest mode of maintaining the atmospheric equilibrium. In most cases, however, the addition of a yard or so to the height of the chimney stack, (supposing that to be above the highest part of the interior of the house it ventilates,) will prove useful.

We are not acquainted with any mathematical formulæ intended for the guidance of the architect as to the height or draught of chimneys. It may, therefore, be of some service to provide a simple table, stating, in the first instance, the principles on which it is calculated.

The only cause of that upward movement which we call the draught of a chimney is the difference between the weight of the column air and vapor in the shaft, and that of a column of equal height of the exterior atmosphere. This difference of weight must be enough to overcome the friction within the chimney shaft, and any resistance to free discharge at the top. It is obvious that the ascending volume consists of matter which, at equal temperatures, is heavier than atmospheric air, as it contains soot, or finely comminuted carbon, carbonic acid, sulphur, and other matters naturally heavier than air. Calling attention to the existence of these two sources of retardation, viz., friction and the loading of the column, it will be safe to neglect them in tabulation, as it is very difficult to determine the absolute heat of the ascending column, and a few degrees more or less will amount to quite as much as the elements thus neglected.

To increase the draught, we must increase either the height of the chimney, or the temperature of its contents. The larger the aperture below the greater quantity of cool air that enters the chimney, and the less draught. The more the air that enters below is compelled to pass through in close proximity with the burning fuel, the higher does the temperature become, and the more powerful the draught. This is the simple key to the whole theory and practice of draught produced by heat. Of course, in different conditions of the barometric column equal amounts of heat will have somewhat different effects. Hence we can see in a moment why our fires should "draw" so much better in clear cold weather than when the air is warm, or loaded with damp. The weight of a cubic foot of air at 32° Fahr. is 0·080728 lbs. avoirdupois.

If the top of a chimney-flue were closed by a flap, or hinged valve (the weight of which we take as counterbalanced), the effect of the draught, or rather of the downward pressure of the external atmosphere which causes the upward draught, would be to lift the valve in proportion to the force of the current. If at the same time a strong wind be blowing over the top of the chimney (in the direction of the hinged end of the flap), its effect would be to force down and close the valve.

In calculating the following table we purposely use round and approximate figures, as quite sufficiently accurate for practical purposes, and as more readily intelligible to many readers than more complicated mathematical expressions. We have also used the pressures proportionate to velocity as allowed by Smeaton. Now, assuming, for convenience of calculation, an increase of temperature of 108° Fahrenheit (that is, from 62° to 170°), as imparted by a fire to the ascending column of air that passes over it up the chimney, we shall have an upward pressure of a fraction over 0·04 lb. for every foot of ascent in the shaft. This is represented in the following table of comparative heights of chimneys, pressures, and velocities of current, calculated for that rise of temperature.

Table for Calculation of Chimney Draught:

Height of Chimney in feet.	Presssure due to 116° Fahr. in pounds per foot.	Velocity of draught in miles per hour.
30	1·2	16
40	1·6	18
50	2·0	20
60	2·4	22
78	2·8	24
80	3·2	26

In rising from 15 feet to 50 feet there is an increase in the local velocity of the same wind from 60 to 70·8 miles per hour. In raising a chimney from 15 feet to 50 feet we should obtain an increase of draught pressure of from 0·6 lbs. to 2·0 lbs. per foot, as against an increase of wind pressure, in a great storm, of from 20 lbs. to 27 lbs. per foot. The gain is more than threefold—the loss less than 33 per cent. We mention this, not as a difficulty, but to show that proper consideration must be given to the whole subject.

It is, of course, apparent that if we have an ordinary fireplace, with a chimney 50 feet high, and with that proportion of fuel and of draught which gives a current of twenty miles an hour to the ascending column of smoke, the aperture at the top of the chimney would be closed by a cross-current blowing at the rate of seventy miles an hour, almost as efficiently as by a valve weighted to 27 lbs. per foot. The fire, in fact, would have to be extinguished. But the pressure of 27 lbs. per foot, or 0·19 lb. per inch, is very trifling in comparison to the pressure of steam in a boiler; and as the action of the injector by induced current is an ascertained fact, it is plain that it is within the province of the engineer to make the hurricane, blow it ever so wildly, produce an induced current through a chimney, so that the draught shall in no way be reversed by storms. As to that, there can be no doubt, although this may be the first time that the statement has been definitely made. We have given what our own experience has led us to believe to be a simple and effective means of producing this induced current.—*The Builder.*

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The Schenectady Locomotive Works in Schenectady, N. Y., are to build four passenger engines for the Cincinnati, Indianapolis, St. Louis and Chicago road. They will have 18 by 24 inch cylinders and 5 feet 9 inch drivers, and will be used on the fast through trains.

The Rogers Locomotive Works in Patterson, N. J., are building five light double-ended locomotives for the Illinois Central road, to be used on suburban passenger trains.

Reports of old and new roads indicate that the demand for locomotives is not falling off. The New York and New England Co. is about to let contracts for 15 locomotives, the Toledo, Cincinnati and St. Louis wants 25, the St. Paul, Minneapolis and Manitoba needs 15, and similar reports are constantly received. It is noticeable that the demand at present is largely for older roads, new roads not making much figure in the market.—*Railroad Gazette.*

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The Shaw locomotive may be classed as a 37 ton soft coal passenger engine, with two cylinders on each side, each $10\frac{1}{2} \times 24$ inches; the two working in combination, being equivalent to one cylinder $14{\cdot}85 \times 24$ inches; two cross-heads, two piston-rods, two connecting and parallel rods on each side. Her drivers are 5 feet 9 inches; weight of engine, 67,000 pounds; coal and water, when in use, 73,000 pounds. Total 74,300 pounds. Weight of tender, 26,000 pounds; water, 15,000 pounds; coal 6500 pounds. Total, 47,500 pounds. Total combined, ready for use, 121,800 pounds, or 60·45 tons. The improvement in engines claimed in the Shaw locomotives are: First—no counter-balanced drivers, no hammer-blows and no nosing around; second—a single movement of valve with duplex action; third—steam is the motor of balance as applied to the reciprocating parts.

⋈

The purest lard oil is that which is manufactured by submitting solid leaf lard to great pressure during the coldest period of winter. Oil of this quality is used for burning in small mechanical lamps; it gives a bright flame and does not incrust the wick. A light-house lamp, however, being of a much larger size and evolving a much greater amount of heat, can consume oil of a coarser character; and it has been found that oil containing a certain amount of solid matter, provided the latter is not too much in quantity to be consumed by the lamp, gives a higher illuminating power.

⋈

NAKED TRUTH ABOUT PATENTS.

A patent is an official document purporting to convey exclusive right "to make, use and vend" the particular thing for seventeen years. The actual protection depends upon the money resources, aggressiveness and tenacity of the holder in fighting out his case. Having sold a certain industrial field, the United States declines to keep off trespassers or to warrant the title it conveys. This title is becoming less presumptive, and the presumption is even getting the other way in case of freshly issued patents which are not in a new field of art.—*New York Times.*

OUR CLUB LIST.

To new subscribers who wish to take The Mechanical Engineer in connection with other papers, we are enabled to offer the following publications; the publishers of which also make reductions from their regular rates.

The rates named cover both publications for one year:

The Mechanical Engineer and *Scientific American*, together one year	$4.36
Railroad Gazette, together one year	5 30
American Miller, " "	2.25
North-Western Miller, " "	3.00
Railway Review, " "	3.90
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⋈

MARKET REPORTS.

By request of many manufacturers in various parts of the country, we renew our publication of market reports of metals and engineers' goods, which was dropped some months ago, it being found a great convenience.

These quotations are made by the houses represented, who alone are responsible for the statements. While every effort will be made to insure strict accuracy, we disclaim any liability that may arise from changes without notice or typographic errors.

John W. Quincy & Co. quote, Feb. 14th, Commercial Pig Iron:

Number 1x	\$25@ \$25½
Number 2x	\$22½@\$23½
English Foundry	\$21½@
Scotch Number 1	\$22 @\$25
Lake Copper	18 @18⅜ cts.
Arizona Copper	17¼@ "
Baltimore	16¾@ "
Tin	22 @22½ "
Spelter	5 @ 5½ "
Antimony	10¾@12¼ "
Babbitt Metal	8 @25 "

American Tube Works quote:

BRASS TUBES (solid drawn).

Per pound, $\frac{3}{8}$, 50c.; $\frac{9}{16}$, 45c.; $\frac{11}{16}$, 40c.; $\frac{13}{16}$, 40.; $1\frac{1}{1}$, 35c.; $1\frac{5}{16}$, 30c. Same price to $3\frac{1}{2}$ diam. Copper tubes for above sizes respectively, 63c., 58c., 53c. 48c., 43c , 38c., for $1\frac{5}{8}$, and same price up to $3\frac{1}{2}''$ diam. Special price for large orders.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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New York, March 17, 1883.

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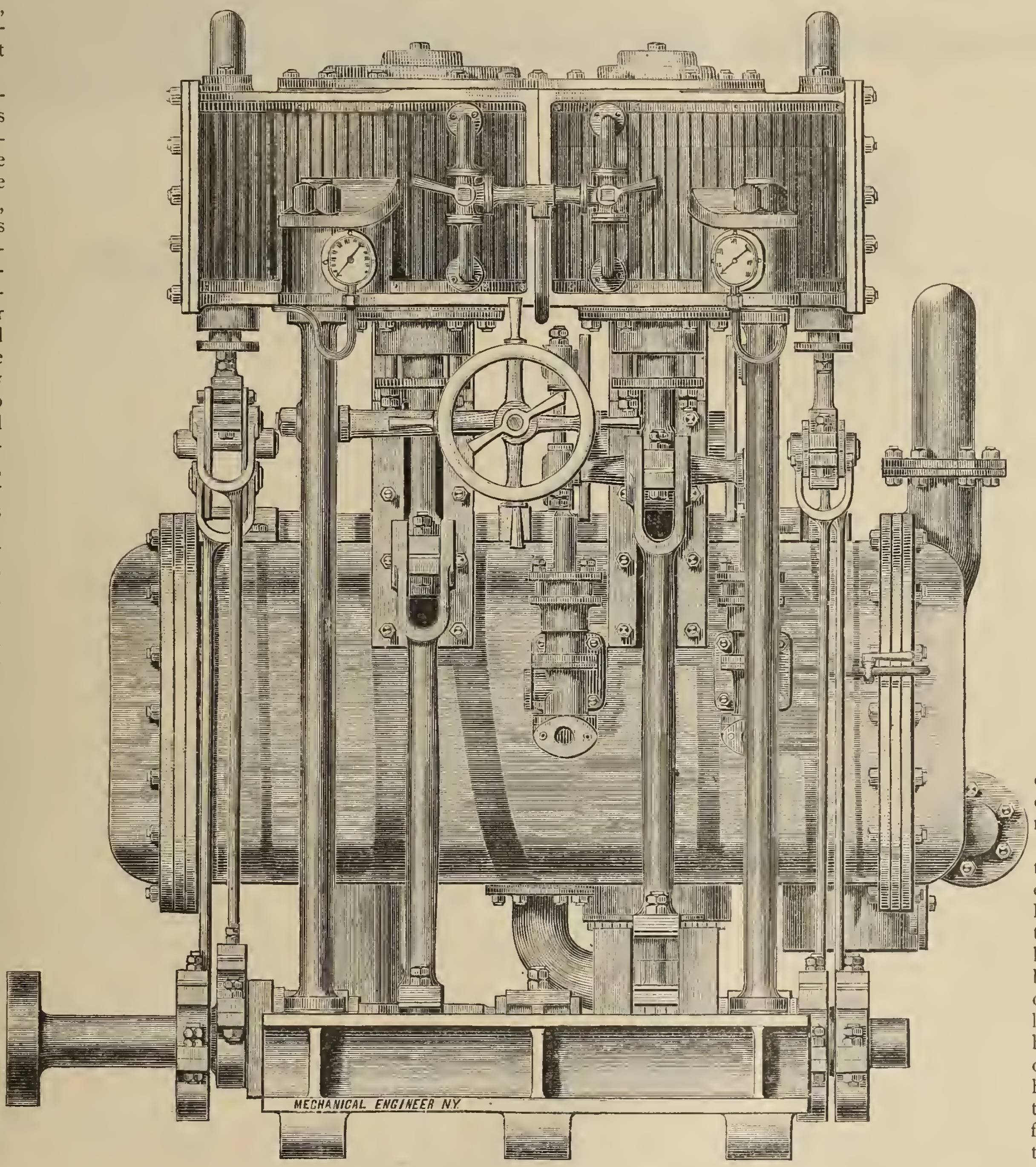
A TYPICAL ENGLISH LAUNCH ENGINE.

What is put forward abroad as a type of an English launch engine is here illustrated, re-engraved by us from an English photo. To American eyes it seems unnecessarily cumbrous and complicated. Launch engines in this country are simple, strong, light, and capable of high speed. They are oftener single cylinder engines than compound, though the latter are gaining ground with us for larger vessels than launches, this term, in this country, being restricted to vessels not over fifty feet in length.

The engines for American steam launches have outboard pipe-condensers which are very simple, of little weight, and as efficient, as regards vacuum, as any other. This arrangement finds no favor in English engineers' eyes, though for what reason it is hard to discover; if space and weight are of any value there can be no choice between inboard and outboard condensers for small steamers, whether compound or single cylinder engines are used.

The dimensions of these engines are: H P cylinder, 10 inches; L P cylinder, 18 inches with strokes of 12 inches, working under steam pressure of 85 pounds.

The propeller wheel is 60 inches diameter by 78 inches pitch, and even with this fine pitch and the very short stroke can only be turned 152 revolutions per minute. To give out adequate power for their space, weight, and dimensions, these engines ought to run at 350 revolutions per minute.



A TYPICAL ENGLISH LAUNCH ENGINE.

STEEL-LINED CYLINDERS.

A considerable number of marine-engine cylinders are now being fitted with liners of Whitworth's compressed steel. This is mild steel which has been subjected to a pressure of six to twenty tons per square-inch by hydraulic machinery, while in a liquid state. It is pretty well known how very difficult it is, if not impossible, to get a large mass of cast steel which shall not be honeycombed more or less, owing to the formation of gas bubbles in the ingots during the process of casting. Whitworth, therefore, instead of allowing the metal to solidify, as usual, squeezes the gas out of the steel after it is run into the mold, thus rendering the metal of the casting perfectly sound and more uniform throughout, at the same time doing away with the necessity for a large head of metal in the casting.

Previous to the introduction of steel liners in the Admiralty service, fractured cylinders were of frequent occurrence—in fact, cracked cylinders were the rule rather than the exception; and when they did not crack they scored, but since steel has been introduced for the purpose of cylinder liners there has been no fractures to give trouble.—*Mechanical World.*

A CORRECTION.

Through mistake we credited in our last issue the Marine boiler, shown on page 51, to the Babcock & Wilcox Company. That company do not make any form of fire-tube or shell boiler, devoting themselves entirely to the production of their well-known water-tube boiler, as shown in the advertisement on cover outside first page.

CURE FOR SLIPPING ON A LOCOMOTIVE.

According to a French engineer, slipping of the wheels of a locomotive can be cured by exactly the thing which often causes it, namely, steam blowing on them from the cylinder blow-cocks. In American engines these are always arranged so that neither drip nor "blow" from them can reach the track, but in the case cited, blowing steam on the rails cured a great difficulty. This was in a coal mine, where there was a grade of 1 foot in 66. Sand had been tried with but little benefit, and they lost pressure to such an extent that they were obliged to stop to make steam. This difficulty caused great consumption of fuel, excessive wear of the working parts of the engine, and a rapid destruction of the rails. About two months ago the joint of one of the cylinder cocks leaked, and a jet of steam escaping from it was directed on to the rail, when the train took the gradient without the engine once slipping. For two days they worked without making the repair, and the locomotive drew all the trains without the slightest stoppage. In consequence of this experience they altered the cylinder cocks so as to make them discharge directly on to the rails, and when they get to the gradient the cocks are slightly opened, so that they ascend without difficulty.

The benefit in this case must have been derived from blowing the rails clean, but it is difficult to see how the steam could leave them dry. We are inclined to think the sand box will remain in American engines some time yet.

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In a test of a feed-water heater, as applied to a locomotive recently, it appears that without the heater the number of pounds of water evaporated per pound of coal was 4.19; with the heater 5.28 pounds, an increase of efficiency of about 22 per cent. The evaporative capacity of a locomotive boiler is about half that of an ordinary boiler, which is due probably to the great velocity of the heat through the tubes.

◆

In a recent address the president of an English mechanical society, said: "The immense strides made of late years to meet the demands of shipbuilders, rolling mills, etc., had caused tools to be designed of a size that a few years back would have been thought incredible. Lathes, planing machines, slotting machines, &c., were now made weighing 100 to 150 tons each, while the fertile brain of the engineer was constantly designing machines to supersede manual labor, producing much better work in larger quantities and at much less cost. No matter how extravagant the demand made upon him, the engineering tool maker fearlessly faced every difficulty; the word 'impossible' was not found in his vocabulary."

"HOW TO KEEP BOILERS CLEAN."

This book, of which 35,000 were issued in seven (7) editions during 1882, has been enlarged from sixty-four pages to seventy-two in the eighth edition, which is before us. It contains matter useful to engineers, and is sent to engineers and steam-users free by mail.

◆

A new expression which we dislike is "Hydraulicking in Railroad Work." The inventor of it should file a caveat at once.

◆

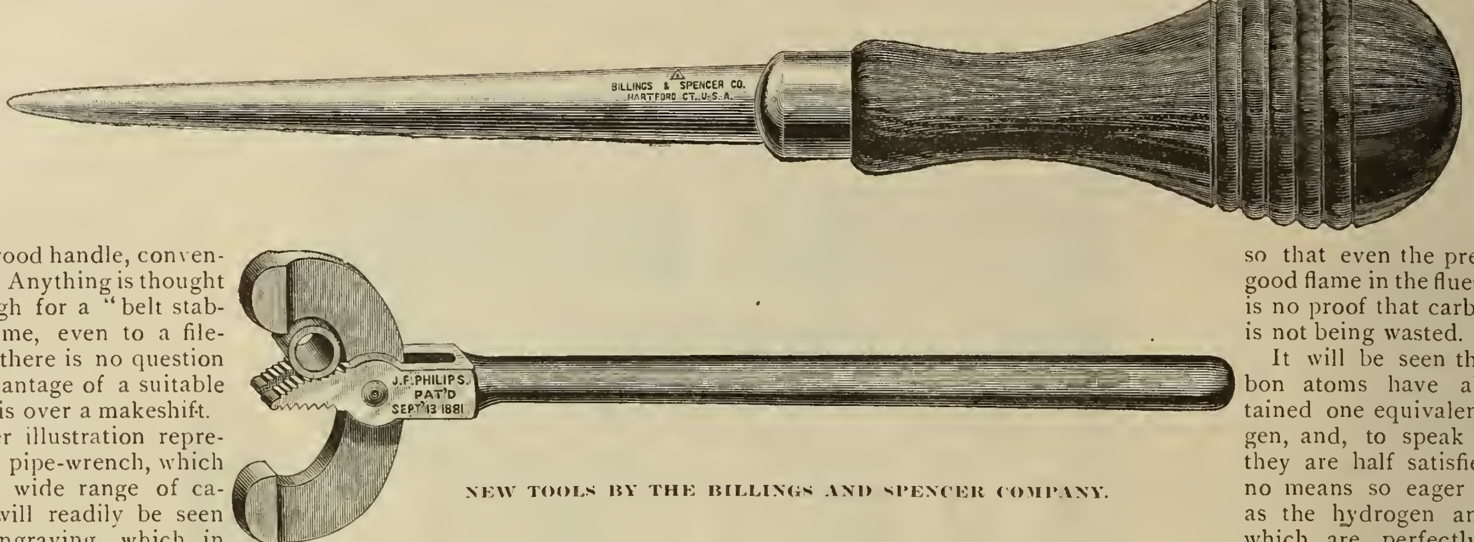
A correspondent of the New York *Times*, in a letter on spontaneous combustion caused by various oils, says that he has "never been able to find a case of spontaneous combustion where linseed oil was not present."

The correspondent above mentioned cannot have had a very wide experience as an observer, or he would be able to read many cases of spontaneous combustion in machine shops, and cotton mills, from greasy waste which had never touched linseed oil.

SOME NEW TOOLS

BY THE BILLINGS & SPENCER COMPANY, OF HARTFORD, CONN.

Two of the many recent additions to the already extended line of trade of the Billings and Spencer Company are here illustrated. The first, although simple in itself, is indispensable in all shops where belts are used, and it is chiefly remarkable for the care shown in its manufacture and the excellence of the material from which it is made; this latter being, as to the awl portion, of the best cast tool-steel, highly finished and spring tempered; the whole mounted in a handsome rosewood handle, convenient for use. Anything is thought good enough for a "belt stabber" by some, even to a file-shank, but there is no question of the advantage of a suitable tool like this over a makeshift.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J.F.PHILIPS.
PAT'D
SEPT 13 1881

NEW TOOLS BY THE BILLINGS AND SPENCER COMPANY.

The other illustration represents a new pipe-wrench, which has a very wide range of capacity, as will readily be seen from the engraving, which in construction explains itself. The wrench is 21 inches long, and is drop-forged from Norway iron and tool-steel, handsomely finished. It takes either round, square or hexagonal shapes, and pipe from $\frac{3}{8}$ths to 2 inches. For all steam-fitting or railroad repair-shops, it will be found a valuable acquisition. Withal the price, $4.50, is very reasonable for such a tool.

The shops of the Billings and Spencer Company present a busy scene. Pioneers in the drop-forging business, they produce an infinite variety of works and special shapes for all trades. Among them forgings for sewing machines are prominent. The marvelous excellence and durability of American sewing machines is largely due to this company, who have displaced malleable iron, brass and common cast iron with their lighter and stronger iron and steel forgings. Of shuttles alone they have made 360,000 in one year, while other forgings — spinning-rings, coal-breaker teeth, wrenches of all kinds—are reckoned by tons. Billings' pocket wrench has been called for to the extent of 30,000, and gun parts by the barrel.

The wide celebrity of these Works, and the Company's reputation, have been honestly won by excellent workmanship and upright dealing in all its transactions.

◆

TO PATTERN MAKERS AND MILLWRIGHTS.

It is very often found that wood which in the board or plank is perfectly straight, or appears to be so, will twist and wind in every conceivable manner when cut up into long, narrow, lengths, or cross-cut into short, broad panels. When wood is "winding," the only remedy is to plane off the high corners and make it true by reducing the thickness; but if it be simply cast (one side hollow and the other round), the defect may be easily got over. If the man, by working on some other portion of his job, can let the defective pieces stand for a day or two, then by placing the wood "hollow side" down on a plane surface, or by putting two such boards one on the top of the other, with the hollow sides facing each other, the wood will draw straight without any more trouble.

It is always best, when possible, to work wood in its natural state, as even if the tendency to cast be overcome previous to working it, there is always the probability of its returning to its normal condition. Some men, when pressed for time, heat the round side on the stove. This does indeed make the wood straight, but there is a great risk of opening and splitting under this toasting treatment, and this liability is very much increasd if the wood be at all shaky. If required, the wood can at once be straightened without this risk, by damping the hollow side with water, when the expansion of the fibre on that side pulls it straight.

It sometimes happens that a piece of wood of some considerable width, such as a carcase end or a wardrobe panel, has to be reduced from $\frac{3}{4}$ inch to $\frac{1}{2}$ inch thickness. If this superfluous wood be all taken off one side, that side will become hollow, whereas if it be taken off equally on both sides the wood remains as before.

In veneering panels, etc., it is always best to veneer on the outside, that is, the side opposite the heart side, the reason for this being that veneer is apt to swell with glue being laid on, and must therefore contract after it is fixed. As the heart side has always a decided tendency to curl, the two forces counteract each other, and the wood remains the same. For this same reason, it is always best to inlay on the outside.—*Builder and Wood-Worker.*

◆

LACQUERING BRASS.

1. Be sure there is no oil or grease on the brass; do *not* touch the work with the fingers, hold it with spring tongs or a taper stick in some of the holes.
2. *Always* handle with a piece of clean cloth.
3. Heat the work so hot that the brush will smoke when applied, but avoid overheating, as it burns the lacquer.
4. It is well to fasten a small wire across the lacquer cup, from side to side, to scrape any superfluous lacquer. The brush should have the ends of the hairs all exactly even. If not so, trim the ends with sharp scissors.
5. Scrape the brush as dry as possible on the wire, making a flat smooth point at the same time.
6. Use the very tip of the brush to lacquer with, and carry a steady hand.
7. Put on at least two coats. It is well (to make a very durable coat) to "blaze off" after each coat, with a spirit lamp or Bunsen burner, taking care not to overheat and burn the lacquer.
8. If the lacquer is too thick, it will look gummy on the work. If too thin, it will show prismatic colors. In the first case, add a little alcohol; in the latter, set the cup on the stove and evaporate some.
9. A good deal of cheap work, like lamp burners, is "dipped." Use a bath of nitric and sulphuric acids, equal parts, dip work, hung on wire, into acid for a moment, remove, rinse in cold water thoroughly, dip in hot water, remove, put in alcohol, rinse around, then dip momentarily in lacquer, shaking vigorously on removing to throw off extra lacquer and lay on a warm metal plate till dry, let cool and it is done.
10. Avoid handling lacquered work until *cold.*

—*Q. Y. X. in Scientific American.*

◆

A story is told in a Saginaw paper about a mill in that district that cut 18,000,000 feet of lumber annually, and the exhaust steam manufactured 20,000 bushels of salt. Thus the fuel for making the salt cost absolutely nothing. The slabs from the logs were sold for fuel at $1 per cord. That manufacturer made a fair thing on his logs, and if all could economize the product like that, there would be but little need of bothering about the tariff question.

[If the fuel cost nothing, the salt cost nothing, but manufacturing by evaporation with exhaust steam as a heater costs something; generally three to four pounds back-pressure.—Eds.]

AIR OVER THE FIRE.

Concerning the admission of air over a fire the *London Engineer* says: "A favorite expedient for the prevention of smoke is the introduction of air above the grate bars. This operates generally by igniting the hydrogen and olefiant gas given out by coal and the carbonic oxide. Flame is produced, and the soot particles are burned. But we must bear in mind that hydrogen, and olefiant, and marsh gas, all have more affinity for oxygen than carbonic oxide; and in a mixture of these gases the carbonic oxide may escape without its equivalent of oxygen, while the other gas gets it, so that even the presence of a good flame in the flues of a boiler is no proof that carbonic oxide is not being wasted.

It will be seen that the carbon atoms have already obtained one equivalent of oxygen, and, to speak popularly, they are half satisfied, and by no means so eager for more, as the hydrogen and carbon, which are perfectly ravenous for oxygen by comparison. To effect complete combustion in the full sense of the term the gases must be thoroughly mixed with air, and they must be kept at a very high temperature; but the admission of air over the fire at once cools them down, and the cooling is further promoted by contact with the comparatively cold boiler plates. It ensues then that while smoke may be prevented by the admission of air, the production of carbonic oxide may be promoted instead of being checked, with great waste of fuel. Here, we have another example of the fallacy of the assumption that because smoke is prevented fuel must be saved.

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A STRONG BOILER.

"About twelve years ago," says a writer in the *Age of Steel*, "I was running a little upright boiler in North St. Louis. The boiler room was an airy concern and the gauge would frequently freeze up in the winter time. To avoid being bothered with thawing it out so often, I used the guage-cock freely to determine the pressure of steam, although I knew that the safety-valve of the boiler was a small one, and that to the lever of it a sledge hammer was suspended in addition to the regular weight. I went down early, and fired up with vim, one day, for the weather was bitter cold and I wanted to warm myself up. An employe came in, and as the boiler didn't appear very warm, and we were both cold, we stood up close to it and put our arms around it. While we were standing in this position I noticed steam coming out around the heads of the rivets. This alarmed me a little and I tried to push in the gauge-cock to see what pressure of steam there was. It required my utmost strength to push it in, and this increased my alarm. I hurriedly looked at the gauge, but, as usual, the thing was frozen up and showed nothing. I grabbed up a piece of newspaper, lit it, and thawed out the pipe leading to the gauge. No sooner had I done this than the hand began to spin around like a button on a barn door, and when it stopped showed 150 pounds, the full capacity of the gauge. What a larger one would have shown I cannot tell—probably something less than 10,000 pounds.

I cast one horrified look at the gauge, and then started for the door. Events, however, were too quick for us, and before we reached the door the safety-valve opened and the noise of escaping steam could be heard ten blocks away. We had to shovel the steam out of the boiler-room with a scoop before we could get in again."

"What became of the boiler finally?"

"It is still doing duty, although it is now over fifteen years since the first fire was started under it."

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

STRESS ON CYLINDER-HEAD BOLTS.

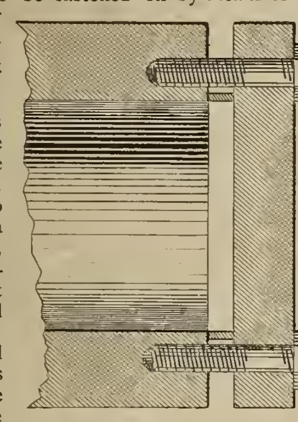
Editors Mechanical Engineer:

As I see there is some difference of opinion with regard to the strain upon the bolts of a cylinder head, I hope you will excuse an attempt to answer your very pertinent questions on the subject. (See page 40 of your present volume, column 1, last two paragraphs.)

"Action and reaction" are doubtless equal and the "steam thrust on the cylinder head" is "just so many pounds added" *under conditions* to be presently examined.

If the nuts are set up "to the last ounce they will bear," they will not "hold on if steam is let in to the piston."

Let us examine a definite case, here drawn to scale. Suppose a cylinder head to be fastened on by means of four 11-16-inch bolts! Their combined cross section will be about 1 inch, and perhaps 2-inch length of each, will be under strain. With the dimensions given in the figure, the area of the joint will be about 4 square inches. and we will suppose it to be made by putting in a separate ring of rubber, iron, or any suitable material, between the flat end of the cylinder and the flat cylinder head.



For simplicity we will suppose that the bolts and packing ring are elastic, and neglect the elasticity of the cylinder head and cylinder, though the latter would, if included, strengthen the conclusions to be drawn. Suppose that each bolt sustains a tension of 10,000 lbs. or 40,000 for the square inch! This will stretch the bolts, say, four thousandths of an inch, or at the rate of one thousandth of an inch for every 10,000 lbs., and at the same time it will compress the metal packing ring, say, four ten-thousandths. Now, let steam be admitted so as to exert a pressure of 11,000 lbs. on the cylinder head! This will stretch the bolts and make them sustain a greater pressure, and will partially relieve the pressure on the packing ring, and allow it to recover somewhat from its compression. Suppose the bolts stretch one ten-thousandth of an inch, they will then be strained to 41,000 lbs., and the packing ring will now press with but 30,000 lbs., which, with the steam, will balance the 41,000 of the bolts.

It will be noticed that we have assumed the area of the joint as about double that of the bolts, and the compression of the packing ring at one-tenth their elongation; but in most practical cases, the compression at the joint is far less in proportion to the stretch of the bolts, and therefore the additional strain, due to the steam, is much less in proportion. Were the compression at the joint to = 0, the claim that there would be no additional strain on the bolts until the steam forced the cylinder head away from the cylinder and escaped through the joint, would be true, but in this discussion we suppose the correct principle is sought.

On the other hand, let us suppose the packing ring to be of rubber or wood, it would compress perhaps 100 times more than the bolts would stretch—say, four-tenths of an inch—and the latter would have to sustain about 50,900 lbs., and stretch, therefore, over one-thousandth of an inch more. The rubber would expand as much, but its compression would decrease only from 40,000 to 39,900 lbs., which amount, plus 11,000 lbs. steam pressure, equals the 50,900 bolt tension.

To say, therefore, that the steam pressure does not increase the strain on the bolts is, we think, manifestly incorrect. To say that with metal packing the increase is generally neglectable is true, inasmuch as it depends entirely on the ratio between the compressibility of the joint and the extensibility of the bolts. J. Burkitt Webb.

Cornell University, Ithaca, N. Y.

◆

STRESS ON CYLINDER-HEAD BOLTS.

Editors Mechanical Engineer:

I cannot accept Mr. Chapman's theory of the stress on cylinder-head bolts, as correct.

He says, when the nuts are set up, producing a pressure of 3,000 lbs. on the gasket, and steam pressure of 3,000 lbs. be applied to the inside of the head, the pressure upon the end of the cylinder will be *entirely* removed, but the strain upon the bolts will still remain the same.

I would ask him: How can the pressure on the end of the cylinder be removed, and why the gasket does not still exert the same pressure, both on the end of the cylinder and the head, unless the distance between the end of cylinder, and head is increased? How can the distance between them be increased by the pressure of steam inside, without increasing the stress on the bolts?

Neither can I comprehend how Professor Wm. D. Marks' explanation of the subject proves his theory correct. I admit that his experiment as described, will produce the results he mentions; but the experiment as illustrated, and a steam cylinder, are not analogous, and will give very different results.

He says: "When cylinder-head bolts are set up so tight as to prevent leakage of steam from the joint at the flanges there is no increase of stress on the bolts when steam is admitted to the cylinder, until the flange-joint leaks."

I would ask: How can the joint leak unless the cylinder-head is forced from the flange by the pressure of steam? and if the head and flange are forced apart, why is there not an increase of stress on the bolts?

Referring to his illustration on page 41, No. 4, let *B B* represent a rubber gasket, which (by screwing up the nuts to produce a tension on the scales *S S*) has been compressed to some extent. Then it will not be necessary to pnll 100 lbs. on scale *T* to observe an increase of tension on *S S*, but even one pound or less will increase the stress on the bolts.

For an example: we will suppose that in screwing down the nuts to produce a tension of 50 lbs. on each scale, *S S*, the gasket has been compressed a distance equal to that which the pointer on *S* has moved from 0 to 50, and when the pressure is removed will regain its original thickness.

Now, by pulling 100 lbs. on scale *T*, the tension on *S S* will be increased to 75 lbs., and the pressure on the gasket will be 50 lbs. Pulling 150 lbs. on *T*, the tension on *S S* will be 87½ lbs., and the pressure on the gasket 25 lbs. By pulling 200 lbs. on *T* the tension on *S S* will be 100 lbs., and there will be no pressure on the gasket.

City Island, N. Y. Chas. Sperry.

◆

STRESS ON CYLINDER-HEAD BOLTS.

Editors Mechanical Engineer:

In his letter on the "Stress on Cylinder Head Bolts," Professor Marks says: "When steam is admitted to the cylinder, etc. . . . the stress on the bolts does not increase until the flange-joint leaks, etc."

I maintain that this is the case only when the bolts are strained to their utmost, that is, when the greatest pressure is placed on the cylinder flange. If we set the nuts down tighter, the bolts yield until there is very little strength in them to resist the steam pressure. As the bolts yield the pressure on the cylinder flange decreases.

Let us, instead of spring scales, in Professor Marks' sketch, use bolts and set the nuts down until there is a pressure of 50 lbs. on each of the blocks which they hold in place. What force is now necessary to release the blocks? Will it not depend on the strength of the bolts? Is this not the case with cylinder head bolts? If the joint is good, it will not leak steam until something gives way and the joint opens.

West Newton, Mass. Observer.

◆

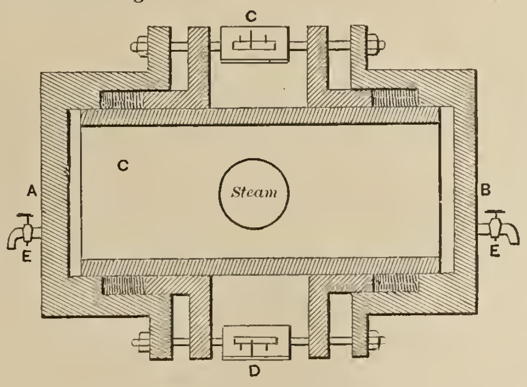
STRESS ON CYLINDER-HEAD BOLTS.

Editor of Mechanical Engineer:

Professor Marks, in your issue of the 17th inst., says, that when cylinder-head bolts are set up so tight as to prevent leakage of steam from the joint at the flange, there is no increase of stress on the bolts when steam is admitted to the cylinder, which so-called fact he attempts to prove by an experiment, as illustrated.

That if *S ST* be three spring-scales and *B B* two separating pieces, and that if you put a strain of 50 pounds on each of the spring-scales *S S*, and then pull on scale *T*. so that it registers 100 pounds, or if you put a strain of more than 100 pounds, the separating pieces will fall out. He is quite right on that point, for the two scales *S S* are pulling *C* toward *A*, with a strain of 100 pounds, but the pieces *B B* take the strain and prevent *C* approaching *A*, so when you put a strain of 100 pounds on scale *T* you relieve the pieces *B B* of the strain which was upon them.

What that has to do in proving that when cylinder-head bolts are screwed up tight there is no more strain on them when steam is admitted to the cylinder than when it is empty, I fail to see. Escape of steam from a bad joint instead of increasing the strain would relieve it, the leak acting as a relief valve—the more leak the more relief. I trust Mr. Marks will arise and explain. I will give him an experiment to prove he is wrong.



Let *C* be a cylinder, and *A B* two covers, made so that they will slide out. *D C* two spring-scales, *E E* two cocks; it will be found that the strain on the two spring-scales are equal to the pressure in cylinder in pounds per square inch, multiplied by the area of cover in square inches, and if you open cocks E E the spring-scales will register a decrease in pressure, showing that a leak would decrease instead of increasing the strain. "Chuck."

Montreal.

◆

EXPLOSIONS OF BOILERS.

Editors Mechanical Engineer:

Reading some of the theories on the subject of boiler explosions, it seems to me that one must feel that the causes for such disasters, are as much in the dark to-day as they were twenty-five or more years ago, and that all these long years of study have developed nothing material to help dispel the mystery that seems to be so ready to attach to every boiler disaster.

I can remember when about all engineers seemed to think that a boiler would "bust" at some time or other, no matter how good care it had, but for years it has been a settled belief with me that there was a common sense reason for every explosion, and one not wrapped up in the gas theory either.

I am led to write this from reading an article in *The Mechanical News*, entitled "Steam Boiler Explosions," in which the writer severely berates the boiler inspection system, and puts forward the theory of water separating into gases, "each of which is as inflammable as gunpowder, and far more sudden in expansion when ignited than giant powder."

While I know these gases are very explosive, I think the condition is seldom favorable for their generation in a steam boiler. The writer referred to mentions the case of an engineer, who said to him: "I was running my engine, and I could not make my pump work, I knew the water was getting low. Soon I began to smell the gas. I lost no time in drawing the fire from the arch, and saved my boiler."

Yes, quite likely he smelled gas, as I have many times myself, but it is also more than likely that when he found his water getting low, he either closed his top damper, or threw open the furnace doors to check the fire, and thus got a sniff of gas from the furnace, I believe that if I was persuaded in my own mind that I was smelling an explosive gas coming from the boiler, that I should lose no time in trying to save my precious neck by putting as great a distance as possible between that boiler and myself. I have been caught with low water, very low, in fact, with a heavy fire on, but I got no smell of gas and felt no danger from that cause. Perhaps it was a case of "where ignorance is bliss, &c."

That there may be a sudden and powerful generation of steam at certain times within a boiler, sufficient to explode it, especially when water is low, I am not prepared to deny, although we have record of cases in plenty where feed water has been turned on after the plates had become greatly overheated, and no harm resulted. I do not claim to be an authority, or an expert on this subject, but it seems to me if this mysterious theory is allowed to gain ground, just in like proportion will boiler explosions become more frequent. I am firmly convinced, after a long experience with steam boilers, that boiler explosions are simply a question of the relative strength of the weakest part of the boiler, and of the steam (pure and simple steam) within, and that all boiler explosions can be traced to some tangible plain reason that could be understood by the average engineer, and the prevention of these terrible disasters is simply to care for the machine for the generation of steam in an intelligent manner, and this education is easily to be acquired by an average man if his heart is in the business.

The writer of the article referred to gives his attention to the boiler-inspection system in rather a forcible manner, to say the least. I know that an inspection made by an inspector in a $60 suit of clothes and kid gloves, is not a very reassuring operation, yet to judge all by some few instances is, in my mind, doing an injustice to many careful, intelligent and pains taking men, and a system that has for its purpose a humane object. I know that some of these local inspectors are a disgrace to the profession, but cannot such men be found in every occupation? A man to see one of the *Hartford Boiler Inspection and Insurance Company's* inspectors "go through" a boiler, will, I am certain, be convinced that he means business; and I have seen local inspectors do their work in just as thorough a manner, yet I do not say they are all as careful, for I know they are not. With one it is a matter of dollars and cents, with the other a matter of duty, depending upon his conscientious scruples for the proper performance of it.

As the writer referred to intimates, the cold-water test is of but little reliability. There are many boilers in use to-day that might stand 100 pounds, or even 200 pounds hydraulic pressure, that I would not like to run at 50 pounds' steam pressure, yet I do not say that the cold-water test is of no use. It has its purpose, and is all right when properly applied and understood. This is a subject upon which a great deal has been said, and I do not hope to enlighten anybody upon it, but if this article provokes replies from those better informed than I upon the subjects mentioned, its purpose will be accomplished. I myself feel more at home with the starting-bar than the pen. Hoping to see those who "know whereof they speak" express their views on these subjects, I remain, etc., L. P. Harvey.

Kingston, Ill., February 27.

◆

FEED PIPES TO BATTERIES OF BOILERS.

Editors Mechanical Engineer:

It is rather strange to me that you should spend time and labor in answering the letters from correspondents who desire information which may be, and oftentimes is, of much value to them and others, without money and without price. If I consult a lawyer or a physician, there is a nice little bill to pay. Why? Simply because they spent many long years studying to fit themselves for their profession.

"Why," said a Venetian nobleman to a famous sculptor, "you charge me fifty sequins ($120) for a bust that cost you only ten days' labor."

"Yes," said the artist, "but you forget that I have spent thirty years learning to make that bust in ten days."

And is it not the same way with you, Mr. Editor? Did you not serve a long apprenticeship in the rough school of experience; or else how could you give your correspondents the information they desire?

I have a few questions to ask, but I am afraid after what I have written, you will liken me unto the fox in Æsop's fable, that made a crow drop a piece of cheese it held in its beak, and which Mr. Reynard coveted, by telling the crow what a sweet voice it had, and asking it to sing! The plan worked well.

I asked a friend how the feed-water was regulated, where a number of boilers are connected, and all supplied by one pump.

"Why, it regulates itself; water will always find its level," was his answer.

I asked him then, whether the water would not flow more freely into the boiler nearest to the pump! He was stuck there!

Will you kindly give a sketch some time showing how a well-planned feed pipe is connected to a number of boilers, with the location of check and stop-valves?

Is a stop-valve necessary? I imagine the water is regulated by it. Is it?

Can the water possibly get higher in one boiler than in the rest?

I have not the opportunity of visiting a factory where several boilers are used, and so apply to you, and shall be obliged for any hints you may give.

Walter Burdekin.

[This is a matter of much interest, and we shall be greatly obliged to correspondents who will furnish a sketch of the feed-pipe and connections to a battery of boilers. We have no such designs ourselves.

In regard to furnishing advice in these answers to correspondents, it is a part of the business of the paper, and one which we value highly.—Eds.]

◆

A CRITICISM OF THE METEOR'S ENGINES.

Editor Mechanical Engineer :

In your description of the *Meteor*, March 3, you state that you are the first to lay before the public a sketch and description of this high-speed steamer which is to cross the Atlantic in five days ! Mr. Editor, allow me to be the first to criticise the impracticability of the engines to perform that work, either from purely practical construction, or theoretical performance of steam.

First—There does not appear to be any real practical construction in the engines, and there is certainly ignorance in the use of high-pressure steam. Who, at this late day, would attempt to use compound engines with the high-pressure cylinder submerged in a condenser, or, in other words, a low-pressure cylinder outside of a high-pressure cylinder ? With the present performance of a glven volume of steam, who would apply a rotary valve to use 300 pounds boiler pressure, and expect to keep them tight with sixteen ports in the chest? From the mechanical construction and design, and the work to be done, I should say the engines will be failures. The constructor ought to handle the shovel, grease an engine a while, and become more familiar with the use of steam at 100 pounds pressure, and the appliances for keeping engines tight with it ! When he has done this he will not build steamships to use 300 pounds boiler pressure, and compound engines with the high-pressure cylinder submerged in what is practically a condenser. N. W. Williams,

Prest. Keystone Council, Stationary Engineers,
Philadelphia, Pa.

[Our correspondent's criticisms are just and pertinent. We presume it is obvious to all why we avoided any allusions to construction in our brief sketch of the *Meteor*.—Eds.]

◆

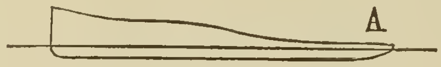
THE FOSSIL ENGINEER HAS SOME FUN WITH A COMPOUND ENGINE.

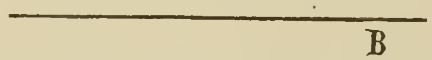
Editor Mechanical Engineer :

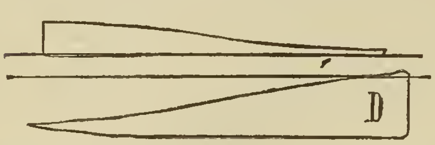
I have read a good deal about engineers, and will now give your readers the history of a stopper and starter whose acquaintance I recently made.

I was called to a place thirty miles off to apply the indicator to a compound engine which I put up in 1878. The engine was said to be out of order.

Diagrams *A* and *B* show most of the work done by the high-pressure cylinder. The low-pressure shows the cut-off out of its place. I reset the same properly, and took cards *C* and *D*.







On starting the engine, the engineer, hearing the water slamming and pounding on both ends of the low-pressure cylinder, raised the cut-off—that is, he carried it away from the back of the main valve by a device used for that purpose.

"What is that for?" said I.

"To let the water get out of the cylinder," was his prompt reply.

"My friend," said I, "the water never gets out where the steam gets in. There are two ways for water to get out : one through the cylinder cocks, which is the right way, and the other through the exhaust into the condenser. On your engine the cylinder cocks are stopped up solid, consequently the water has to go down into the condenser, as I said. To prove this, just look at the vacuum gauge when I open both cylinder cocks. If they are stopped up it will not affect the vacuum ; if they are open you will lose the vacuum at once, and the engine will not keep up her speed."

It was just as I said ; open or shut, the vacuum was all right, and too much for the engineer's head. I left the engine-room to figure up some cards, and shortly after I noticed that the engine had stopped.

I walked into the engine-room. There stood the engineer by the high-pressure crank-pin, with a big hammer and a big monkey-wrench loosening the set-screw, giving the key a blow, setting up the screw again and starting the engine. All this was done in an astonishingly short time.

"Well," says I to myself, "I'll be ——— if that pin don't heat." I went to work, and about ten minutes after the engine stopped again. Before I reached the engine-room I smelled the burning oil, which told the whole story.

The pin had got hot, and was perfectly blue, probably for the twentieth time. The engineer and fireman were pouring on water, trying to cool it down ; the engineer loosened the set-screw, drove the key back with one blow, and started the engine again. This made the worst noise I ever heard in my life ! After all this, I saw him screwing up a stuffing-box with a fifteen-inch monkey-wrench, first one side as far as he could, and then the other side, without paying any attention as to whether it was straight or not. It is no wonder that the piston and valve rods are ornamented with grooves of all sizes !

I informed the proprietor that his engine needed overhauling ; that he should get an engineer that understood his business, pay him good wages, and he would then stand some chance of saving the rest of the engine.

Troy, N. Y. Caution.

◆

THE INDICATOR PISTON CAUGHT.

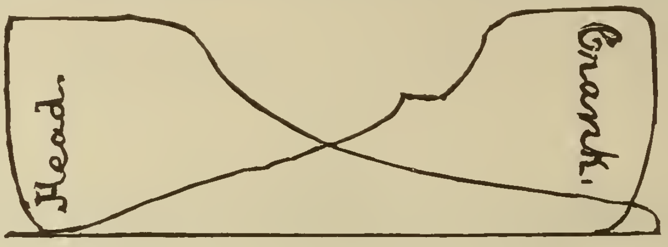
Editor Mechanical Engineer :

Enclosed please find a diagram taken by me with a Crosby No, 2 indicator, from an engine 12x32″ cylinder, at 60 revolutions per minute and 75 lbs. steam. A 50 spring was used with the indicator. Can you tell me what makes the step in the crank diagram expansion line? I can see that the exhaust valve opens too soon on that end, but I don't see what causes the jog in the expansion line. I used a 40 spring in the indicator, but it made no difference in the card.

The Crosby improved, No. 2 indicator, is a splendid instrument, and I am highly pleased with it.

I am a young engineer, and am trying to learn all I can about that calling, and I believe that knowing how to use the indicator is a part of it. I hope you will publish more articles about it in your paper. Right here let me say that The Mechanical Engineer, once a week, is just what I want. I have three or four mechanical papers on file in my engine room, but there are none of them that I have to refer to as often as The Mechanical Engineer.

Westboro, Mass. Blower.



[The piston of the indicator stopped for an instant, probably through grit or dirt ; it doesn't need to stop very long to make a jog in the expansion line at 66 revolutions! Be very careful of your indicator and have it absolutely clean and free.—Ed.]

◆

INDICATOR DIAGRAMS.

Editors Mechanical Engineer :

I am employed in a shop where the building of steam engines is almost the whole work. There is a man at work in this same shop who can tell what kind of a diagram an engine will form before he tests it. Will you be so kind as to inform me, as near as you can, how he does this?

Troy, N. Y. J. S. G.

[No man can tell what kind of a diagram an engine will make until it has been tested with an indicator, unless he has built a great many with the same point of cut-off, used at the same pressure and run at the same speed. Even then he can only approximate it.

Indicator diagrams depend upon the points above enumerated, and the causes of variation in them are many.

For example, leaky valves and pistons, contracted steam pipes, etc., etc. A diagram can be plotted (laid down) for a given pressure and point of cut-off, but it will be a theoretical diagram and not an exact one.—Eds.]

◆

A SARCASTIC INVESTIGATOR OF BOILER EXPLOSIONS.

Editor Mechanical Engineer :

Some years ago the writer was the victim of an explosion. This is how it happened : I was running a small engine, the blow-off cock on the boiler consisted of a common one-inch globe-valve. A nipple, three or four inches long, connected it to the lowest and coolest part of the fire-box of the boiler. This valve leaked just a little, though it might have been remedied by screwing a soft-wood plug in the outlet and allow sediment to collect in the leak. After awhile I investigated for a result. I crawled under the boiler and took hold of the plug to pull it out. The result was the aforesaid explosion. With the least movement of the plug it popped out, a flash of hot water and steam following with such violence that it, or the uncomfortable sensation of its temperature, drove the cranium of the operator upward very suddenly, until its motion was arrested by the barrel of the boiler, a rivet-head acting as a sort of air-cushion, as it were !

After a few moments of serious reflection (wondering what part of the wreck had struck the noggin previously alluded to), the young engineer ventured to take in the surroundings. Finding everything running along as if nothing had happened, his next thought was, did any one see the performance ? No one was near and the experimenter felt better, except for the impression of the air-cushion.

Now, this flashing of water must be accounted for by some of the various theories on boiler explosions. Superheated water was then considerably in vogue ; could it have been superheated by being projected through a small leak by the friction on the sides of said leak, or did this heat the valve to such a degree that the water assumed the spheroidal state? Why couldn't electricity have been generated, and that make it flash like gunpowder? Then, again, who knows the character of the gases that might be formed by a combination of wooden-plug, brass, water, scale, mud, etc. Here is a grand opportunity to utilize learning !

One other thought suggested itself : that is, if the plug had been secured to stand the pressure inside the boiler, and been let alone, there would have been no flash or explosion !

At the time of the Sandy Hook experiments on boiler explosions, how I wanted to tell those scientific engineers to take the head out of a boiler, and plug the hole up, then get up pressure, pull out the plug, or let the pressure force it out. What a vast amount of scientific facts could be crowded into such an experiment ! I. L.

Sturgis, Mich., February 15, 1883.

SOME QUERIES ABOUT ENGINES AND BOILERS.

Editor Mechanical Engineer :

Being a new reader of your highly appreciated journal, I wish to ask a few questions which I hope you will answer through The Mechanical Engineer. I believe, Mr. Editor, you are a safe criterion to refer to, and by demonstrating the following questions with examples and rules, you will fulfill the anticipation of an *advocate* a thousand miles away.

1. How would you find the heating surface of a horizontal (tube and tubular) boiler?—your own dimensions.
2. How would you find the horse-power of a boiler?
3. How would you ascertain the amount of water a boiler will evaporate per horse-power?
4. How would you calculate the dimensions of a chimney, to insure good draft?
5. How high should the lowest gauge cock be above the flues ; also second and third cock?
6. How do you ascertain the quantity of water a boiler will hold?
7. How do you ascertain the grate surface of a boiler?
8. How would you find the horse-power of an engine of any size; speed and pressure being known? Why do engineers take less than half the boiler pressure for the mean effective power of an engine?
9. How would you ascertain the length of connecting and eccentric rods?
10. When lap is added to a slide valve, must the throw of the eccentric be increased to the amount of lap added, or must the eccentric angle be increased?
11. How would you calculate the proper size pump for a boiler?
12. Explain the philosophy of the workings of an injector, that is, how can an injector taking steam from a boiler through a small pipe, force water into the boiler?
13. I wish you would publish a list of books most desirable for boiler makers and machinists, or in other words, a list that would constitute a library. Novice.

St. Louis, Mo.

It is impossible to answer all our correspondent's queries with examples and rules. He will see from the space we have given him that it would take too much room.

Answers to the above question are appended in their order:

1. The heating surface of any boiler is all that directly opposed, and exposed, to active heat ; not radiated. For instance, the water-bottom directly under the grates, and the legs inside below the grate (if there are any legs) are not counted as heating surfaces. In the case of tubes or flues, the upper half of the diameter in fire-tube boilers, and the lower half in water-tube boilers, are counted as effective. We would estimate the whole of a fire-tube surface (internal) as effective, since heat reverberates from wall to wall of a tube, and acts on every inch. The first half of the length of a flue, or tube (depending upon its diameter to some extent), is more efficient than the last half of the length. The heating surface of a boiler is all that part above the grates in the fire-box, and all that part in the tubes or flues. The superficies—that is, the dimensions in square feet—of these constitute the heating surface of a boiler.

2. The horse-power of a boiler is its ability to evaporate a given quantity of water per hour with a given heating surface. Thirty pounds of water evaporated at 70 pounds pressure, starting from 212° (that is, the boiling point), was adopted at the Centennial as a standard, and it is the one generally accepted as the best expression of the horse-power of a boiler. Where heating surface is taken as the basis of a horse-power, a tubular boiler should have 10 to 15 square feet heating surface ; a flue boiler, 8 to 12 square feet, and a vertical boiler 15 to 20 square feet heating surface per horse-power.

3. Tests of the amount of water evaporated in any given boiler, for a given period of time, are many. It is a very delicate matter to determine with absolute accuracy. Approximately correct results are obtained by starting with the water at a certain height in the boiler, as shown by the gauge, and stopping with it at the same height, and the same temperature. The amount of fuel burned is weighed and charged to the evaporation, but the trouble begins when the experiment is ended, in *estimating* the amount of fuel left on the grates, and its efficiency. That is, how much of it should be charged to, or dedncted from, the total quantity used.

Another method is weighing the fuel for a given time (starting and stopping with fires in good condition as estimated by the eye), and condensing all the water made into steam, during the experiment, in a tank. After which it can be accurately determined by weight or measure. Another method is by the indicator diagram. This accounts for a certain amount (weight of steam) used in any given run, the relative volumes of steam and water, at given pressures of steam determining the amount of water needed for it, less leakages through the valves and piston. In all tests for evaporation the greatest source of doubt is the condition of the fire at the end of the run.

4. For dimensions of chimney, see article on "*The Draught of Chimneys*" in last issue.

5. No lower gauge-cock should be less than two inches from the crown sheet for ten horse-power and under, and from that up to four and five inches over the crown sheet for larger boilers, depending wholly upon the rapidity of evaporation in the boiler.

6. The quantity of water a boiler will hold, is estimated by the cubic inches of the water spaces. This comes under the head of mensuration. For one example, take this : the water in a cylinder boiler fills half of it, say ; then the water space is the segment of a circle. It is required to find the superficies of this segment :

"*From three times the diameter of the cylinder deduct twice the height of the segment. Multiply the remainder by the square of the heighths, and that product by .5236 ; the sum is the capacity or solidity of the segment. This, multiplied by the length of the cylinder gives the amount of water contained in any given boiler. If there are flues or tubes in the cylinder, the solid contents of them must be taken out.*"

A much shorter way would be to estimate the solid contents of the cylinder. This is done by multiplying the area of the end of it by its length. This gives its contents in cubic feet. If we multiply the cubic feet by 62.5, we shall have the total quantity of pounds of water any given cylinder will contain. Deduct from the above any space not occupied by water.

7. For this our correspondent must mean, "How do you ascertain the grate surface *for* a boiler?" The grate surface *of* any boiler is found by multiplying its length in feet and inches by its width in feet and inches. Conventional allowance of grate surface is about 24 to 1, that is, 24 square feet of heating surface to every foot of grate surface. A boiler of 120 square feet heating surface (total), would have a grate of about 5 square feet, say 20″x 36″.

8. The horse-power of any engine can only be determined by an indicator. Cut-and-dried rules are useless. The actual power is determined by the average pressure in the cylinder, which includes, of course, the pressure in the steam-chest at the commencement. Engineers do *not* take less than half the boiler pressure of an engine as the mean effective. Some engines may not obtain any more than that, but this obviously depends upon conditions.

9. Length of connecting rod should be (conventionally) three times the stroke of piston ; that of an eccentric rod is determined by the draughtsman in laying down the engine, from the two extremes of throw of the eccentric and the position of the valve gearing.

10. In adding lap the throw of the eccentric must be increased and the angle advanced to give more lead. If you add to the length, the valve is "behind" in admitting steam to the piston.

11. To determine the size of a pump, the probable evaporation must be known, but there is really no occasion for this. Pumps are generally very much larger than they need be, and the feed supply is gauged by limiting their capacity. A boiler supposed to evaporate a certain quantity of water per hour should have a pump greatly in excess of it to allow for exigencies.

12. We decline to attempt to explain the injector, for the reason that we do not know how. We have seen theories without number, but none of them explain anything, for they start from no bases, or from assumed bases. It is an anomalous, paradoxical instrument, of which but little is known by any one, except the bare fact that it does what is claimed for it.

13. We must refer you for a list of books to the catalogues of publishers who advertise in our columns. They will be sent upon application.—EDS.]

SMALL ENGINE CASTINGS WANTED.

Editor MECHANICAL ENGINEER :

I have taken your valuable paper two years, and like it very much. I would like to know—and perhaps others of your readers would like to also—where castings for small steam engines, about 4″x 4″ and 5″x 7″, of good design can be bought. An upright would suit me the best.

STERLING, Ill. W. B.

PLEA FOR A NATIONAL LICENSE LAW FOR STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER :

I wish to express my views on the subject of licensing engineers. It is surprising how rapidly these associations of engineers are gaining force and favor. That they are appreciated by all good engineers is quite evident. Years ago when I was running a stationary engine in Detroit, and before there were any societies of, or licenses granted stationary engineers, I often asked myself why it was that stationary engines and boilers were so often entrusted to incompetent men ; more so than marine engines and boilers were. The danger to life and property on land, in most cases, is tenfold greater than on water.

I know of a firm who engaged a young man to run the engine and fire in their shingle mill. It was his first experience, as previously he had worked on a farm. The first week he was shown how to fire and how to distinguish steam from water by the saw-filer, which was as much as he (the filer) knew himself. But our ploughboy soon learned more : he found out that by adding more weight to the safety valve he could have more time to tumble the shingle-packers about, and have other sport with the help around the machines. The pressure on the boiler previous to this had been 75 and 80 pounds, but now 120 pounds was very common ! To add to this, on the upper and lower floors, and just behind the boiler, there were fifteen to twenty employes at work : had the boiler burst it would, without a doubt, have blown each and every one of them to atoms.

Some time afterward the boiler was blown off, and it was found that *all* the braces at *both* ends of the boiler were broken ! This is only one case out of thousands; hence the great necessity of having licensed engineers in charge of steam engines and boilers all over, not only in crowded cities, but in towns, villages, and in the country. And why not in the country? Why can't it become a United States law on land as well as on the water? I hope the time is not far distant when a general license law will be passed. It would certainly be a benefit to property owners and the public in more ways than one. REASON FOR IT.

MICHIGAN.

TROUBLE WITH GRATE BARS.

Editors MECHANICAL ENGINEER :

I have been troubled with grate bars breaking, and if you, or any of your readers, can tell me what causes it I will take it as a favor. They break just at the front end, next the fire-doors—nine of them have broken in about seven months. The bars are 4 feet long and the furnace is about 8 feet wide, used for two 40-inch boilers, 22 feet long (externally fired). We use coal screenings, or slack, to fire with, and in cleaning out the fires let them die entirely out (one at a time), and after raking the cinders out, draw the next fire over and throw in enough fresh coal to cover the bars. They are ⅝ths thick bars, with ⅝ space.

The boilers are in a flouring mill and run the entire week without letting steam down.

COULTERSVILLE, IND. J. B. BEATTIE.

[Probably the cause of this is poor stock. If the grate bars are made in the average country foundry they contain a large proportion of worthless scrap. Anything is thought good enough for a grate bar! There is nothing in the use, or proportions of the bars, that should make them give out in two weeks regular work.—EDS.]

OBITUARY.

Editors MECHANICAL ENGINEER :

Please insert the following notice in your valuable journal, as Mr. Hemmingway had a host of friends among all.

J. C. KIRSCHNER.

TEXAS STAR FLOUR MILLS, Galveston, Tex.

DIED.

At 8:30, February 15, JERRY HEMMINGWAY, aged 37 years, after a lingering illness of ten weeks. He leaves a wife and four children and a host of sorrowing friends.

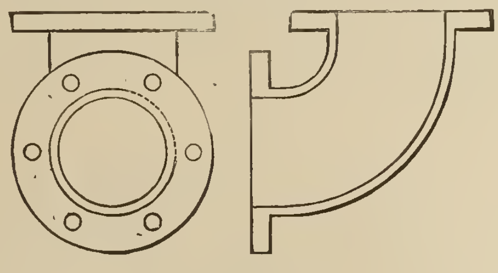
MACHINISTS OF THE FUTURE.

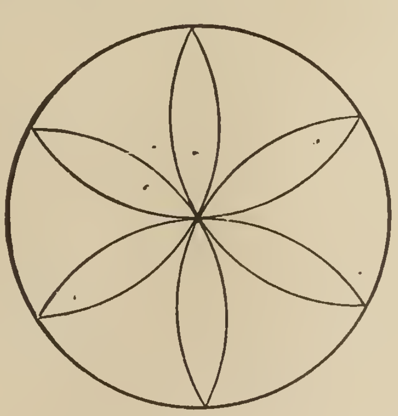
Editors MECHANICAL ENGINEER :

THE MECHANICAL ENGINEER just received. "The Professor in the Machine Shop" suits me exactly ; also a good many others. I am not acquainted with the writer, but if I were I should probably say : "Go ahead, Moulton ! likewise Jacob and Rhombus ; although the name 'Rhombus' would indicate something out of square, perhaps for lack of braces." Being trained in a thorough machine shop has a wonderful effect in bracing a man ! But to the original subject : Are we, or should we not be, as much interested in training the coming generation of machinists, who are to take our places, as in building the best machine work ? I take, in every way, as much interest in our boys as I do in my machine building, and I am pleased to find that most of those that I have hitherto trained are in demand at good wages. Help the boys along ; don't forget that we were all of us boys once. A man who has not been one, is not, in mature years, good for much. Give them work that requires responsibility, and trust them to do it ; if one should not do as well as we think he ought to, just turn our mind's eye inward and backward, and try to recollect how much this "*old boy*" knew and did at that age. Give the boys to understand that they have their places, and that if they cannot fill it, others will have to do so. One of the worst things you can do, is to show a boy, by your actions, that you consider his time of no value. If *you* consider it so, how can you expect him to feel otherwise ? And then good-bye to self-respect and self-reliance, the two most essential points in the business of life if based upon correct premises. I would say to the ladies, if any of them read our paper, encourage your boys; show that you take an interest in their studies. I well remember in years gone by, when my mother watched my attempts at drawing in the evenings, and was pleased when I attained sufficient proficiency to be entrusted with work by the boss ; her approval was worth more to me than all the rest. My father encouraged me in every way, but he was at sea most of the time.

So I say, gentlemen, go ahead ! If you can tell us how to do better by our boys than we are now doing, how to become better men ourselves, and to improve those with whom we associate, it will be worth ten times the price of the paper each year.

We have a drawing class for our young men every Monday, and there seems to be a good deal of interest shown, and quite as much proficiency as can be expected. By the way, I don't envy the college professors who have to teach drawing to boys who know nothing about machinery !





I append the following drawings by two of our pupils—the elbow by George A. Silver, aged nine years, and the other by Frank Silver, aged seven years. He thinks it a shame he cannot stay up for the drawing class, but he goes to sleep too early ! W. T. SILVER.

SILVER IRON WORKS, SALT LAKE CITY.

◆

For cutting narrow slots in a hardened steel plate a disk made of Muntz metal, revolving at about the speed that would be used for turning wrought iron of the size of the disk, and using fine quartz sand and water has been found to work better than disks of other material.

NATIONAL MARINE ENGINEER'S ASSOCIATION.

President J. H. Reid, of the *National Association Marine Engineers*, has been to Milwaukee and reports active interest in the cause there. No. 9, Milwaukee, is once more in line, with good men to the fore, who are very anxious to rank among the first in the Association. President Reid adds that we shall have a good report from them January 1st, 1884. No. 4, *M. E. A.*, Chicago, were very active in making President Reid feel at home during his short stay there, and he instances Brothers Ponsonby, Ritter, Quinn, and Donly, as prominent in their attentions.

President Reid also says, in a letter of later date, that he has divided the country into districts, and appointed officers for each district with full power to extend the interests of the Association in all proper ways. The crowded state of our columns will not admit of fuller reports.

Brother E. Graham Brown, of No. 15, *M. E. A.*, New Orleans, representing John S. Snediker & Co., National Oil Works, paid us a visit on the 23d, and reports an active interest in the Association in his section.

ECHOES FROM THE WORKSHOPS.

BY OUR OWN REPORTERS.

The Allegheny Valley Railroad Company has in its shops at Verona a car wheel grinding machine. The wheels used by this company under its passenger coaches and engine tenders are all ground before going into service, and all flat wheels are reground and used on trucks having no brakes. The Company is highly pleased with the machine.

The A. V. R. R. uses the Miller coupler, and is now fitting the tenders of its passenger engines with rear platforms and a coupler and buffer, railing, steps, and all complete. The link and pin-box being removed, room enough is obtained for a narrow platform, and a piece of timber bolted to the endsill gives ample width. A pair of draft-timbers is fitted in, reaching from the endsill to the body-bolster. The whole arrangement is very neat and ornamental, and gives great satisfaction.

The Pittsburgh, Fort Wayne and Chicago Railroad turned out one hundred and twenty freight cars and two locomotives from their Allegheny shops during January.

Passenger Engine No. 310, on this road, made 5,123 miles, and Freight Engine No. 501 made 5,220, while six other passenger engines and three other freight engines each made over four thousand miles. A good showing.

◆

A new repeating rifle, which can be fired from the shoulder with great rapidity, is now in process of manufacture, and will be on the market in due course. It is the work of Mr. Spencer, a well-known inventor in this line, and has been fired by him from the shoulder at the rate of 36 shots in one minute. The mechanism is very simple and the weight not excessive. A new armory devoted to its production will be erected in or near Windsor, Conn.

◆

We have received the first number of the *Water Gas Journal*, a monthly paper, devoted to the gas interest apparently, and contains matter useful to persons in that line. Not knowing very much about gas, or its literature, we are unable to express an opinion of the *Water Gas Journal*, but we are quite willing to wish it success. It is published in the Gerard Building, Chestnut street below Fifth, Philadelphia, Pa.

◆

The deepest sounding ever made in the Atlantic was obtained recently from the United States Coast Survey steamer Blake ; the lead did not touch bottom until 4,561 fathoms had been paid out. The greatest depth heretofore found in the Atlantic was 3,862 fathoms. A fathom is six feet.

◆

The importance of quickly stopping ocean steamships and river steamers leads the *Marine Engineer* (English), in its December issue, to illustrate and describe Tate's electric apparatus for closing valves and stopping steam engines. The invention is equally applicable to all kinds of steam motors whether in or out of the factory.—*Engineering Review.*

Sometimes there is danger in stopping a steamer quickly. We recall a steamer on Lake Erie, many years ago, the engine whereof was stopped (unhooked) at once, by order from the pilot-house, while the vessel was under full headway. The result was that two long holding-down bolts, four inches in diameter, from the beam centre pillow-blocks to the bed-plate, were broken short off.

◆

A rubber-lagged pulley will work better after the soapstone coating has rubbed off ; when it gets greasy it loses grip.

The Mechanical Engineer.

EDITED BY EGBERT P. WATSON.

FORTNIGHTLY.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NEW METAL UPON OLD METAL.

Instances are not wanting, within the experience of old mechanics, where putting new material upon old material has been followed by immediate disaster. We call to mind a case which occurred several years ago upon Lake Erie, which was a signal instance. A beam engine had been repaired by having a new bottom put into the cylinder, and the engine had scarcely been run two days when the cylinder itself split from top to bottom, with no apparent cause for the accident. We have also vague recollections of similar disasters occurring to engines and machines immediately after repairs, which could be accounted for upon no reasonable grounds. "Vague recollections," in the above instance, is somewhat prejudicial to our inquiry, inasmuch as it implies that we know nothing of a certainty; but we use the expression advisedly, merely because we cannot cite time and place for a given disaster. Engineers of experience have doubtless remarked that putting a new sheet, of any size, on an old boiler is certain to cause leaks. That is to say, the work may be tight, cold, under great hydraulic pressure, but when the boiler is actually at work under steam pressure, it leaks more or less in the vicinity of the new sheets.

It is not so difficult to account for this as for the other disasters mentioned. A boiler is by no means a rigid structure, and the cutting out of old rivets, with the jar attendant upon such work, to say nothing of that incurred in rivetting new sheets to old ones, might easily cause leakages; through knocking off scale, or dirt out of the seams, if nothing more. It is therefore not so wonderful that putting new sheets into old boilers should start leaks.

The first instances mentioned in this article, are, in our estimation, sufficiently established to warrant comment, probably inquiry into the cause, or causes. Why should the mere substitution of new material of the same kind applied on, and connected with, old material, in such a way that the structure as a whole is one piece, be liable to cause accident. Variable expansion is a tremendous force, that is to say, two metals rigidly connected, expanding in different ratios, tear their bonds asunder. Is there any difference in the ratio of expansion between new cast-iron and old cast-iron? We do not know, and we do not see how there can be. Expansion is caused by the ability, or capacity of a substance to receive a given quantity of heat, and there should not be a marked difference in this respect between new cast-iron and old cast-iron.

In some instances, however, within our recollection, expansion could not have been set up, for there was no heat. Machines in daily use, such as lathes for example, have broken after having been repaired. We recall at this writing a sort of A frame, which had been repaired by burning. One of the legs was broken and the parts were joined again by being burned together, a process which is too well known to the trade to describe here. This frame broke soon after having been put into use, not where it was burned, however, but on the opposite side in the old metal. Of this case it may be said that the cause was unequal shrinkage, and that strains were introduced by the act of burning. This is plausible enough in itself, but does not apply in many other accidents.

Incidents are many, no doubt, in the experience of others besides ourselves, where repairing old work has been followed by an extensive breakdown, not of course inevitably, but in so many cases as to be marked. It is chiefly to record them and stimulate inquiry that we made these remarks.

If any of our readers can cite cases where break downs have followed closely upon repairs, we shall be pleased to hear from them.

◆

OUR PROMISES.

A correspondent alluded in our last issue to the fact that, thus far, we had fulfilled all our promises and that he had no doubt but that we would continue to do so. His surmises are quite correct on this point, and our readers may rest assured that the full bill will be presented. The amount of original instructive matter, valuable to mechanics, presented in every issue of this paper is not given by any other extant.

◆

AN ENGINEERING DILEMMA.

What appears to the dispassionate observer on this side of the Atlantic, a curious dilemma in steam engineering, occurs in the *Polyphemus*, a new English naval vessel. It seems that the boilers with which she is fitted do not perform satisfactorily, and are to be removed. This is not a simple matter. It was assumed when they were put in that the boilers were all right, and the vessel was therefore decked over and completed as to her uper works, leaving the boilers built in, and actually one with the ship, so far as removal is concerned. Upon trial it was ascertained that the boilers not only leaked around the tubes badly, but also primed, perhaps, with malice aforethought.

These defects do not appear to us wholly without remedy, but they were enough to cause the boilers to be condemned by the Admiralty.

Now, the question is, how to get the boilers out without tearing the ship to pieces!

The Irish method of casting cannons is, we are given to understand, to take a hole and pour melted iron around it. Some similar process appears to have been followed with regard to these boilers—the ship was built around them, and there they are.

In commenting upon this matter the *Engineer* says:

> "It is now officially announced that the locomotive boilers in the ship are a total failure. They are to be removed and replaced by cylindrical multitubular boilers of the ordinary kind. It has not been officially announced, however, that the ship will have to be cut to pieces in order to get the old boilers out and the new ones in. We believe that it has not been decided whether the old boilers will be dropped through her bottom while the ship is in dry dock, or whether her decks and upper works will be cut away to let them be hoisted out; but we know that the former method of removal and substitution would be the better of the two. The *Polyphemus* is armored all over her turtle-shaped deck with plates or tiles of Whitworth steel. To get these tiles off will be no easy matter; and they could not be taken off and replaced without racking the whole structure underneath. To cut a great aperture in her bottom will be a simple matter, although, we may add, one not unattended with expense."

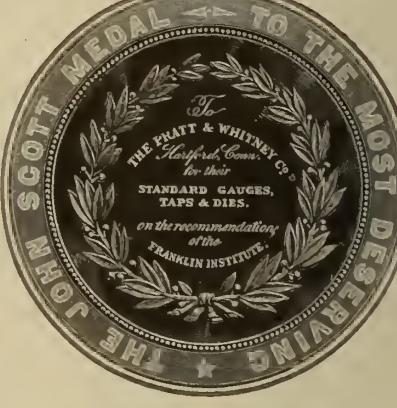
It is so easy to be mistaken! We are tempted to ask, in no captious spirit, what would have been said of American engineers if they had made such a blunder as this?

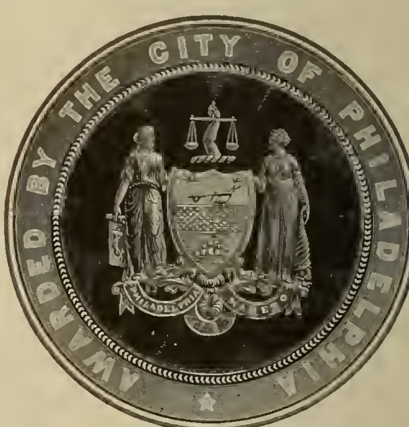
◆

A MARKED DISTINCTION.

The Pratt & Whitney Company, of Hartford, Conn., has recently received a handsome trophy in the form of the "*John Scott Legacy Medal.*" This honor is seldom awarded to any firm, and only for more than ordinary excellence in any given line of manufacture. In the limited time at our disposal we have not been able to trace the origin of the *Scott Legacy Medal*, but in the transactions of the Franklin Institute, for 1835-'40, the following allusion to it is made:

> "By an ordinance of the City Council of Philadelphia, the award of the premiums and medals for the Scott Legacy Fund was vested in the Franklin Institute, Feb. 27, 1834, and by the managers of the Institute the duty of recommending such awards was confided to the Committee of Arts and Sciences. . . .
>
> The die for this medal was executed in a transfer lathe, by Franklin Peale, Esq., by the aid of an iron cast, admirably executed by Isaac Babbitt, of Taunton, Mass.




AWARDED BY THE CITY OF PHILADELPHIA
PHILADELPHIA

We have procured engravings of this medal and present them herewith. The original is bronze, four inches in diameter, inclosed in a morocco case, with the coat-of-arms of the city of Philadelphia upon one side, and a laurel wreath upon the other. The inscription reads:

TO
THE PRATT & WHITNEY COMPANY,
HARTFORD, CONN.,
FOR THEIR STANDARD GAUGES, TAPS AND DYES.
On the Recommendation of the Franklin Institute.
TO THE MOST DESERVING.

The medal was accompanied by a letter from the secretary of the Franklin Institute, announcing the award.

This is a merited recognition, and one wholly unexpected to the Pratt & Whitney Company. Their efforts to establish exact measurements, through their standard gauges, and accuracy in taps and dies, have met with cordial recognition all over the world, for their trade is not confined to the United States, by any means.

◆

The oldest locomotive engineer in active service in this country, is William Galloway, on the Baltimore and Ohio Railroad. He is 74 years old, says the *Railway Age.*

A DANIEL COME TO JUDGMENT.

Somewhere in the office of the *Iron Age* there lurks a gifted being who is constantly relieving himself of such perilous stuff as this:

> "Some men, especially mechanics, never seem to be able to learn the lesson that a slow machine is often cheaper than a fast man. The other day, when talking with a very expert machinist in regard to a certain job of work—we forget now just what it was—he said that he could do it in 15 to 20 minutes any time, and in about half the time which it would take the ordinary machine to perform the same job; but he forgot that he is worth about $4 per day, while the machine and the boy to run it is probably not worth more than half as much. The complaint is often heard that planer hands, lathe hands, drill-press hands and special-tool men are driving out the good and expensive machinists; that the boy learns to run a drill-press, and so takes the bread-and-butter out of the mouths of men who not only know how to handle a drill-press, but make it as well, if necessity comes. The fact is forgotten that when the drill-press is simplified so that a boy can do a certain class of work on it, a great many extra boys and drill-presses can be employed doing work which it would never pay to do if the first-class machinist had to furnish the labor. The machinery in such cases lifts boy and machinist together. The man that has the brains is taken where his brains and skill are of the most value, and the day-laborer finds himself in a better position than before. Instead of turning a crank to furnish power, as was the fashion years ago, he has advanced several steps, and is perhaps at a drill-press or an emery-wheel, or doing a class of work considerably more valuable than that which he would have had in the last generation."

This must have been thrown off in an idle moment, the argument being left out as superfluous. What there is appears to be in favor of employing unskilled mechanics, instead of skilled ones.

A touch of Darwinism enlivens the oracle when it speaks of the modern drill-press man (a being, let us say, we have never yet met) as having "evoluted" from a common laborer. He has shed his skin, so to speak, and risen by reason of this decortication.

> "The day laborer finds himself in a better position than before; instead of turning a crank, etc., he finds himself at a drill-press, etc."

Bless your inexperienced heart! he is the same old day laborer, with the same old rate of wages. His position is no better, nor is his status higher.

Our gifted being reasons from false premises when he cites man against machines, and he is insincere in his illustration as well; not through intention, but for the reason that he does not know, of his own knowledge, whether the machinist's statement is correct or not. We know that it is not correct!

The assertion is made that, for a given piece of work a man can beat a machine. Taken broadly, the man cannot.

Asserted as true, in special instances he may.

A machinist may take up a piece of cast iron, say 2 inches by 6 inches, and face it off reasonably true. By working at the top of his speed for a short time, he may get it out of hand sooner than a man with a shaper can pick it up, set in the shaper, get his tool adjusted and do the same amount of work. Even this is doubtful. Let the machinist at $4 per day, however, work ten hours against the shaper for ten hours and see which will accomplish the most work in surface covered and weight of metal removed.

◆

"ENGINEERING REVIEW."

We have received the first issue of this publication, it being the weekly edition of *Mechanical Engineering*, a well-known illustrated monthly, printed at 16 Charing Cross, London, and conducted by A. Tolhausen, C.E.

As its title implies, *Engineering Review* is a retrospect of events in its specialty all over the world, and at the price for which it is sold, about $1.60 per annum, is a valuable compendium. It is very well edited, and due credit is given to the sources of information. No one can lose anything by subscribing for it.

◆

"Care killed a cat" saith the proverb, but it never spoiled a job in the shop, ran a ship on shore, or endangered a life. "I guess so" has done all this, and more. "I think so" has made as many misfits, and slouch jobs as the law allows, and "that's good enough" is the worst man in the shop.

◆

This city employs 892 men in the Fire Department, and pays, for the item of salaries alone, the sum of $1,047,591.

THE PROFESSOR IN THE MACHINE SHOP.—NO. XXIX.

In pursuance of our agreement with Mr. Blank to survey his premises and report upon the changes needed for economy, Jacob went over on Monday last and examined the works. To say that they were old-fashioned expresses the case very mildly indeed. Where the engine came from originally, even Mr. Blank could not tell us, for it was old when he bought it. There it stood, anyway, and we had to make something out of it that would be creditable to us and useful to the owner. One thing was good about it, there was plenty of iron in it, for in the days when this machine was built the art of making "heavy" castings by the aid of ogees and fillets was unknown. How to describe it without being extravagant, or seeming to pile it on, I don't know, but I will try. Perhaps many readers have seen its counterpart elsewhere. I am free to say I never did. It was a twelve-inch cylinder by three-feet stroke, and the flanges of the cylinder were two and a half inches deep and an inch and a half thick. The steam-chest was cocked up on two long ports, bolted to the cylinder, not cast on it, the chest and ports being all cast in one piece. The connecting rod was of wood, with wrought iron heads on each end, terminating in long straps which embraced both sides of the wooden centre of the rod, and were fastened to it by bolts through and through. Old engineers have seen such engines half a century ago, but I doubt if any of the younger ones ever did.

When I saw it I despaired of ever making any sort of a job of it. There is no need of going into more minute details of the machine, as I am sure they will be of no interest. Jake told me all this which I have narrated, and said I had better go over and look at it and see what we should do. So I went. I met Mr. Blank at the depot and together we went in the "engine room."

"What do you make of it?" said he.

"Well," said I, "Mr. Blank, if you want us to overhaul this veteran, we will, the same as any other job; but, while we can reduce the expense of running it, it will never be anything more than the oldest of old-fashioned steam engines."

"Have you put the indicator on it? I don't see it anywhere!"

He asked this question much as if the indicator could be laid on top of the engine, as a monkey wrench lies on a bench, and immediately reveal what was going on!

"There is no occasion to put an indicator on this engine, Mr. Blank. It cites its own story, as it is. If you have boiler enough to run this engine you have boiler enough for the place. Where is the boiler?"

"It's out here," said Mr. Blank; "let's go and look at it."

"Out here" meant, it appeared, two hundred feet, by actual measurement, from the engine.

"What is the object of having the boiler so far away?" said I.

"No particular object, only this stack draws better than the other nearer to it, and we thought, sooner than build a new one, we would move the boiler."

What could I say to the man? He did not know anything about the business of using steam as power, and didn't pretend to, so, if I had been sarcastic it would not only have been thrown away, but have been ill-mannered besides. To fill up the gap I opened the furnace door and looked in. What I saw was a species of cave, or wide space, unbroken from boiler-front to chimney-throat. This latter loomed so wide and vast in the distance, that I suspected the person who set the boiler had moved it up against the old stack, and broken out a hole big enough, in his judgment, to make a good draft. This was actually the case. After looking around a little we went back to the office.

"Pretty old style, ain't she, said Blank.

"Well, yes. Rather out of date."

"Is it worth while to overhaul her?"

"Yes, if money is of any value it certainly is."

"How much will it cost?"

"To effect a great saving it will cost very little, but if you want to modernize this establishment the only thing to do is put in a new engine and boiler, for the first thing."

"What's the matter with this one we have besides its being old-fashioned?" said Blank.

When he asked me this question, I saw at once how useless it would be to attempt to convince him that anything was amiss, so I did not undertake it. I contented myself with saying that time had changed the methods of engineering in fifty years, and that he was losing a great deal by remaining in the condition he was at present. Your business must be a profitable one, said I, to stand such a loss as this!

Blank grinned "Moulton," said he, "you are a pretty cunning man, but you are out now. Do you suppose if it was profitable, I would be going to all this expense? Other folks can make goods cheaper than I can, all on account of their confounded water-power, for one thing, I guess."

"Blank! did you ever happen to notice that the man who uses water-power is, as a general thing, a good ways from large markets?"

He said he had not noticed it, but believed it was so in the main.

"Things are about as well balanced in this world," said I, "as they would be if you and I were to boss the job, and I don't think you will find that there are, in the long run, any special dispensations in anybody's favor," but I will skip this and go on to business.

"Moulton," said Blank, "you ain't going to get any job out of me until you tell me what this thing will cost. I ain't going to begin without I finish, and I know how much I have to spend better than you do. What round sum of money will these repairs come to?"

"Answer me one question," said I, "how much does your fuel cost you in a year?"

"What's that got to do with the matter?" said Blank.

"It's got this to do with it: that we will make these changes in either of two ways you prefer; for a fixed sum, when the work is done, or for a percentage on the amount saved in fuel. Take your choice."

"You can't play any fuel-saving dodge on me, young man," said Blank. "If there is any saving effected, I am the man who is going to get the benefit of it. I will pay you a certain price, as I said, for these repairs; and that price has got to be named right here now, or I won't be bothered with it. I am a man of few words, and no foolishness. Life ain't long enough to go on fooling with estimates for a fortnight. What do you say?"

"I say this," said I; "we will fix this old trap all right, and make a good job for ——— dollars, paid inside of thirty days after the job is done."

Blank thought a minute and said, "Will you reset the boiler, too?"

"No, sir; neither will we build a new stack, or an addition on the shop. We will specify in black and white what we will do, so there will be no mistake as to what you are paying for. Our estimate is confined to the engine alone; not an inch from it.

"How much will it cost to include the boiler?"

"It won't cost you a cent, if you furnish help and material. We won't charge you anything for advice, but that boiler will have to come to not over ten feet from the engine; where the old stack is."

"It won't draw."

"Leave that to us."

"When will you begin?" said Blank.

"Now," said I.

"All right! come in the office and make your specification, and I will sign it, and you can go ahead."

This was done, signed, sealed, and delivered, and we went back to the engine-room.

"Can you begin to-day?" said Blank.

"We can begin this afternoon, first thing after dinner. I will telegraph my partner to send up two men, and we will break the joints and see what is inside of that cylinder." This I did; the boys came up on the train and we tackled the job at once. It *was* a job. I suppose that cylinder-head had not been off in ten years certainly, and the bolts were burned with grease and dirt just as solid as iron, almost. I had looked out for this, and had the boys bring tools to handle it with. Some of the bolts broke square off, but this was so much the better, as we got the thing apart quicker, and when we did we beheld a curious interior. The piston had no rings of any kind, nor any follower. Instead, it was a solid block of iron, grooved around its circumference. In this was poured some soft metal. The "packing" was attained by driving, or upsetting, this soft metal through holes left in the flanges of the piston, on the face, all round its circumference. The cylinder itself was worn all ways out of truth, and had to be bored out where it stood. No man living could ever have got that cylinder off the frame it stood on, safely, without breaking the lugs which held it down. Then we took measurements of all the parts, the lengths between the flanges for a new steam-chest and valve, the size of the shaft for a new eccentric, to be bolted on in halves, put the old piston back again, "upset" her packing a little to stop some of the leaks, made the joint on the cylinder-head, and left her. all ready to start next morning, to run until our new parts were completed.

What further happened to the veteran will appear hereafter.

PATTERN MAKING—NO. IX.

BY A PATTERN MAKER.

Examples.—There is probably no pattern made for machine work, that comes around with greater frequency than the pillow-block.

Pillow-blocks are of all sizes, various forms and kinds. They are made to receive a lining of Babbit-metal, or for brasses, or for neither. They are bolted to framing, are cast on the frames, are corner-blocks, brackets, standards and hangers; for all are modifications of the old pillow-block. We might do worse than take it for our first example.

Fig. 59 represents a pillow-block of the simplest kind, complete with its cap and bolts, as it would appear upon a drawing of some machine. Fig. 60 shows the block in plan.

Leaving the cap for the present, we decide that the block shall by molded base uppermost, as in that position the whole of the pattern will lie in the lower part of the mold, the under side of the base presenting a straight and level surface for an easy parting.

To accommodate the holding-down bolts, two oval holes must be made in the casting, also round holes for the cap bolts, with square recesses to receive the heads of such bolts.

Figs. 61, 62 and 63 show the pattern with the necessary core-boxes for obtaining this casting.

Plane up a piece of board for the base, giving a little taper, or draft, to the ends, but leave the sides square until the other part of the pattern is attached. Draw, with a steel scriber, or cutting knife, a centre line across the base on both sides lengthways of the base. The bottom of the pillow-block, or side uppermost in Fig. 60, is the cope-side of the pattern. On the cope-side lay off the recesses for the square-headed cap-bolts. On the reverse side draw the oval holes for the holding-down bolts.

To obtain the fillet at the base, take a piece of board of the same thickness as the radius of the fillet and gouge the fillet on the edge of it; the body of the block can be sawed at the band-saw. The sides of the block are supposed to be square, therefore very little draft can be given to them, say $\frac{1}{32}$ inch for 6 inches of depth; but twice that amount may easily be given to the ends of the body, as draft at that part interferes with nothing whatever. On the base of the block, in Fig. 60, we observe two projecting pieces having a great deal of taper. These are prints, which form recesses in the cope to steady the long cores which pass through the whole body of the block.

The reason so much taper is given to these prints is because cores projecting into the cope, if not well tapered off, will catch on the sides of the recesses made for them in the cope, and damage or destroy the mold when it is being closed up.

These prints should have recesses cut out in the base of the block to fit them, so that they may be loose on the pattern, otherwise, if the block is to be molded in a flask, and not in the floor of the foundry, the molder will have to cut holes in his bottom board. Parts of a pattern that rise into the cope are preferred loose by the molder, and the only objection against making them so is that such pieces are liable to be lost when the pattern is stored away, an objection which, I should say, would have but little weight where a proper system prevailed.

The core box, Fig. 62, for the cap-bolt holes, is formed of three pieces, exclusive of the ends. One piece, marked *a*, must be in length equal to the depth of the pillow-block, with lower round prints less the depth of the square recess in the base. In this piece plane out a semicircle of the diameter of the core. The piece next to it, marked *b*, is for the recess; it therefore corresponds to the heads of the bolts in thickness; it is, in fact, somewhat thicker. In this piece a triangle is cut equal to, or a little larger, than half a bolt-head divided diagonally, as shown at *d*, the end view of the box. The piece marked *c* forms that portion of the core which is to fit the recesses in the cope left by the square prints on the base of the block. The piece *c* is therefore cut out to fit the half of one of these prints cornerwise; the taper will then, of course, be the same.

These pieces, when fastened together and having ends nailed on, form a box in which half a core can be made. The half-cores when dry are pasted together.

The oval core-box, shown in Fig. 63, is formed by pegging two pieces together, so that they part freely, and cutting out an oval whose centre line corresponds with the parting line of the box. The box equals in depth the base of the pattern and the oval print, as indicated by the letter *e*.

Fig. 59.

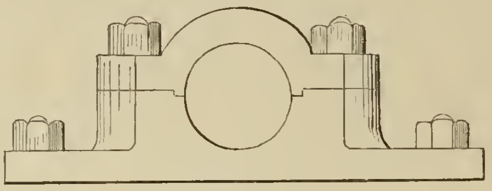


Fig. 60.

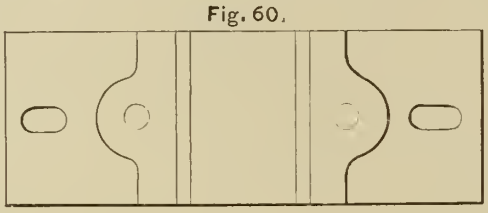


Fig. 61.

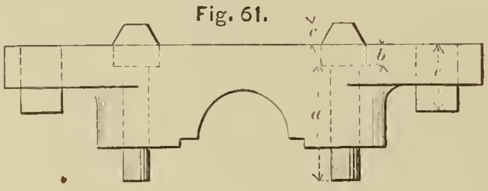
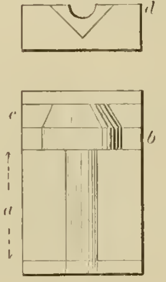


Fig. 62.



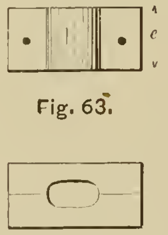


Fig. 63.

Fig. 64.

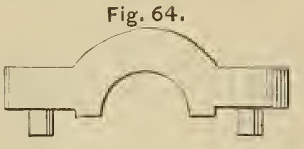
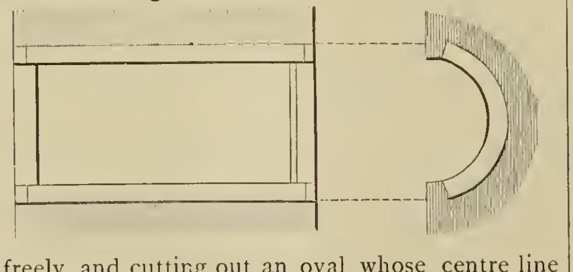


Fig. 65.



The cap pattern, shown in Fig. 64, can be made at the band-saw; the two prints afterward to be bradded on to match those in the block.

A core box is not necessary, as a portion of a core, made in box, Fig. 62, would serve, though most foundries are provided with boxes for making plain round cores of any size up to 3 or 4 inches.

When a pillow-block is required with a babbitt-metal lining, it is usually made as shown in Fig. 65. The patterns for the block and cap are made as before, with the exception that the bearing, or place to receive the shaft, is cut out as much larger than the shaft, as is needed to give the required thickness of babbitt. A half-ring is then glued in each end of the bearing, of such thickness as to reduce the diameter to the size of the shaft, better say a little larger, so that the shaft will be sure to go at once to its place without having to chip the block. Two light strips of wood run the whole length of the bearing; they must be loose and yet keep their position during the operation of molding, therefore, in each extremity of the half-rings a check is to be cut to receive the end of a strip. The strips must have a little play endwise, and also be planed a little back from the rings, or they will stand out beyond the rings in the casting.

In small bearings, say under an inch, the strips, which are to keep the babbitt from turning with the shaft, or from falling out, are sometimes omitted, in which case a recess may be cut in the pattern at the bottom of the bearing, or holes may be drilled in the casting. A goodly taper should always be given to both strips and half-rings, as I have endeavored to show in the figure.

If thought more convenient, the cap may be made to mold the reverse way to that here shown.

In cases where a number of bearings of the same size are to be cast on a frame, it is often preferable to core them out, as then we get a stronger pattern, and have only the one core-box to fit up with strips, etc., instead of the whole number of bearings. How this may be effected we will proceed to show in our next article.

VERNI NOIR.

DIES AND DIE-SINKING—NO. VIII.

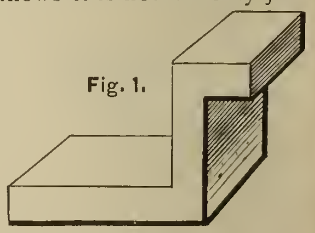
BY A DIE-SINKER.

To enable the reader to better understand these articles, I have divided the forging dies into classes and intend to illustrate two or more of each class, to show the different principles upon which the dies are made. There is a great variety of work that can be made in such dies as I have already described, and I think the careful reader will now know how to make similar ones, so we will take up another of a different class.

Necessarily, all drop-forging dies resemble each other to a certain extent, but the person who has seen one or two drop-forgings made, must not think he knows how to make all the dies for them. The different principles are clearly defined, and the man accustomed to the work can tell upon what principle the dies should be made as soon as he sees the model. Not so the novice. He has to be carefully educated up to the methods, be he ever so good a mechanic. If the principle upon which the forgings are to be made is wrong, no matter how well the dies are made, they will never give satisfaction in working. "Be sure you are right, then go on ahead," I have heard some one quote this motto; I don't know where, but I think it must have been written for a die-sinker.

Now, look at this forging (see sketch). It looks simple; you will naturally say that it is an easy thing to make. Anyone can bend a piece of flat iron like that! But it is not easy. Look at the corners where it is bent and see how square and sharp they are! Anyone who has tried to bend a piece of iron and make sharp, square, internal and external corners, knows it is not an easy job. But suppose we want one hundred thousand of these pieces exactly alike, how then? We must make dies for them. But how are we to make the dies? Can we make them similar to the last ones? No. It will be plain that we cannot draw a centre line through it like the last, except we set it on edge, and that would not do, for the die would then be too deep in proportion to its width.

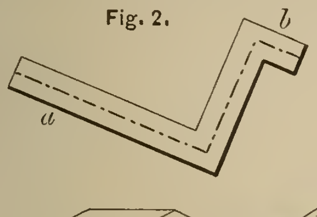
Fig. 1.

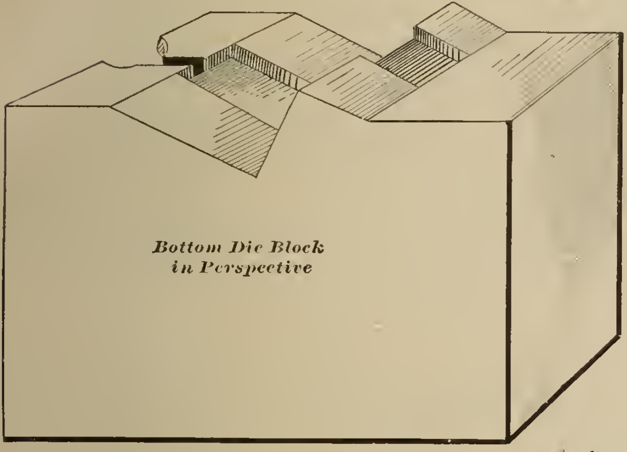


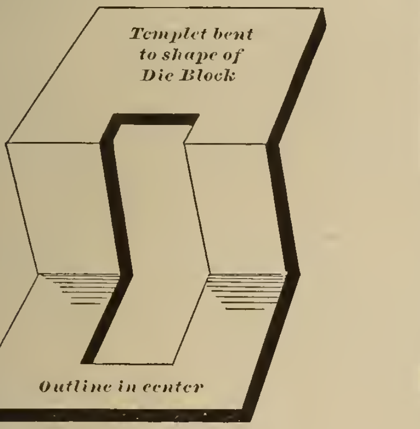
I should mention here another rule, which I have not called attention to before, that is, that a forging should always be put in in such a manner as to keep the dies as shallow as possible. Narrow dies, that are deep, stick fearfully in forging, so they must always be avoided when possible.

We will draw a centre-line through this one, following its shape, as shown by the dotted lines in the sketch. Instead of the faces of the dies being flat, as in former examples, we will make them follow the shape of the forging, but not in the position represented in the sketch; that would not do, for reasons that I will point out hereafter, but in the position in which it is placed in Fig. 2, in which is also shown the faces of the bottom die-block. The top template (see engravings), shows the shape of the top die, and the other the bottom one. The engravings fully explain how they should be made, so there is no necessity for further describing them. The first thing to do is to plane the faces of the die-blocks the shape of the templates, and fit them together nicely. As usual we make an outline template, but as this differs from any of our previous ones it merits a brief description.

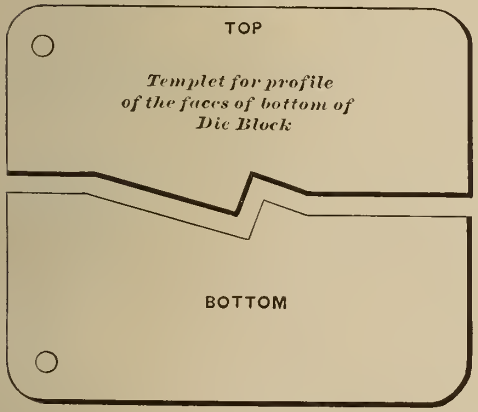
Fig. 2.




Bottom Die Block in Perspective


Templet bent to shape of Die Block

Outline in center



Templet for profile of the faces of bottom of Die Block

Take a piece of sheet-iron large enough for the purpose and bend it exactly to the shape of the die-blocks as here shown. After this is done draw centre lines across it, and cut out as usual the shape of the 'orging. There will be only one impression in this die, for this forging can be made in one blow if the proper iron is used. It will not require blocking or breaking down. Neither will it be necessary to make hot trimming dies, as there will be a very small fin, or burr, on the forging, which can be taken off in cold trimming dies. By looking at the sketch of the finished dies it will be seen that we could not use a solid force for sinking them, so we must make the forces in three pieces, one for the place marked *a*, one for *b*, the other for *c*. It will not be necessary to describe them here; they are easily made, being of a regular form. No doubt the reader of these articles understands the use of them now from previous articles. Some persons have made objection to my using the term "force," and say it should be called a "hub;" others say it should be a "drift." These terms as used in die-sinking are synonymous, and are used in different localities, varying a little with the class of work done. This is not worth making a discussion about, but for my part I think the term "drift" is the most expressive, and for the future in these articles will use it instead of force.

Assuming that we have the drifts (or forces) and templates made and the dies ready for laying out, we take the outline template and place it on the bottom die-block in the proper position and scribe the outline, following the shape of the die-block. Lay out the top one likewise. This is another shape in which machine tools cannot be applied, so we chip it out in the usual way (described in previous articles) using the drifts to assist us. This forging is only $\frac{3}{16}$ thick, so there will just be one-half in each die; consequently they (the dies) stand well if properly hardened, and twenty or thirty thousand forgings can be taken from them. Some readers may think one hundred thousand pieces is a great number of these parts to be required! my only answer is that there have been *millions* of them made. It is a feed-rider for a Howe sewing machine, and this is the exact way in which they are made at the present time, the writer himself having made dies for at least a quarter of a million of them. Every one of the dies that have been made will be illustrated in these articles.

The reason we put the impression in the die-block in the position shown, is, that every part of it shall receive the full force of the blow in the drop-hammer. If we were to put it in the position shown in the first sketch, the part that is there perpendicular, would not get the benefit of it, but would tend to throw the dies away from each other, and they would be sure to shift from their places. The way we have made them overcomes this, and gives good results in working. There is only a cold trimming die required for this forging, and the face of it should have the same profile as the forging die for obvious reasons. The punch also must correspond.

Such a die as this is very wasteful of steel, for when the die is worn out you have to plane so much off to make it over again. It must be planed flat and then have the profile made again. Apparently this would not be required. One would think that we might save some of it by just planing off the depth of the impression, but this is not so, for we would then be carried away from the centre, which we must keep to as closely as possible. Again, a die made with a wedge-shape in the centre like this, generally cracks in forging operations. Sometimes the cracks will extend half an inch below the bottom of the impression. These must be entirely taken out before any attempts are made to sink them again, lest, when you come to the hardening process, you have all your labor thrown away by the cracks opening up. If the steel is sound and of good quality, there is never any trouble in hardening, if properly carried out.

Some people try to make a great mystery of hardening; in reality there is none. If the dies crack it is generally the fault of the person hardening them, either by inexperience, carelessness, or bad judgment.

As I have said so much about planing off dies to sink them over again, it is proper that I should here speak a little about annealing them. This is as important to the die-sinker as knowing how to harden. These forging dies, after being hardened and used in the drop-hammer so much, are fearfully hard (except the edges of the impression). They seem to get crystallized, and if not properly annealed are terrible to work with tools.

Some may criticize what I am now going to say, and talk learnedly of the decarbonization of steel by overheating, etc., etc., and show plainly, in theory, that I am all wrong. I do not pretend to know much about the component parts of steel, or exactly what it is composed of. Neither do I care! That is someone else's business, and it would not help me much if I did. All I know about it is what I have learned by long years of practice, working it into dies and tools in the workshop. What the mechanic wants is a good reliable brand of steel and he will come out all right. What I was going to say was this: That however much overheating of steel for hardening purposes is to be avoided, it is not so for annealing. To anneal these drop-dies properly they should be heated in a furnace *a very bright red*, until you can see a light scale arise on them. Then they should be put into an iron box filled with powdered charcoal (and if there are two or three dies so much the better, they will retain the heat longer), cover them deep with the charcoal and let them cool off completely before taking them out. This will take about three days, if they are properly covered, for the charcoal takes fire and burns slowly out; but you will be well repaid for waiting, as they will be (to use a shop expression) as soft as cheese. You can tell by the color, when you take them out of the charcoal, whether they are soft or not. If they are black they will have a certain amount of hardness; if they are of a nice blue color they will be quite soft and easy to work.

When I began to write these articles I made some resolutions not to take up too much time describing details. I have since found out that this subject of die-sinking is necessarily full of it. Indeed, to neglect the details would be to neglect the most important part. Some things that I have mentioned, that may appear simple when described are very far from it in actual practice, and have been the causes of numerous failures on the part of good mechanics, who were too impatient to pay proper attention to them. Details are the very essence of this subject, and to take them away would be to leave nothing worth writing about. So the reader must make up his mind to get plenty of them; on this subject they are inexhaustible. Again, the reader must not grow impatient at the apparent simplicity of the forgings shown. It is just these simple, insignificant looking things that are the most troublesome to make, and it is, mostly, a deal easier to plan out ways to make some intricate looking forging than it is to make these simple ones. It is just the same in a man's life, the great troubles are the easiest to bear; it is the little ones that worry us to death!

◆

"Foreign mechanical journals seem pretty generally to have come to the conclusion that shape and dimensions of a propeller for vessels is for the most part a matter of cut and try—as they say; more pitch, less pitch, greater area, more diameter, less diameter, fewer blades or more blades, are all changes that at some time or other are made upon screws that do not perform as they should. Now, this problem of screws for steamships would be greatly simplified if the modelling of the vessel for which the propeller is intended were taken more into consideration. The screw in itself may be all right, but it may be and often is in the wrong place."

The foreign mechanical journal which said this happens to be THE MECHANICAL ENGINEER. The New York *Times* cribbed it, and set it afloat under an alien flag!

◆

In steam boiler engineering, the only observable change seems to be the slow but steady gain made in the introduction of water-tube coil boilers and sectional boilers, and in the extension of a rational system of inspection and test while in operation. To-day, the intelligent owner of boilers secures inspection and test, with insurance, by intelligent engineers and responsible underwriters, as invariably as he obtains inspection and insurance of his buildings. Under this system, steam boiler design, construction and management is becoming a distinct art, based upon real knowledge. The system of forced circulation proposed by Trowbridge and others, seems to me likely to prove useful in the solution of the problem to-day presented.—*Thurston.*

◆

The *Mechanical News* says: "Where Southern pine floors are to be laid the carpenter should reserve all straight grained pieces that have been cut from the outside of the log, to be laid where the greatest wear comes, laying the heart-pieces near the walls and away from where there is much travel. The floor will not look so handsome when new, but will last five times as long.

"A flood of water never should be put on a Southern pine floor. Such floors, as soon as laid, should be well waxed with a little oil mixed in. This will give a good surface, keep the water out, and greatly assist in preserving the floor. A damp cloth or mop will take off all the dirt and leave the floor as good as new. For stables, stores where heavy trucking is carried on, the ordinary white pine floor is the best. It wears well, can be kept white and clean, and will not show breaks and indentures like a floor of yellow pine."

◆

A leather-lagged pulley requires time to get into best working condition, especially if the lagging is bolted to the pulley-rim; as even flush-bolts hold the belt off a portion of the lagging.

MECHANICAL DRAWING—NO. VIII.

BY EDWIN H. MARBLE.

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We have now examined the prism, pyramid and cone, each of itself a study and complete in its own construction, yet bearing certain relations to each of the others, as we have found. The cylinder and rectangle remain yet to be examined, and we will now place the first mentioned on our model stand and endeavor to resolve it into its different elements.

In the first place we will place it perpendicularly upon its base, and draw an elevation and plan as it appears to us. We now have two figures, which, taken individually, show but little, but together, make the complete drawing from which all necessary measurements can be obtained. The circle A B D E we will consider $3''$ in diameter, and the rectangle A' K' H' B' $5''$ in height. This cylinder we will now cut by a plane perpendicular to the vertical, but inclined to the horizontal plane of projection, represented by the line S' T'. It must not be thought that in your mechanical work you will always find the cutting plane, or section in the position as here shown. It will rarely occur that it will be so favorably situated, but more often will be found to be inclined either toward or away from this line, so as to necessitate the revolving of the object to properly show it. That it has not been done here is very plain to see, and we will only give as a reason the extra drawings required to show it, without touching upon any new principle. In fact, it has been my aim to give only such lines and drawings as were needed to properly represent the different subjects as they were taken up. Returning now to our cylinder we will more fully examine it. The cut or section being shown by the line S' T' in elevation, and the plan being untouched, we must resort to a side elevation of the portion below the cut to properly show its character. This we will now make, and the figure produced is to be seen on the right.

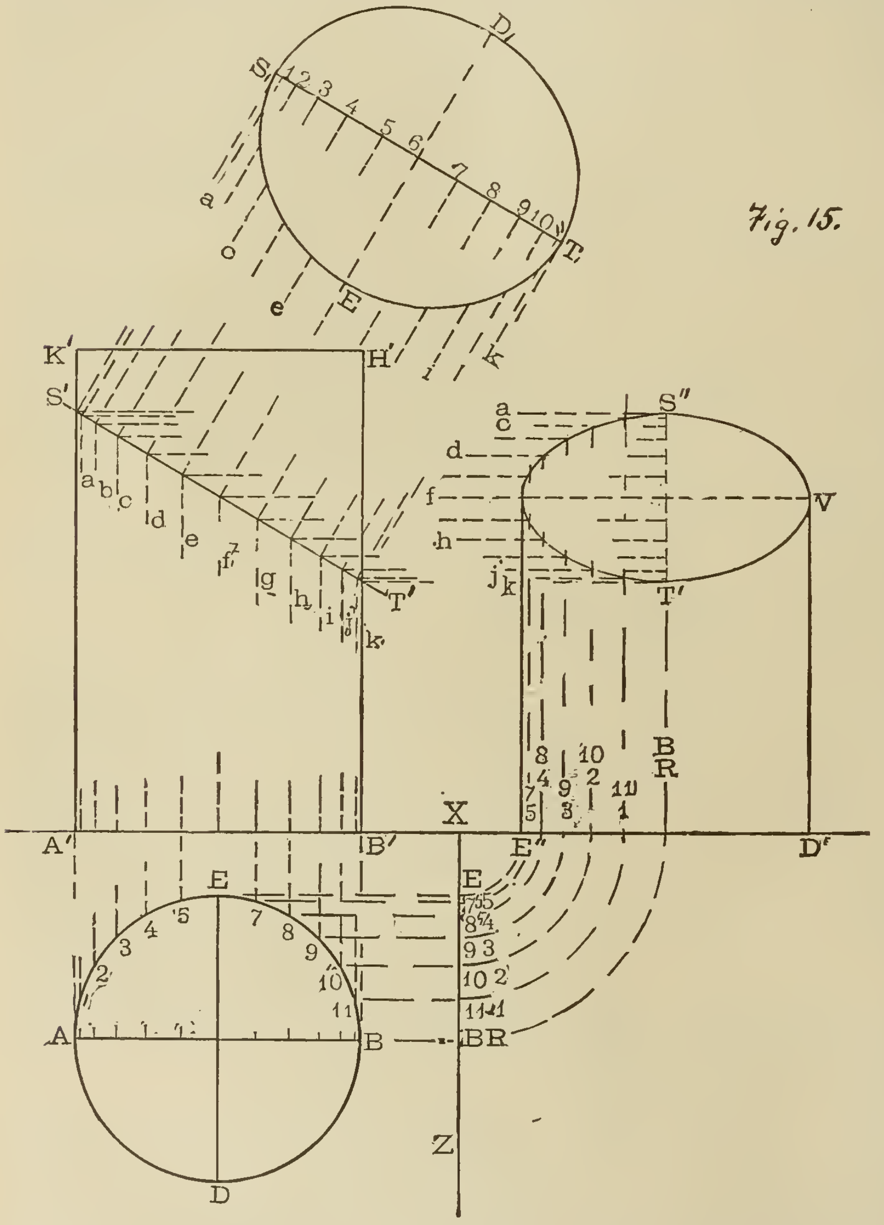


Fig. 15.

Referring again to the principle of the construction of the cone, we will consider this cylinder as composed of twenty-four sides. Since we find that number will give us points in the curve, sufficiently close to construct it with ease, and in Fig. 15 we have divided the circle representing the base into the required number, designating the same 1, 2, 3, etc., around the circle. It must be remembered that as we look upon this cylinder from the direction of A, we see A directly before us, with B behind it; 11 falls behind 1, 10, and 2, 9 and 3 are similarly situated. The numbers in the lower half of the circle are given, but the construction of only the upper half, and the corresponding half of the side elevation sections are necessary to carry out the problem. It is perhaps needless to remark that the doubling of the numbers is not confined to the plan alone, but is also to be found in the other parts of the problem. For the sake of distinctness, however, I have used the first twelve letters of the alphabet in the elevation, also in the side elevation, reserving the numbers for the plan and its corresponding divisions; and also the divisions upon the centre line of the cut.

It will be found of value, often to *carry* the distances from one view to another, by other means than the dividers. Such a method is here shown, and the upper half of the circle, with the corresponding points of the plan, are to be passed or carried to the side elevation. To do this we must first locate some fixed point; in this case the line A, B, is used. It is evident that this line, if drawn perpendicularly to a given plane, or rather if a plane is placed perpendicularly to it, it can be used as a starting-point by which to determine other points.

We will place the plane in the position XZ, being such a position, that when swung on the point X it will carry with it the points projected upon it into a given or fixed position. Such a position we have assumed by placing the boundaries of our cylinder as seen in side elevation at $E''D''$, and having first projected the points E, 7 and 5, 8 and 4, etc., upon our plane, we will swing, or pass, the same to our new position, and we find them at 7, 5—8, 4—upon the base of the side elevation. Projecting them upward, and we have shown the lines dividing the 24 sides to our circle in the proper position for further work.

On examining our figure we discover the fact, that the points, as shown in the cut of our elevation, are at the intersection of the lines, 1, 2, 3, 4, etc., of our plan with the lines, a, b, c, d, etc., in our elevation. These same lines we have transferred to the side elevation, and the intersection of the same will give us the points in their new position. Through these points we will draw the curve, and it is shown in the figure, S'', a', b', c', T''.

The true shape of this section will now be formed by projecting perpendicularly the distances S, a, S, b, etc., upon a line drawn parallel to the cutting plane, and setting off the proper distances as seen and measured in the corresponding lines in our plan, and through the intersections drawing a curved figure as shown in S, a, b, h, T; such figure being, as well as the curved figure seen in the side elevation, of varied curvature, according to the inclination of the cutting plane to the horizontal plane of projection. Should the plane be parallel to this horizontal plane, the side elevation will show a line, while the plan will present the section in its true form; while if the cutting plane be perpendicular to the horizontal plane, we shall have a rectangle of the height and width or diameter of the cylinder for our side elevation, and the same will show our true section. As long as we cut the cylinder at an angle that will confine its section to the cylinder-sides, as show in the elevation, we shall have a curved surface for our true section.

The comparison of these curved figures with the ellipse formed on the lines, E'' D'', or E, D, and S'' T'', or S, T, by the method given in our former article, proves them to be identical, and should we carry the comparison farther by cutting the cylinder at various angles we can safely assert that the cylinder, when cut by a plane at an angle to its axis, will give us an ellipse, showing its major and minor axes, defined by the length of the cut and the diameter of the cylinder. It would be well, however, for the student to perform the operation of finding the curve by the method here given, rather than to attempt to find the points by means of the elliptic form. It is best, in fact, in nearly all cases, to form the sections by direct operation, rather than to approach the same by rule of thumb methods. The figures give us all the points necessary to properly construct any section or curve, that is contained therein, and these points can be easily manipulated without altering the corresponding positions of the same. The results obtained are much more accurate than any obtained by other methods, in nearly every case.

The development of this cylinder will be as easily constructed as any we have as yet had, and can be set off from the constructions already formed, with but little else to interfere. The completed cylinder, when unrolled, or developed, will present a rectilinear figure, having a width equal to the height of the cylinder, and a length equal to the development of its base.

In this connection let me state what I should have in my last article, regarding the development of a circular body. The method given is but one of several, often quoted, graphic methods, and, by computation, according to Prof. Rankine, gives us an error of about $\frac{1}{900}$ of the length of the circular arc, or of the entire surface which we develop, an error so slight as to be within the thickness of a pencil line for a 5-inch circle. While it is well for the student to be able to compute any such examples as may occur, yet these graphic methods furnish us with a ready and practically correct method of setting off circular distances upon straight lines. The true relations that the circumference of a circle bears to its diameter is expressed by the numbers 3.1415926, but this is often inconvenient to use and the graphic method of determination is preferred.

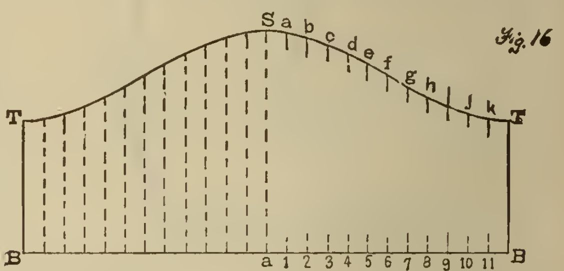


Fig. 16

Returning to our development of the cylinder, from which we have so completely gone astray, we will continue our study. As we have already stated, the cylinder when developed will present a rectangle. Now, if we cut this cylinder we will also cut the development in the same proportion. Should the cutting plane be parallel to the base, it will cut off a certain part of the rectangle in the same parallel line, while if the plane is in an inclined position, as in Fig. 15, we must determine its shape when developed by means of points. Taking this same figure 15, with its cut section, we will unroll the body of the cylinder and find its length to be shown in Fig. 16 by the line B, B. As we have divided our cylinder, for the purpose of the other constructions, into 24 equal parts, we will do the same with this developed line. For the sake of uniformity of figure we will commence with the point 12 or B on our plan, and commence our unrolling of the surface.

The height of the cylinder at this point is shown in the elevation to be the distance from the base or ground line A', B', to T. This distance we will set off by B, T, Fig. 16. The next division, 11, is shown by the height of h. This we will set off in the same manner; continue the setting off till we come to a. This will be the highest point of our development, and will be shown from A to S. The points on the reverse side of the curve will be found of the same height as the same projected points on the side of the cylinder already examined. Through the points we will draw a curve of the general characteristic outline shown in Fig. 16.

As remarked in our former article, this process of development gives us a much clearer knowledge of our models than can be obtained by any other method.

That the subject of the elliptic curves may be the more completely shown and mastered, we have taken for our study a cylinder, placed at an angle to the horizontal but still parallel to the vertical plane of projection Fig. 17.

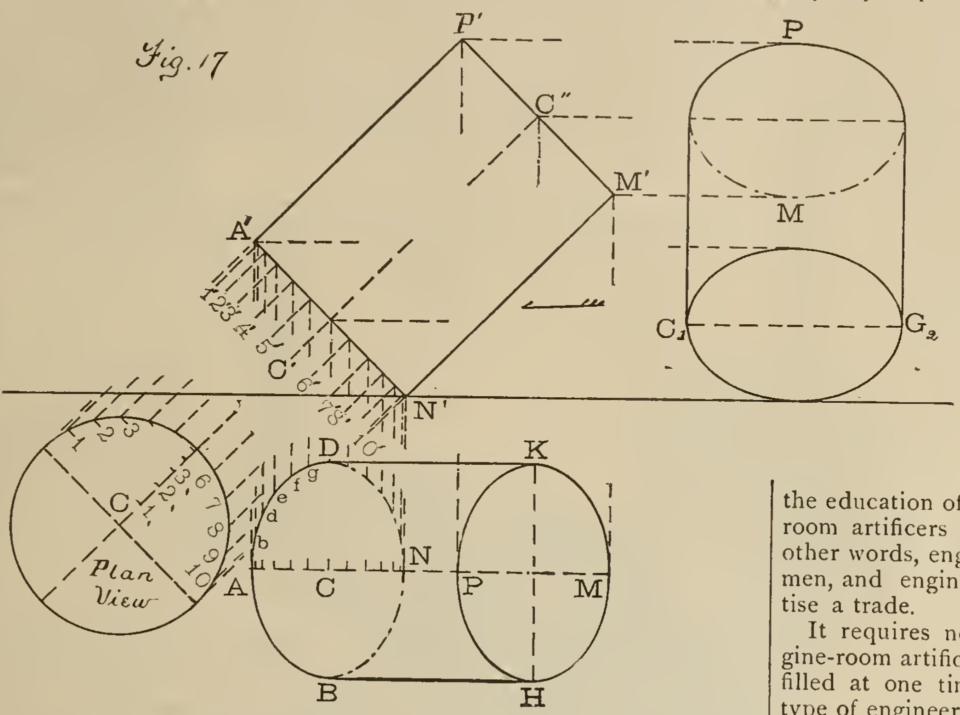


Fig. 17

This cylinder will be constructed after the same manner as the other objects we have examined, the difference being only in its curved boundaries.

The elevation will show the cylinder as being 6″ in height, while from the width of the rectilinear drawing, and the knowledge we have of its position, we may safely conclude it is 4″ in diameter.

It is now our purpose to draw the plan of this object, and we must obtain a plan-drawing of the base to accomplish the result. This we will draw on the continued line *y' h'*, which line is perpendicular to the line of inclination through its middle point and thus is the axis of the cylinder. Marking our drawing "plan-view" to distinguish it, we will divide it into 24 parts, to represent the sides. We do not take this number for any other reason than its being easily found; since every side is at an angle of 15° from its adjacent one, we can set off the boundaries by means of our triangles.

From these divisions we obtain the points 1, 2, 3, etc., as seen in the elevation, with the corresponding projection in the plan, and from the intersection of these lines of projection, and the measurements as taken from our plan view, we obtain the points of the curve *A, b, d, e, f*, etc., as well as the opposite curve through *A B N*. This curve we have already proved to be an ellipse. In this case we have the diameter of the cylinder for the major axis, and the projected distance *A, N*, for the minor axis. The curve *KPHM*, will be found by the same method. It will be noticed that the line *DNB* is shown by broken and dotted lines. On looking on the elevation we readily note the fact of the said line being hidden from view by the remainder of the cylinder.

Let us now look upon the cylinder from the direction of the arrow, and note the change in the form of the corresponding curves from those shown in the plan. Without going into the details we will simply refer to the outline as shown, and the hidden and full lines give us our full construction, which we trust will be readily understood.

We shall, in the course of another article, touch more fully upon certain points regarding the curves, which will be formed by variously cutting the cylinder and their corresponding projections.

◆

COMPETENT VERSUS INCOMPETENT ENGINES.

In writing this communication I am aware that it is difficult to portray all details connected with the routine of an engineer's daily life. Also, that there is a diversity of opinion among engineers as to the best modes of management. The duties of an engineer are subject to many variations, brought about by circumstances existing in different localities, the many uses to which the steam engine is put, and construction of the various appendages to an engineer's plant.

It has been demonstrated that the safety and life of a steam plant will depend to a great extent upon the ability and knowledge of the engineer. Undoubtedly, the most profitable investment manufacturers could make, which would yield the largest returns, would be in hiring competent engineers, as the incompetent are dear at any price. In busy times the competent man will make transient repairs. Although proper facilities for doing a job are not at hand, yet he will do his best with what he has until the repairs can be made properly. This alone is of much significance, for the stoppage of the works entails serious loss to the manufacturer.

In a case of this kind, the incompetent engineer has no aptitude to help the manufacturer out of the dilemma in which circumstances may have placed him. But in the face of indubitable facts, some employers (for a paltry sum) combat the competent man and hold up the incompetent one against him.

Every unusual sound or action has to the competent engineer its significance, and he is enabled to take measures against accidents that otherwise might occur. Through wrong conceptions and misapprehension, the tyro, or incompetent, keep things moving, with the result of serious accidents and costly repairs, when a short stoppage at the proper time to investigate, would have been all that was necessary.

I do not consider an individual an engineer unless he possesses general knowledge of engines for all the various purposes for which they are used, as also the machinery operated.

Many, by permanence in one station, as engineers, have familiarized themselves with the details and management of the particular plant of which they have charge, and are, to a certain extent, competent for a special place, but they are without any definite knowledge of the principles involved, because special practice in one direction, with one particular engine, has disqualified them. Even these men, through ignorance of the philosophy of every-day routine, will omit minute details, and cause loss. But without any previous instructions, for instance, put them in charge of a large compound, or condensing engine, and they will be lost. They are in a new world. They know it is a steam engine, but see no sense or reason in all this apparently needless complication. Of the nature and uses of the new machine they know nothing; they are confounded. They are automatons, with no more conception of the various details than the uneducated Indian has of the workings of a clock. Such men are engineers nominally, but they have not the ability to reason, or adapt themselves to existing circumstances.

How can we elevate the standing and dignity of the working engineer? It seems to me that this can only be accomplished when the employer, the engineer, and the public, labor earnestly for the same end. Then we shall not so frequently find incompetent men filling responsible positions, but in their stead, will be men whose abilities and experience have qualified them to perform their duties profitably and safely. SMOKE ARCH.

Beverly, Mass.

◆

An English engineering firm has just completed a lathe 60 feet in length, weighing 80 tons, for ordnance work, in which a new principle has been introduced—the lead screw is stationary, and a rotary motion is given to the nuts. By this arrangement an independent action is secured for the various slides.

In 1844 the first iron steamship ever built in the United States was launched at the yards of the Harlan & Hollingsworth Company, at Wilmington, Del., which is said to be the birthplace of iron shipbuilding in this country.

ENGLISH NAVAL ENGINEERS.

Successive governments have been impressed with the idea that men in charge of machinery in her Majesty's ships should receive a technical education of a high type; but this theory is erroneous. Men who design machinery and superintend its construction do need such an education, but those who have charge of it do not. They require a different but not less important training. A knowledge of German, and more or less profound acquaintance with higher mathematics, will not in any way help a man to cool a hot bearing, pack a gland or mend a burst feed-pipe. Those in charge of machinery at sea should be versed in the broad principles of mechanics; be able to read a diagram; to make a fair drawing, and competent to do, or superintend, repairs.

Hitherto it has been found impossible to produce a good engine-driver and an educated scientific engineer in one. There are such men, it is true, but they are exceptional. As a rule, the scientific young man has a soul above engine-driving, with its dirt and drudgery. He is too intellectual for his work. The Admiralty found this out some time since; and so, while they give engineers the education of gentlemen, they employ engine-room artificers (machinists) to do the work. In other words, engineers in the navy are professional men, and engine-room artificers learn and practise a trade.

It requires no perspicacity to see that the engine-room artificers have stepped into the places filled at one time by engineers, and that the new type of engineer is an addition, not a substitution.

It was complained that the old type of engineer was not a gentleman, and this was true, with certain exceptions. Then it was expected that gentlemen would do the necessary work, but it was found that they would not, and so the old-type engineer still finds his place, and the new type is something thrown in.

The truth is, that the engine-room artificer is the right man in the right place, and the highly-trained engineer is not. Plain speaking is best in this matter for all parties; and we assert that there is not sufficient scope to be found on board a man-of-war for the display of talent, or even of ability of a high order. The work to be done is simply engine—driving when a ship is running, or engine watching when out of commission. There is in all this no demand on the higher intellectual powers; and if there were a compliance with the demand would bring no return.

Engineers have no chance of distinguishing themselves in action. They have no chance of doing anything, in fact, in the way of making use of a somewhat expensive education. The artificers do the work and the engineers look on; and very wearisome and irksome work this must be to young men of brains and abilities.

* * * After a time it will be understood that a steam engine does not know whether it is in a Government ship or in that of a private firm. Steam is above Admiralty regulations, and the class of men and the system of management which does best in the mercantile marine is just that which ought to do best in the navy.

The chief engineer of a great Transatlantic passenger ship holds very much the position which we would assign to the chief engineer of one of her Majesty's ships of war. Engineers in large steamers get as much as £30 a month, and a first-class table is kept for them, and while at sea they have literally no expenses, save what they think proper to incur.—*London Engineer.*

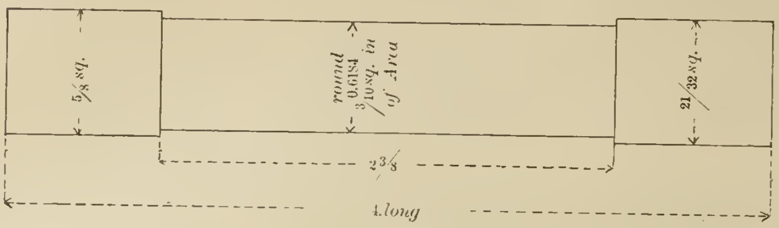
◆

The hotter the glue is when applied, the greater will be its binding power in holding surfaces together; therefore, in all large and long joints glue should be applied at once after boiling. Glue loses much of its strength by frequently remelting, and that which is freshly made is preferable to that which is reboiled. In melting ordinary glue in the double vessel containing water, it is an excellent plan to add salt to the water in the outer vessel. It will not boil then until heated considerably above its ordinary boiling point; in consequence, the heat is retained longer, and when the water boils the glue will be found to be evenly and thoroughly melted.

TORSIONAL TESTS MADE BY THE PRATT & WHITNEY COMPANY, HARTFORD, CONN.

Dimensions of Test Pieces. December 6, 7, 8, 1883.

Material Tested, Round Tool Steel.



Figures represent pounds at a Radius of 6 inches.

		Number of Test.	Brands of Steel.				
			B. Atha & Co.	Spaulding, Jennings & Co.	Jonas & Colver.	Thos. Firth & Sons.	Wm. Jessop & Sons.
			A	B	W	F	J
Unannealed.	Direct from Bar.	1	853	864¾	894½	790	954¾
		2	855¾	768	887¾	863	916¼
		3	840	861	896	809½	931¼
		4	849½	872½	900	856½	896
		5	853½	884¾	896½	857½	916¾
		6	849½	873	877	....	900
		Total..........	5101¼	5124	5351¾	4176½	5515
		Average.....	$850\frac{5}{24}$	854	$891\frac{23}{24}$	$835\frac{3}{10}$	$919\frac{1}{6}$
Annealed.	Twenty-four Hours.	1	769	645	833¼	759¾	891½
		2	774	770	813	758½	869½
		3	790	770	789¼	765¾	805
		4	773	762	784	764½	859
		5	792	581½	773	767½	894½
		6	768	600	771	759½	849
		Total..........	4666	4128½	4763½	4575½	5168½
		Average... ...	777⅔	$688\frac{1}{12}$	$793\frac{11}{12}$	$762\frac{7}{12}$	$861\frac{5}{12}$
Hardened.	Medium Straw Color.	1	1349½	1440	1180	1352	1330
		2	1400	1166½	1456	1430	1309
		3	1402	1560	1349	1402	1215
		4	1434	1606	1630	1427	1247
		5	1550	1302	1500	1480	1254
		6	1101	849	1702	1329	1243
		Total..........	8236½	7923½	8817	8420	7598
		Average.......	1372¾	$1320\frac{7}{12}$	1469½	1403⅓	1266⅓

The Pan Handle Railroad Company are about to build shops in Columbus, Ohio, the estimated cost of which, including the tracks and exclusive of tools, is $537,000. Besides having facilities for doing all necessary repairs these shops will have capacity for building fifty locomotives, thirty-six passenger cars and 3,000 freight cars per year.

A writer in the *Grain Review* says: "The manner in which the conducting pipes in a house are exposed to, or projected from, the changes of temperature, which often amounts to thirty degrees in twenty-four hours, has much to do with the difference in gas bills, as in many houses the pipes are so exposed, owing to walls with the mortar all on the outside, that the gas after leaving the metre, and being measured, rapidly condenses the heavier hydrocarbons (the most valuable part for light) and drops in the form of tarry water back into the metre and fixtures, often to such an extent as to cut off the flow of the fresh-coming gas, impoverishing the power of the light and the pocket of the consumer."

Even poor mortar will remain unbroken upon a rigid wall, but the best possible composition of lime, sand and hair will quail and crumble before the shrinking of sills and floor joists, the warping and twisting of studs and the failure of furrings to hold their place. As a coat of plastering is not absolutely inelastic, the slight bending of joists in upper floors is not sure to cause visible cracks in the ceiling below, but the settling of any part of a partition will certainly be followed by zigzag cracks that usually indicate by their course where the weak spot is to be found.—*Builder.*

Rectangular masses of cast iron, one foot square and more or less than an inch thick, can be weighed by multiplying 37½ by the thickness in inches or fractions of an inch, as the case may be, as 37½ pounds is the weight of a square-foot of cast iron one inch in thickness. The weight of a cast-iron pipe may be found by multiplying the diameter of the pipe in inches by 3.1416, and again by the thickness of pipe in inches or decimals of an inch, and this product by 3.15.

When work does not come together properly, do not drive it or force it. Any job of machine work that does not connect readily after being fitted shows conclusively, on the face of it, that something is wrong and needs attention.

The scrap pile is a good thing—that is, if you know what kind of iron it contains. From 10 to 15 per cent of a foundryman's iron goes into his scrap pile and is saved for future use. If he has built his pile from iron which he had previously melted, he knows the quality of his scrap, and how and in what proportion to use it. But if, as is often the case, the pile has been built up with scrap bought in the market, the foundryman can only guess at the kind of scrap he has on his hands. Frequently such scrap contains a very large percentage of burnt iron, such as grate bars, liner boxes for fire-doors, and cast-iron retorts, and the result is a big percentage of slag. The scrap which was cheap enough in the market loses its cheapness in the foundry.—*Found Adrift.*

◆

It is stated that glass pump barrels are bored in Berlin by ordinary lathes and tools specially hardened, aided by dilute sulphuric acid.

◆

The lime cartridge method of getting coal has not given as satisfactory results as could be wished at an English colliery; the coal, according to the last issue of the *Mining Journal*, being far too strong for the lime.

◆

VELOCITIES OF WOOD-WORKING TOOLS.

The velocities required for wood-working machinery are as follows: Circular saws at periphery, 6,000 to 7,000 feet per minute; band saws, 2,500 feet; gang saws, 20-inch stroke, 120 strokes per minute; planing machine cutters at periphery, 4,000 to 6,000 feet. Work under planing machine 1-20th of an inch for each cut. Molding machine cutters, 3,500 to 4,000 feet; squaring-up machine cutters, 7,000 to 8,000 feet; wood-carving drills, 5,000 revolutions; machine augers, 1½ inch diameter, 900 revolutions; ditto, ¾ inch diameter, 1,200 revolutions; gang saws require for 45 superficial feet of pine per hour, 1 horse-power. Circular saws require 75 superficial feet per hour, 1 horse-power. In oak or hard wood three-fourths of the above quantity require 1 horse-power.

Sharpening angles of machine cutters—adzing soft wood across the grain, 30°; planing machines, ordinary soft wood, 30°; gauges and ploughing machines, 40°; hardwood tool cutters, 50° to 55°.—*Builder and Wood-Worker.*

◆

A SINGULAR CASE OF CORROSION OF STEEL.

Through the kindness of Chief Engineer Farmer, my attention has recently been called to the appearance of two cold chisels found in the U. S. S. Triana in 1874, and which have since been preserved in the Department of Steam Engineering at the Naval Academy. These chisels were taken from the channelway leading from the jet condenser, and they were located between the foot valve and the air pump. Both chisels were of steel throughout, as was proved by tempering the head. For use, of course, only the points had been tempered. During the time of exposure to the action of the salt-water in the channelway the chisels were deeply corroded, but the corrosion was confined entirely to the soft metal, the tempered points not being attacked in the least. The corrosion was deepest at the line of contact between the tempered points and the untempered metal of the haft. The line of immersion, on tempering, is as distinctly marked as if drawn with a shading pen. Since meeting with these chisels I have heard of a similar case of corrosion, although the object has been lost. It was a hammer which had been taken from the boiler of a merchant steamer, the tempered faces of which were intact, while the soft metal was corroded.

Remembering the heated discussions going on in metallurgical circles on the question "What is Steel?" I shall not attempt to decide whether the change which takes place in the tempering of steel is a chemical or a physical one; but it is evident that this change produces a body which is not so readily acted upon by salt-water as untempered steel is. It is also probable that when the untempered and tempered steels are brought in contact in the presence of salt-water we have an electro-chemical couple, and that this hastens the destruction of the untempered metal. I beg to suggest that this observation may have a practical bearing upon the construction of steel ships.—*Prof. Chas. E. Munroe, U. S. N. A.*

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THE MECHANICAL ENGINEER.

New Series. Vol. V.—No. 7.
Enlarged, Jan 1, 1883.

New York, March 31, 1883.

Single Copies, 8 Cents
$2.00 per Annum.

A NEW SHAPING MACHINE.

BY HEWES & PHILLIPS, NEWARK, N. J.

Our engraving represents a new design of this indispensable machine in all shops. It possesses valuable features which will commend it to the trade everywhere. Our readers do not need to be told the uses of the shaper, or a historical account of its rise and progress, and we, therefore, content ourselves with appending the makers' description of their machine and the points claimed by them.

As will be observed by general design and construction, this tool embodies all the latest and most approved theories and practices found desirable in this class of machine tools. The particular features for which especial merit is claimed are as follows: Form of bed is of the pillar and box type, of unusual length and breadth.

The ram-guide is almost entirely within the rectilinear line of the frame proper, there being, practically, no overhang. The ram when at full length of stroke never runs out of the guides more than 25 per cent. of its length.

Base of frame is extra broad, and thickness of walls throughout will average five-eighths of an inch.

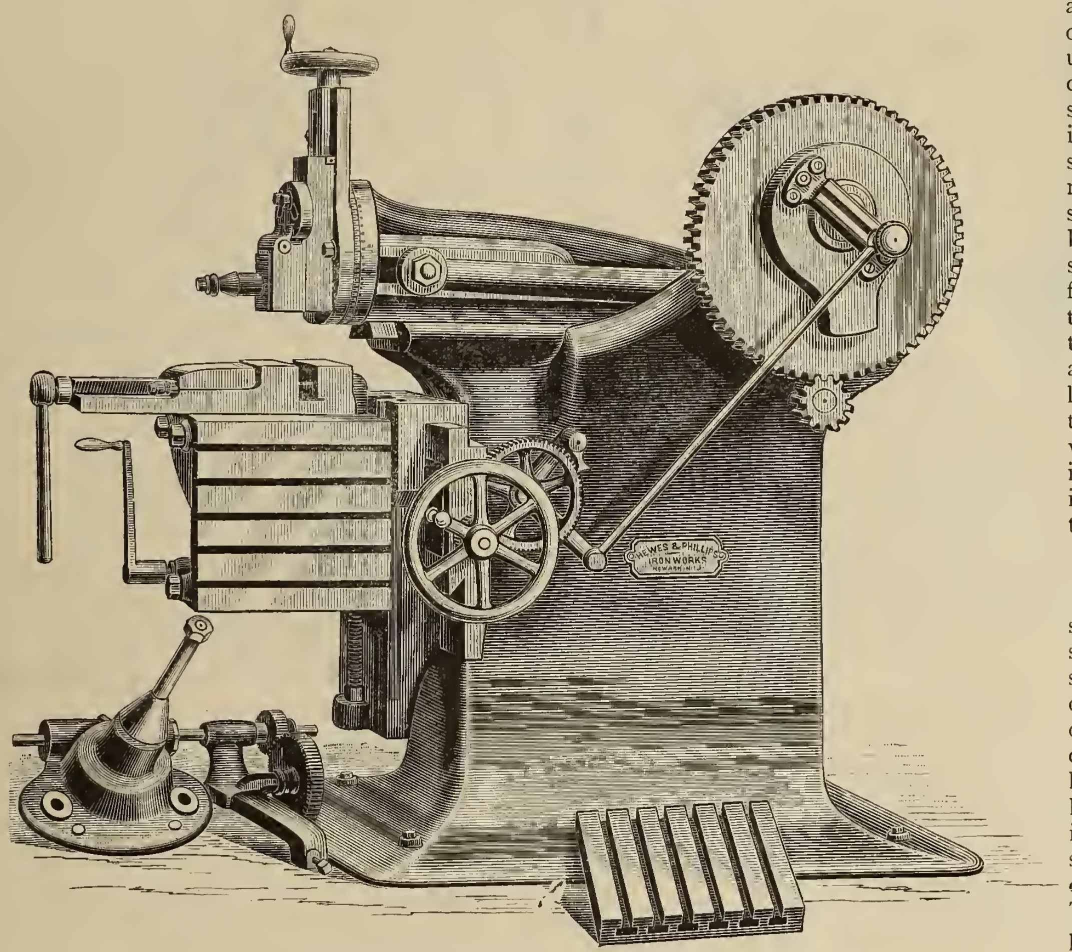
Vertical depth of cross-head considerably exceeds overhang of table, a feature which, in addition to those before enumerated, gives great rigidity to the machine and insures perfect work. The tool has a cross-feed of 28 inches; vertical tool-feed of 10 inches, and vertical-table adjustment of 12 inches.

The jawed vise is so designed that it is interchangeable with a slotted table which may be used when work too large to go in the vise requires planing; the side of table is also slotted for bolted work.

Each machine also has a circular motion for planing circular work, such as sectors, washers or crank-eyes. The reciprocating motion of ram is secured by means of the Whitworth crank-motion, which gives a return motion triple the velocity of forward motion. The path of motion has been so carefully studied and developed that the ram speed is practically as uniform as that of a planertable.

The driving motion is placed as nearly as possible at the rear end of frame, with the object of securing a long connecting rod, and thereby slight crank angles. The feed motion is variable, from fine to coarse, by means of a slotted disk-crank; feed takes place at back end of stroke when table is traveling either way. All lost motion is taken up by composition taper wedges with screw adjustment. All the gearing is cut and the sliding surfaces are scraped down from surface plates. The machine is massive and strong in every detail, and has been especially designed to meet the wants of the railroad trade and other establishments doing a heavy class of work.

The total weight of tool complete is 4,770 pounds.



HEWES & PHILLIPS NEW SHAPING MACHINE.

◆

C. G. Buchanan, Rockaway, N. J., builder of rock-breakers and ore-concentrators, is fitting up the ground floor of 108 Liberty street as an office and exhibition room for his manufactures. He is putting up shafting for power, and will have his machinery running in about six weeks.

◆

We think we may justly pride ourselves upon the number and quality of the illustrations in this issue of THE MECHANICAL ENGINEER.

The formula for ascertaining the power of water is almost akin to that for ascertaining the power of a steam engine, and is simply the weight of the water in pounds multiplied by the space or fall through which it passes in one minute, and divided by 33,000. Take, for example, a quantity of water equal to 1,000 cubic feet per minute, which is equal to 62,500 lbs. This falling a distance of 10 feet is equal to 19 horse-power,

$$\frac{62{,}500 \times 10}{33{,}000} = 18.94$$

without allowing for any loss; and we would expect to get, in useful work, fully 13 horse-power if applied to an overshot wheel, about $9\frac{3}{4}$ horse-power if applied to a breast-wheel, and $5\frac{3}{4}$ horse-power if applied to an undershot. This being nearly the useful effect in their order of the respective wheels.

◆

Common iron rust, such as is formed on the surface of iron articles exposed to air and moisture, is a hydrate of the oxide, *i. e.*, a compound of oxide and water. In perfectly dry air, iron does not rust; and in water from which air has been expelled by long boiling, polished iron and steel may be kept without tarnishing, provided all air be excluded.

◆

Iron oxides abound everywhere. If a handful of soil be picked up anywhere, and some solution of ferro-cyanide of potassium (yellow prussiate of potash) be added, a deep blue is struck at once, showing the presence of iron in a highly oxidized state. All the ordinary rocks that form the earth's crust contain oxide of iron, and are tinted by it, its color running through yellows, reds, light browns, and dark browns, to slate color and black. All ordinary sand is similarly colored by it. What is commonly sold as "silver sand" contains a little—but still so much that the glassmaker cannot use it for colorless glass.

◆

We have received No. 2 Vol. 1, of the *Grumbler*, a weekly journal published at 42 Duane street, N. Y., but we do not know why.

The *Canadian Manufacturer* recently sent a circular to its patrons asking whether they wished a weekly, fortnightly or monthly. Not more than five per cent. wished a weekly trade paper, while the remainder were almost equally divided in their preferences for a monthly of fortnightly paper.

It might depend somewhat upon the paper!

◆

A foreign paper says that glue dissolved in skim milk, two quarts to the pound, is waterproof.

◆

An organ of the German leather industry calls attention to the importance of the adhesive substance used for belts being applied carefully, and not used in such quantity as it sometimes is. It is admitted that in some instances it may be necessary to use a liberal supply of adhesive substance, but the theory is refuted that such a measure is necessary for maintaining the proper tension of the belt. When there has been an excessive application of material the leather adheres more or less to the metal, and there is a waste of power occasioned in consequence. This fact, it is remarked, also causes the belts to run crooked.

◆

Recently, in Jersey City, six locomotives were left standing on a side-track for some time, when a man out of work began stripping them of all the brass and copper he could lay hands on. These he sold to junk dealers, and he made such good wages at it that he hired a man to assist him, telling him that the company was doing the work These two stole everything portable but the bells, and were carrying them away when arrested.

◆

We suggest to the associations of stationary engineers throughout the country that it would be a good plan to prepare a short circular setting forth the object of the association, its times, and place of meeting, with an invitation to come and see the institution in operation. This should be addressed to desirable men by mail. In large cities a great many might be brought in in this way. In smaller places, of course, persistent button-holing works best!

◆

The non-conducting material known as Fossil Meal is having a wide sale, and is being generally adopted by large steam-users all over the country. It is peculiarly well adapted to prevent radiation, and has the great merit of being plastic and readily put on by any one who can use a trowel. This enables it to be applied to all irregular forms and in places where no other material can be used. It is shipped in bulk and sold by the pound, so that it may be in operation almost as soon as received. The Union Ferry Company of this city have adopted it, also the Cromwell line of steamers, Knickerbocker, Louisiana, New Orleans, &c. It is also in use in some of the largest factories in this vicinity, and well deserves its popularity.

◆

Engineers and firemen are called in England engine *tenters*, and boiler *tenters*, the difference between this word and tender, seems equivalent to that between tweedle-dum and tweedle-dee!

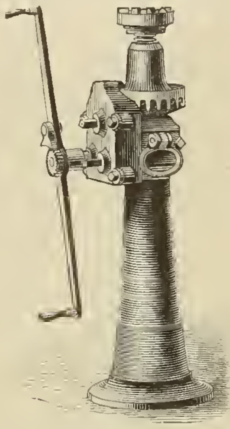
NEW CAR JACK.

BY GEORGE A. OHL & CO., NEWARK, N. Y.

The last few years have seen a marked increase in the weight of railway rolling stock. Everyone has noticed the huge Mogul engines, the twenty-ton freight cars, and the drawing-room and sleeping cars, which have been placed on the trunk lines. These changes have brought about an increase in proportion in all railway plant.

Even in the apparently trivial details of the machinery for these heavy cars, new and radical departures have been demanded.

We illustrate herewith a new jack, designed for raising the ends of the palace cars. The trucks are erected separately from the body of the car. These jacks lift nineteen inches, high enough to allow the truck to be rolled under the body of the car, and into position, when the end of the car is readily lowered on to the truck.



The mechanism of the jack is very simple. A hollow, conical stand carries on its upper end a bevel-gear, which is threaded to form a nut, and carries, in turn, a screw of cast-steel. The screw is prevented from turning, and can move in a vertical direction only. On turning the bevel-gear the screw rises, and with it, also, the load. Cast-steel washers, hardened and ground, with cast-steel friction rollers, are placed between the bevel-gear and the standard, and the friction is thus reduced to a minimum.

The details for driving the bevel-gear are inclosed in a box, which can be moved to any point of the compass around the neck of the stand; and in this way the power can be applied at any side of the jack. The handle, moreover, being provided with a ratchet can work the jack with a short pumping motion like that of the hydraulic jack, or it can make a full circle likean ordinary crank handle.

The motion of these jacks being positive, and easily controlled, the workmen can lift the corners of the car regularly with no danger of twisting and straining the body. They cannot run down of themselves, so they can be left over-night with the load on. They are light and easily portable, and have been used with satisfaction by a number of our leading roads. Address, George A. Ohl & Co., East Newark, N. J., for circulars and price-list.

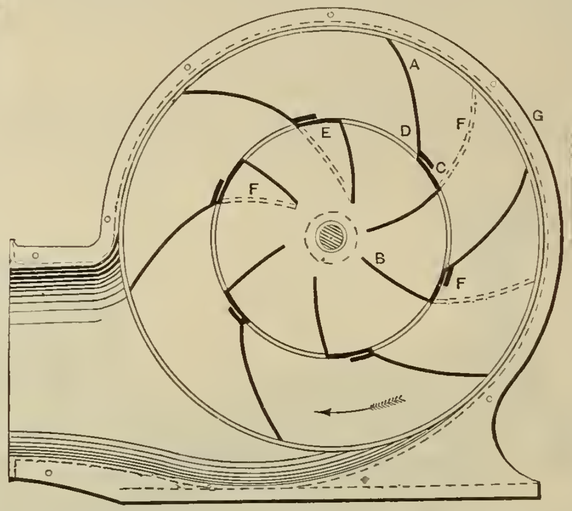
◆

A NEW ENGLISH BLOWER.

We illustrate here, from the *London Engineer*, a fan which gives results so remarkable that they tend to prove that all theories hitherto held concerning the action of fans must be modified.

Our contemporary then goes on to say: "We have carried out some experiments with a model 6 inches in diameter and 3 inches wide, which gave results quite unparalleled by any fan of the size with which we are acquainted. With a velocity of 4,200 revolutions per minute it supported on the exhaust side a column of water over 7 inches high, the exhaust tube end passing through a hole in a piece of board placed over the central orifice, which is 3 inches diameter. A 14-inch fan, worked by hand, and making 2,100 revolutions per minute, supports a column of 8 inches. The velocity of the tips of the blades is 7,700 feet per minute.

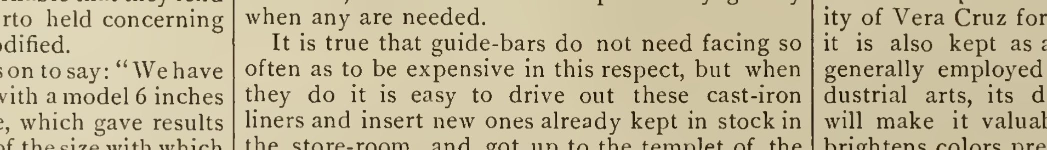
It is not easy to see why it should be so powerful. If we had not convinced ourselves by direct experiment, we should not have hesitated to condemn its design. It will be seen that it consists of two sets of blades, an outer set *A* and an inner set *B*. There is nothing remarkable about the curves of these blades, nor does it appear that any particular curve must be accurately followed. The outer blades are fixed on a drum *C*, and in this are cut ports *D*. The sheet-iron is cut along three sides, and bent along the fourth, so that the inner blades *B* consist of the sheet-iron removed to make the ports *D*. Nothing can be simpler. The inventor has carried out many experiments with fans. It would appear at first sight that the drum *C* is a positive evil, hindering the escape of air. Accordingly he constructed a fan similar in all respects to that which we tried, with the difference that the drum was suppressed and the blades were carried inward, as shown by the dotted lines at *E E*. The result was that the fan could only be got to lift about 2 inches of water instead of 7 inches. Then a fan was tried with the blades *B* extending outward, as shown by the dotted lines *F F*. The result was, if possible, worse. It would seem, therefore, that the entire value of the fan resides in the remaining portion of the drum *C*. With the greater portion of the outer case removed, the fan will still lift 7 inches of water; and it is a noteworthy fact that if an anemometer be held to the fan when the casing is removed, at about the point *G*, double currents will be found to exist. If the anemometer be moved toward the suction side of the fan—it only inhales at one side—the wheel will revolve briskly, showing a strong outward current thrown off by the fan blades. If, now, the anemometer be moved toward the opposite side of the case, still at the same level it will be found that there is a strong *indraught* at the circumference of the fan.



◆

A SUGGESTION FOR A LOCOMOTIVE GUIDE-BAR.

The sketch herewith represents an improved guide-bar for a locomotive. It is intended to be made of wrought iron, as usual, but instead of the wearing surface being directly on the bar it is taken upon a cast-iron "liner" or bed, dovetailed into it. This has some advantages which are more than balanced by the increased expense of fitting up the bars. It insures a better metal, with lessened coefficient of friction, and consequently less wear, and it facilitates repairs very greatly when any are needed.



It is true that guide-bars do not need facing so often as to be expensive in this respect, but when they do it is easy to drive out these cast-iron liners and insert new ones already kept in stock in the store-room, and got up to the templet of the original size. The cross-head should have cast-iron gibs also, and when too much worn, all the surfaces can be renewed, and the alignment preserved at slight cost compared to that now entailed.

A bar like this has all the advantages of a cast-iron surface, with the strength of a wrought-iron or steel body.

◆

BROTHERHOOD OF LOCOMOTIVE ENGINEERS.

A delegation of the locomotive engineers on the St. Paul, Minneapolis and Manitoba road recently presented to the officers of the road a request for an adjustment of the rate of wages, involving some increase in their pay. After full conference a friendly settlement was reached, the basis of which is that the engineers on the freight trains receive $3.90, and those on the passenger trains $3.70 per day; and that after two hours have elapsed over schedule time, the balance of time on duty will be accounted to them at the rate of 22½ cents per hour. The company, unsolicited, advanced the wages of freight firemen from $2 to $2.25 per day.

The engineers of the Wabash, St. Louis and Pacific road have presented a statement of grievances to General Superintendent Andrews, and were to be assisted this week in their efforts for a settlement by Grand Chief Engineer Arthur. In addition to poor pay for delays and overtime, the engineers complain that their wages are not uniform, men in some parts of the road being much better paid than in other sections.—*Railroad Gazette.*

◆

PECULIAR OILS.

Crocodile Oil.—The oil of the Indian crocodile contains a larger proportion of solidifiable fat than either neatsfoot or any fish oil. It solidifies at the melting point of ice, while the others only thicken. In comparison with the softening qualities of other animal oils on leather, it has been found that leather treated with crocodile oil remained much stiffer than when other animal oils were used. It has been inquired after for leather dressing, but is not yet a commercial article. The tail of an alligator of 12-ft. in length, on boiling, furnishes 50-70 pints of excellent oil, which, in Brazil, is used for lighting, and in medicine. The alligators of Central America and the United States might be similarly turned to account.

Niin Oil.—An insect belonging to the genus *Coccus*, affords an oil having considerable economic use in Central America. It feeds on the resinous sap of a species of *Spondias*, whose local cultivation is so easy that even thick cuttings germinate quickly in almost any soil. The breeding of the insect is dependent simply upon the multiplication of this tree, which is already under extensive cultivation all over the tropics of continental and insular America. The oil is extracted from the insects by boiling them, and amounts to 26-28 per cent. of their weight. It is bright yellow to yellowish brown in color, and possesses a peculiar odor. When recently melted, it is homogeneous, but soon becomes granular and lighter-colored. Its melting-point is about 49° C.; when melted, it remains fluid at even 27°–29° C. Cooled to—12° (10° F.), it becomes hard and brittle, like suet At ordinary temperatures, it is thick and pasty, like lard, and its sp. gr. is about 0.92. It is insoluble in alcohol, but freely soluble in hot and cold ether, forming a yellow oily liquid; it is very soluble in turpentine, producing an oily liquid of special value for mixing delicate oil-colors; it is also freely soluble in benzine and chloroform. It is a thorough drying oil, though its absorption of oxygen is slow, and is not hastened by boiling with oxide of lead. Its composition resembles that of ordinary animal fats.

The present native uses of this remarkable oil, which has yet to find its way into general commerce, are almost confined to its admixture with the pigments employed by the Indians and Mestizos of the peninsula of Yucatan and in the vicinity of Vera Cruz for adorning household articles; it is also kept as a drug by apothecaries, and is generally employed as a drying oil. In the industrial arts, its drying solution in turpentine will make it valuable to artists; it remarkably brightens colors prepared with it.—*Oil and Paint Review.*

◆

The Graydon & Denton Manufacturing Company, Jersey City, have adopted the system of giving their men a half holiday each Saturday, paying them for full time. They say the men work more and better for it.

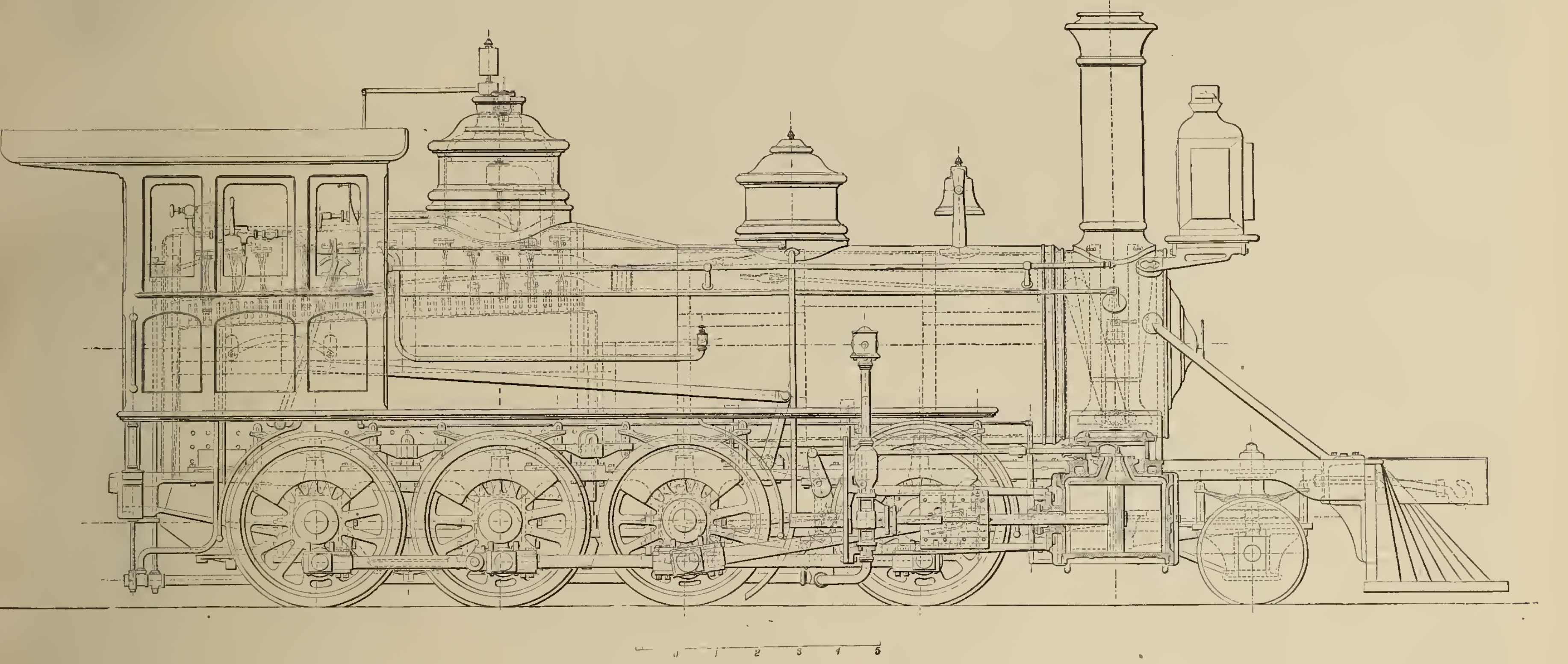
◆

Mr. William Fletcher, so long known to many of our readers as a successful builder of marine engines, particularly of the beam class, died in this city on the 2nd of March. Mr. Fletcher was born in Scotland in 1824, but served his time in this country.

PERFORMANCE OF AMERICAN CONSOLIDATED LOCOMOTIVES.

At the time of publishing the engraving of a foreign consolidated locomotive on page 39, Vol. 4, together with its performance, we endeavored to procure the results of American engines, but were unable to do so in time to present the two simultaneously. Through the courtesy of the Baldwin Locomotive Works, we are now enabled to present a side elevation of one of their engines of the class mentioned, together with a brief abstract of its capacity as shown in actual work. The details from the Baldwin Locomotive Works are appended, as received:

"The engine in our practice which is most nearly like the St. Gothard engine described, is our Consolidation type of locomotive, class 10-34-E, pages 104-5 of our catalogue. Our Consolidation engine has the same cylinders, viz., 20 x 24, as the St. Gothard locomotive. It has a slightly smaller boiler, however, the total heating surface of the St. Gothard locomotive being 1,702 square feet, while the total heating surface of our Consolidation locomotive is 1,300 square feet. The weight of the St. Gothard locomotive in working order is 50.8 tons; the weight of our Consolidation locomotive 46 tons.



In order to compare the performance of one of the St. Gothard locomotives with our Consolidation locomotive, it may be noted first, that the specification for the St. Gothard locomotives stipulated that each should be able to haul 150 tons on a gradient of 2.7 per cent. This is equal to 143 feet per mile. On page 110 of our catalogue you will find that a Consolidation locomotive has hauled up a nearly similar grade (145 feet per mile), on the Tyrone Division of the Pennsylvania Railroad, 197 net tons, equal to 175 gross tons (see letter of George C. Wilkins, superintendent Tyrone Division of the Pennsylvania Railroad, page 110 of illustrated catalogue). On a still steeper grade on the Cumberland & Pennsylania Railroad, viz., 171 feet per mile, a Consolidation engine has hauled 160 gross tons (see letter of C. Slack, general superintendent Cumberland & Pennsylvania Railroad, page 112 af our illustrated catalogue). On a grade of 130 feet per mile on the Lehigh Valley Railroad, a Consolidation engine hauls 282 gross tons of cars and lading (see letter of J. Z. Blakeslee, superintendent Mahanoy Division, Lehigh Valley Railroad, page 116 of our catalogue).

The printed account of the foreign engine also says that two of these engines have hauled a train of 410 tons over the mountain section of the St. Gothard Railway at a speed of 9 to 12 miles an hour, but the grade is not stated.

It is also said that on the Valley section, with grades of 1 in 100, one engine easily hauls 500 tons at 15 miles an hour. To compare this with the performance of our Consolidation locomotive, see letter of H. B. Stone, locomotive superintendent Chicago, Burlington & Quincy Railroad, page 116 of catalogue. It will be seen that our Consolidation locomotive takes 40 loaded cars over a grade of 1 per cent., 10,100 feet long. The weight of the 40 cars would be about 892 gross tons.

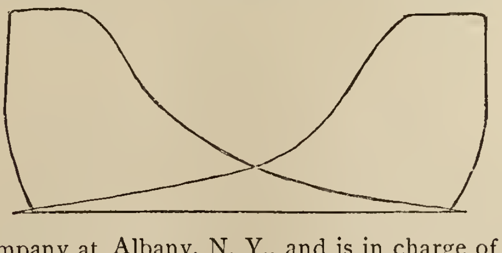
Two-cent postage throughout the United States is an assured fact, and the stamps are now being prepared to be delivered at all the post-offices in October next.

A NEW ALLOY.

Mr. Alexander Dick, the inventor of phosphor bronze, has succeeded in producing an alloy which he calls "Delta metal," which has some remarkable mechanical and physical properties, and appears to be as much superior to brass as phosphor bronze is to gun-metal, or steel to iron. The chief advantages are great strength and toughness. Delta mêtal cast in sand has a breaking strain of 21 to 22 tons per square inch; rolled into bars or forged, over 33 tons per square inch, and drawn into wire of 22 w.g., 62 tons per square inch. It can be made as hard as mild steel, and when melted is very liquid, producing fine castings of a close, fine grain. The color can be varied from that of yellow brass to that of fine gun-metal. It takes a high polish, and when exposed to the atmosphere tarnishes less than brass. A peculiarity of Delta metal is that it can be rolled and forged hot, while it also stands a certain amount of drawing and hammering when cold.—*The Engineer.*

"GOOD ENOUGH."

The card subjoined comes to us with the indorsement, "Good enough, W. H.," which seems to us deserved under the circumstances. It was taken from a Buckeye engine built by the Hartford Engineering Company, of Hartford, Conn., and is the exhibit made after three years' hard work without any repair or adjustment—that is to say, the card was taken from the engine in regular work. The engine is 16x32 inches, makes 93 revolutions per minute and works at 60-lb. boiler pressure. It is in the Albany Card and Paper Company at Albany, N. Y., and is in charge of a careful man; the card says so, that is our only authority.



BRASS FINISHING LATHE.

An English machinist writes to a foreign contemporary upon this question, as follows:

Having seen a letter in your impression of the 27th, referring to brass-finishing lathes, in which it is asserted that American lathes turn out 200 to 300 per cent. more work than any other make, I thought it an astounding assertion. The writer of that letter cannot be acquainted with what has been in use in this country for a quarter of a century. I made a lathe for finishing gun-metal cocks and valves about twenty-five years ago, that, I think, will turn out as much work, and as good, in as quick time as either the Fox or Cooper lathe, and has been doing so ever since it was started. By it a 2-inch gun-metal gland steam-cock body can be bored and faced, the two ends bored, faced, and screwed, including the chucking and shifting the lathe from the taper to the parallel, in twenty minutes, and be made a good job of. The boring taper is self-acting; the turning is self-acting; so also is the screwing; while the Fox lathe has nothing self-acting about it except the screwing motion.

The lathe I am describing has no back poppet-head to it; I designed it for work to be done on the face plate or universal chuck only, and is especially adapted for it, the other parts being done in another lathe, as I consider that to be the quickest and cheapest way of getting the work done. Of course, quantities are given out to a workman, and not one at a time, as I have described. Therefore they can be done quicker than the time I have mentioned; the one I timed was done at a great disadvantage, the lathe having to be shifted in the time from taper to parallel.

I think I can challenge the Cooper or American Fox lathe to do the same work in the same time as I have stated. I therefore do not believe that the American lathe can do brass work any cheaper or quicker. Besides that, the American lathe costs about $300, while I could get nearly three lathes made that I have described for the money.

This interests all of us, and we shall be glad to publish anything from our friends bearing on it.

PAY OF LOCOMOTIVE ENGINEERS.

On the Canada and Grand Trunk Railway, says a correspondent of the *Engineers' Monthly Journal:*

Our passenger engineers are paid 3¼ cents a mile; freight, 3½. There are three classes of engineers, and you must run a year in each class after promotion from fireman before first-class wages are paid. The firemen get 1¾ cents a mile, and both men on a main line Mogul get ¼ cent a mile extra. The eastern division, from Battle Creek to Port Huron, is 160 miles long; from Battle Creek to Chicago is 175. The freight men do not run to Chicago, but stop at Corwith, 7 miles out. Switch engineers are paid from $2.25 to $2.75 per day, according to station, as Chicago rates are 25 cents more than the other stations. If we are detained on the road more than two hours over our schedule time, we are allowed 25 cents an hour "detention time," which helps us out some on the long runs. The local trains do not run over the entire division, there being two local trains on each division, the shortest being 66 miles, the longest 121 miles, for each day's trip, and extra mileage is allowed on these trains.

On the Canadian Pacific Railway the month's pay comes close to $200.

Engineers of locomotives on freight trains in Russia are timed to make on average 9.25 hours, labor per day.

Taber's Pulley Cover is certified by many users of it to be an efficient device for curing slipping belts. It is advertised elsewhere.

According to an observer, who says he timed the speed by the mile-posts, a train on the Pennsylvania Railroad recently made 66 miles an hour for five miles, down a heavy grade.

NOTICE.

We have to announce that we have purchased the entire stock of the Egbert P. Watson Company, holding every share.

Our business of publishing The Mechanical Engineer will be carried on as heretofore at 150 Nassau street, N. Y., under the old style of Egbert P. Watson & Son.

The next issue will contain further details of this transaction.

◆

Mr. H. W. Granger, United States Local Inspector of Steam Boilers, at Detroit, recently lectured to the Marine Engineers' Association of that place, explaining Zeuner's diagram of the slide-valve to them, with additional remarks upon valves and lead required for various uses. Mr. Granger's lecture was listened to with attentive interest.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

FROM PROFESSOR MARKS.

Editors Mechanical Engineer:

If votes counted and were not weighed by your thoughtful readers, I should be overwhelmed by the four letters in your issue of March 17, on the "*Stress on Cylinder-Head Bolts,*" question. May I beg of your correspondents that they will consider an actual steam cylinder (one for a locomotive for instance), and leave out rubber gaskets and metal packing rings, &c., which I believe, do not generally occur in actual practice.

Prof. J. Burkitt Webb makes a virtual admission of the practical truth of my statement when he says, "*To say that with metal packing the increase is generally neglectable is true,*" to which I will add that without metal packing the increase is inappreciable.

I cannot reply to the correspondents who are not bold enough to sign their own names and will not further discuss this question, which is one of experiment and not argument.

Respectfully, Wm. D. Marks.

Philadelphia, March 12, 1883.

[Correspondents have, in all cases, sent their true names, one instance only excepted, that of "Triangle," whose favor appears in this issue.

For many reasons, that we can understand, it is sometimes inexpedient for correspondents to write over their own signatures, but we require them in all cases.—Eds.]

◆

STRAIN ON CYLINDER-HEAD BOLTS.

Editors Mechanical Engineer:

I have studied with much interest the explanations given by your several correspondents on the stress on cylinder-head bolts.

I cannot see the application in Mr. Chuck's illustration (in last issue) to the question in hand.

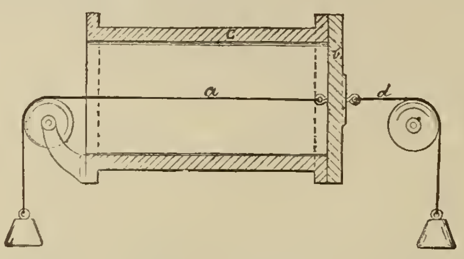
There seems to be in this discussion a tendency to overthrow the theoretical demonstration by a few practical facts! These are objectional only so far as we are unable to analyze their bearing on the subject.

For instance, when the pressure made by the bolts between the cylinder flange and cylinder head is "exactly" counterbalanced by the pressure against the cylinder-head, made by the steam within the cylinder, there will be no strain between the flange and the cylinder-head.

Right here comes an argument which throws no light on the subject; which is this: owing to the physical nature of steam, it will rush from between the two surfaces, thereby making an apparent separation of them. This only shows that the pressure within has slightly exceeded the pressure obtained by the bolts.

Evidently some of your correspondents think there is some trick connected with Prof. Mark's wooden blocks!

Will some of your correspondents explain why, in the following illustration the rope *a* does not bear the same relation to the cylinder *c*, as any bolt relates to its cylinder. We place a weight of a hundred pounds on one end of the rope, pass the other end over the pulley and attach it to the cylinder-head *b* by means of an eyebolt, which shows a force of 100 lbs. between cylinder and cylinder-head. Now, if to the opposite side of the cylinder-head we fasten one end of another rope, *d*. and to the other end 100 lbs., which represents the force exerted by the steam within the cylinder. If any one thinks the last weight has increased the strain on the rope, *a*, he had better apply an indicator to the rope between the pulley and the cylinder-head.



Again: if an eyebolt be attached to the head of a cylinder-head bolt, and a weight be attached equal to the force exerted by that bolt in pressing the cylinder-head against the cylinder, will there be a greater strain on the bolt, or merely a displacement of the same amount of strain? Triangle.

New York.

[This correspondent omits to give his real name. We must insist upon names and addresses accompanying all communications.—Eds.]

◆

STRESS ON CYLINDER-HEAD BOLTS.

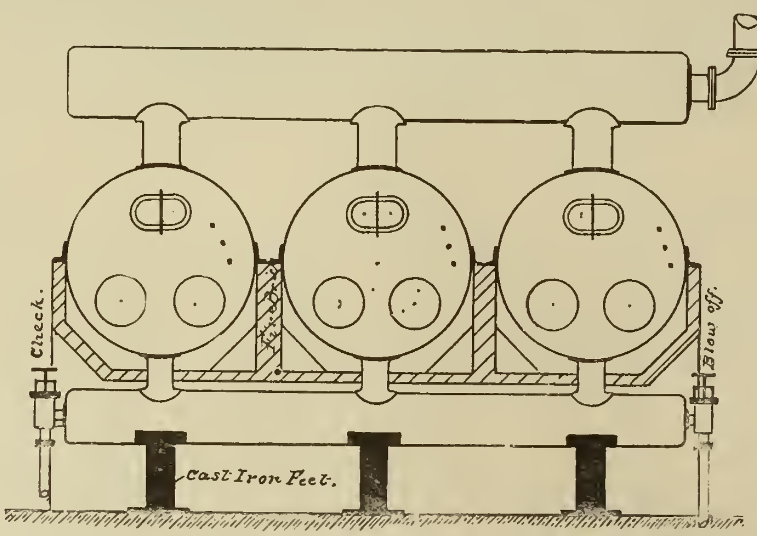
Editors Mechanical Engineer.

The following, I think, is a practical illustration of the "*Stress on Cylinder Bolts*" question:

Fit the end of a cylinder with standing bolts long enough to extend some distance beyond the cylinder head. On each of these bolts place a spiral spring; hold the springs in place with a nut on the end of each bolt; screw the nuts down so as to just touch the spring; disconnect the connecting-rod from the cross-head and move the piston up against the head.

Now turn on the steam; this will force the piston against the head, and the head against the springs, and the springs will be compressed until the full steam pressure is transferred to the bolts. Screw down the nuts until the head is against the end of the cylinder and then remove the steam pressure. As the head cannot move any farther, is it not evident that the stress is the same when steam is in the cylinder and when it is not? Chip.

New York.



FEED-PIPES TO BATTERIES OF BOILERS.

Editors Mechanical Engineer.

I enclose you tracing of arrangement of feed and steam drums for three boilers, requested in No. 6, Vol. V. When the boiler connections are all of proper size, the water will stand at the same level in all; but if the steam connections are not properly proportioned, or are obstructed, the water will stand higher in the boilers which have least fire under them, as the pressure will be lower in them than in those having the best fire, and the excess of pressure will drive the water to the cooler ones.

The feed enters one-third of the length of the boilers, measuring from back end, and enters the mud drum first. L. O. Danse, C. E.

Pittsburg, March 5, 1883.

[What is the use of a mud drum if the feed is to enter and stir up the sediment all the while? It seems to us this is wrong. All the value of a mud drum is to have a quiet place for sediment to settle in.—Eds.]

◆

FEED-PIPES TO BATTERIES OF BOILERS.

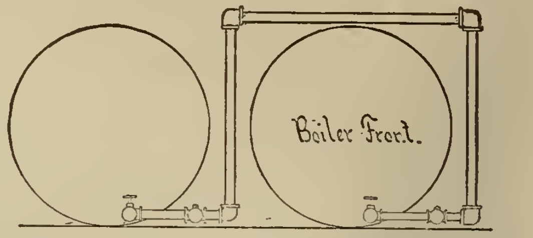
Editors Mechanical Engineer:

I hand you a sketch of the feed-pipe and connections to a battery of boilers that have been in operation the past ten years, day and night.

A stop-valve is necessary, and it should be located between the check and boiler (as per sketch), also to regulate the water for each boiler to examine the check-valve if out of order or, in case the feed-pipe or fittings give out outside of the stop-valve, each boiler can be shut off by itself. Sometimes a stop-valve is put on both sides of the check.

It is not safe to feed more than one boiler at a time. If one of the checks leaks, and two stop-valves are open with a brisk fire under the boiler, it will blow the water all out. I witnessed a case of this kind some years ago, not a hundred miles from this city.

In running the feed-pipe from pump to heater, and to the boilers put them above ground, in sight, for inspection every day. Run them across the front of the boilers, and drop from a T connection to each boiler, as per sketch. Each boiler should have a safety-valve, steam-gauge, three gauge cocks, and glass water-gauge. Then if shut off by carelessness, or neglect, with a fire underneath it, it will be an independent boiler in itself. Feed-Water.



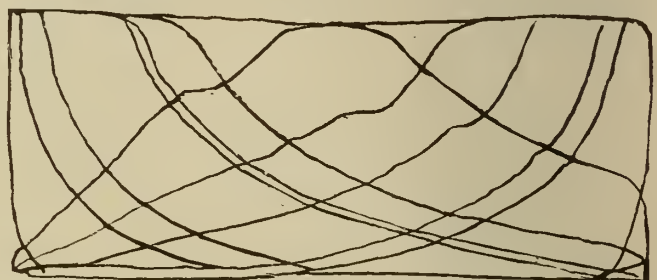
New York.

◆

JOGS IN THE EXPANSION LINE.

Editors Mechanical Engineer:

In your issue of March 17 I notice a diagram taken by "Blower" from a 12 x 32-inch cylinder, and at 60 revolutions, with a Crosby No. 2 indicator. This card shows a peculiar step in the expansion curve, which I see you attribute to sticking of the indicator piston caused by grit.



Herewith you will find a card which will, I believe, throw some light on the case. It was taken from a 12 x 34-inch engine, and with the same kind of an instrument used by "Blower." I carefully cleaned and adjusted the indicator before I used it, and can take my oath it was in good condition. The first cards taken were like the one you presented, which surely looks as if the piston did stick. To see if the step would always occur at the same distance from the atmospheric line (as it would if caused by grit), I took a lot of cards like the one sent, by moving the governor counter-weight arm up and down while the indicator was working, thereby changing the point of cut-off. After looking the engine and diagrams over, I concluded the trouble was with the engine, not the indicator. My proofs that this theory is correct are:

1st. I know the indicator was in good condition.

2d. The step never occurred in the back-end card.

3d. It does not always occur at the same distance from the atmospheric line.

4th. I know the engine to be blowing very badly on the crank end.

Mr. Editor, allow me to express my appreciation of your very valuable paper, and to wish it continued success. Gilman W. Brown,

Agt. for the Porter-Allen Steam Engine.

Boston, Mass.

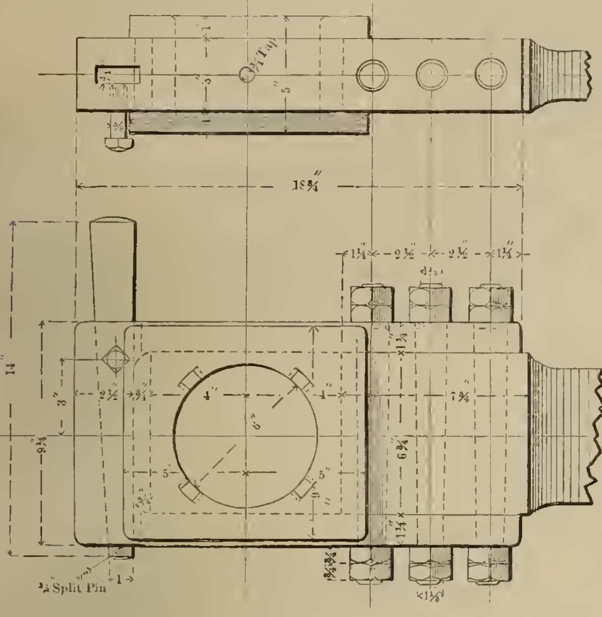
◆

A LOCOMOTIVE CONNECTING-ROD END.

Editors Mechanical Engineer:

This stub-end of a connecting rod has a few points that may be new. I claim nothing original in it except combining several good ideas picked up at different times. The most noticeable feature is the bolts; these have nuts on both ends and a taper of one-quarter of an inch to the foot. They are fitted to drop loosely to within about a quarter, to three-eighths of an inch of their places, and are then drawn down by the under-nuts. Afterward, setting the upper nuts insures a solid, iron to iron, binding of the strap on the top, as well as the bottom. No tits are formed on their ends, as it is the intention not to use a hammer—in fact, none is needed, as the nuts work both ways. Those below draw the bolts in and those above will draw them out, when the lower ones are removed.

The flanges of the boxes are not turned off to lighten them, leaving but a small facing, just the diameter of the collar on the pin, as is usual, but are left of full thickness out to the edge. This arrangement lessens the chances of heating to a very great extent. The philosophy of this I cannot explain, but I know it is a fact. More than a dozen engines, on a certain road in New England, were originally fitted with thin-flanged boxes, and were much given to heating. In fact, it was only with the greatest care that they could be kept cool. They were furnished with a set of this new pattern (no change being made in the pins) and no case of heating has come to the knowledge of the master mechanic, though the engines have been run faster and more heavily loaded.



A heavy iron liner of the full width of the strap is interposed between the key and the brass, which saves the hammering of the key into the brass.

Lastly, the set-screw is placed away from the centre of the strap. It being found that the key will not come out so readily as when the screw is placed in the centre, for if the parts become loose, the key will vibrate on the point of the screw and hang there. Whereas, if it were in the centre, it would have a sliding motion which would soon grind the point off, when it would be—good-bye key!

A good thing to remember is, that where the key comes between the rod and the box, the strap should be relieved from the key about a thirty-second of an inch. This will keep the strap and rod both solid against the bolts, which, from the wear and tear of driving in and out, eventually become loose, and if the key bears against the strap, the rod will have free play to knock the whole machine to pieces.

What's the matter with the Dome steamship, the Meteor? Is her engine a Keeley motor?

BOSTON, MASS. "DROF."

AN INQUIRY FROM TEXAS.

Editors MECHANICAL ENGINEER:

I have been running in this State for over eleven years, and am now running an engine with cylinder 14x28 inches, with the Rider cut-off, which has given all engineers more or less trouble; but I have about cured it by giving the valve one-fourth of an inch lead, which has lessened the fuel bill to some extent. The engine now runs smoothly, and gives all the power that we need. We are driving three pairs of burrs, with cleaning and bolting machinery for same, on two cords of green post-oak wood every twelve hours.

I have some trouble with the valves getting loose on the rod at times, and would be glad to know how to make them fast, except when I want them loose. If any of your readers know of a remedy they will do me a favor by communicating it. How would a collar and set-screws do? or would a collar with a key-way through it be better?

Is metalline better for lining boxes than babbitt, and can it be melted as easily?

Who makes an indicator that will take a diagram from both ends of the cylinder at the same time?

* * *

[As to fastening the Rider valve to its stem, we can give no information without some idea of the details; we presume it is not a difficult matter. Metalline is a compound of various substances, said to be chiefly plumbago, and is not fusible; it is inserted in bearings in the form of small plugs. Of the two materials we prefer babbitt.

William Heuerman, 40 John street, New York, sells an indicator of the kind mentioned.—EDS.]

WHICH WAY?

Editors MECHANICAL ENGINEER:

Will you oblige me by stating in which way the fly-wheel of an engine should be turned to find the dead centre for setting the valve? Some authors say to turn it forward because the engine will run that way when at work; others say to turn it backward because the power is applied at the wheel instead of at the piston, and it must be turned backward to take up the lost motion in the right direction. J. B. B.

INDIANA.

[It makes no difference which way you turn the wheel, forward or back, if the engine is in good order. If it is slack all over, take up the slack before you set the valve. Of course, as a rule, an engine should be turned over in the direction in which it is to run. If a valve stands still half an hour, more or less, while the engine makes half a turn, it is a sign that something needs looking into!—EDS.]

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER:

I have three applications this week from Denver, Col.,—C. R. Elliott, 832 Blake street, Sec.; St. Louis, Mo., Chas. Lesser, 1,417 Wash street, Sec.; Chester, Pa., Jas. A. Platt, 1,027 Upland street, Sec.

The cause is growing. At our convention there were 11 societies represented; now we have 20. There are societies organized at Baltimore, Pittsburg and New Orleans, with whom we have had correspondence, and expect applications from soon.

Although the organization is young and some of its rules crude, yet it, on the whole, is received with better approval than the most sanguine of its organizers dared to hope. At our next meeting we will strengthen it, and then we hope to see it one of the best societies in the country. It cannot fail to be if we adhere to the principles we have laid down. We expect soon to see many of our employers connected with it in some way, as they will be when they learn upon what foundation we have builded.

All communications and applications for minutes of the National Association directed to me will receive prompt attention.

A. M. DAVY, Secretary,
175 Elmwood avenue, DETROIT.

RESPECTING A BALANCED VALVE.

Editors MECHANICAL ENGINEER:

The valve and steam chest, in issue of February 17th, is very similar to one patented about 1870 by a Louisville inventor named Watson, His valve and chest were in one casting; the entrance for steam was through the face, as in locomotive cylinders. The chest extended over these openings, the valve being shaped on the face as an ordinary valve. To hold the valve down, a bar extended over the top of the chest supported by standards at each end of the cylinder. On top of the chest were two grooved rollers; the bar was adjusted on these rollers by nuts on standards, tight enough to not leak and yet move freely. With the exception of the steam-pipe *a* in the illustration, it appears to be the same as the one described. The pressure would lift the valve were it not held down by the bar, or screws, but from dust and other causes the wear was equal to the ordinary valve, and they were discarded. I believe, of a number that were put to work in the city, none are left to tell of the once bright hopes of the inventor. H. CHOATE.

SHELBYVILLE, KY.

DIAMETRAL PITCH.

Editors MECHANICAL ENGINEER:

Can you give a rule for finding the diameter of gear-wheels (the pitch and number of teeth being given) without recourse to tables? I have tried three or four rules, but none were correct. One from an old copy of Haswell was:

True pitch × No. of teeth × ·32 = Diam.

I tried this by the wheels of four different lathes in our shop—a Pond, a Gould and the other two different-shaped teeth; in each case the answer by rule was less than outside diameter, or pitch line diameter, of wheels by measurement. Some of the lathes being short of wheels for certain threads, if we knew a correct rule we could make our own blanks, and have them cut any time.

2. Is 11½ threads to the inch the exact fractional quantity for pipe-threads (1 to 2 inches)? I have been told the fraction was less than ½.

By kindly answering the above questions, you will greatly oblige a sincere admirer of your valuable paper. H. A. H., Lathe Hand.

[If by "rule" our correspondent means a steel scale we can advise him that the Brown & Sharpe Manufacturing Company, of Providence, R. I., make a steel rule specially graduated for gear-cutting. Anyone can tell the diameter of a gear on the pitch-line from it, without recourse to tables.

A simple method for finding the diameter of any required gear, the pitch and number of teeth being known, is to divide the number of teeth by the pitch. Thus, a wheel of 48 teeth, 8 to the inch, would be six inches on the pitch line. The depth of the tooth is equal to twice the pitch, divided each side of the pitch line. Thus, an eight pitch wheel would have a tooth one-fourth of an inch deep, or one-eighth of an inch on each side of the pitch-line.

We cannot say, from actual count, whether gas-pipes 1 to 2 inches in diameter, is 11½ threads to the inch, or not, but it does not seem a difficult matter to determine.—EDS.]

FROM THE FIRE-ROOM.

As the proper care of steam boilers is of the first importance to engineers, perhaps some remarks on this subject will not be objectionable to readers of THE MECHANICAL ENGINEER.

As the safety, performance and life of the boiler depend upon the ability of the attendant, it should be his aim to acquire a thorough knowledge of them.

I was much pleased with Mr. Burdekin's letter. I think his ideas sound, and that his methods of managing the fires are correct and practical. It occurs to me that preventing a too hasty escape of the gases is correct; also, I think that experience has taught him that, with the kind of fuel which he burns, he can keep steam only by firing on the pancake principle. I think the admission of air above the grates is of slight importance in assisting combustion. If there is any gain it is so slight as not to be apparent by close observation. It is claimed that if an artificial draft is produced by the use of a blower that there is always an excess of air forced through the fire, hence it is reasonable to infer that additional air supplied from any source would detract from the efficacy of the fuel consumed.

I think that if we could note the fluctuations in temperature in the furnace for one day, the knowledge would be a direct benefit to us, as well as a great surprise.

If we could know what we now have to surmise—that is, just what is going on in the furnace—we could then manipulate the fires to burn the combustible gases, and reach the highest attainable results It is undoubtedly true that we know but little of combustion; we can only gain information on this subject by extensive practice, and experimenting under various conditions, carefully noting the results. Knowledge so acquired is far more valuable than any derived from works on combustion.

I notice that Mr. Burdekin is aware that covering the entire fire with fresh coal is harmful to the boiler. This is correct, as it rapidly diminishes the temperature of the furnace and conduces to shorten the life of the boiler.

I think that it can be demonstrated that if air is necessary above the fire, at the furnace doors is about the poorest place to admit it. I have a suggestion to offer, which though it may not be new, I think is worthy of consideration. This is to bisect the furnace by a partition-wall, extending the masonry up within a few inches of the shell, then by firing alternately allowing one side to burn up bright before firing the other, it would, I think, prevent excessive fluctuations of temperature in the furnace, and conduce to better economy, as well as to prolong the life of the boiler.

Although we can predict the temperature of the fire by the color of the flame, we cannot infer with as much certainty whether the gases are burned or not. Therefore it behooves the aspiring fireman to closely watch the results of different modes of firing, and by observation, systematize the management of the fires so as to reach the highest evaporative results. His own interest is involved in the results obtained.

BEVERLY, MASS. SMOKE ARCH.

A speed indicator is in use on English railways, but it is a very complicated affair, with a glass tube like a water glass, an oil reservoir with a sort of centrifugal pump, and a belt to drive the whole from the hind axle. This seems rather a cumbrous arrangement. We omitted to say that the speed in miles per hour is indicated by the height at which the oil stands in the tube.

It would seem that a much simpler arrangement, using an air column derived from a small fan, could be devised; but where is the necessity for a speed indicator of any kind?

Steam cylinders weighing over 7,800 pounds have recently been cast in steel in Scotland. It is claimed that they are perfectly sound and are easily bored. We are slow to perceive the benefit of them, never having found any trouble with good cast-iron. A disadvantage would seem to exist with a soft metal steam-cylinder.

THE

Mechanical Engineer.

FORTNIGHTLY.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

WRONG END UP.

It is a curious commentary on the system which prevails in building railway cars, that up to the present writing, no satisfactory method of ventilating them has been found. There are no lack of cabinet work, cushioned seats and easy springs, but there is great dearth of fresh air, an adjunct of civilization, let us call it, which most people find essential.

Any observant person, making a continuous journey in an express train in cold weather, cannot fail to notice that fresh air is a very scarce article. This occurs through the fact that there are no means by which it can get into the car. In some there are, it is true, oblong openings over the stove, which, if they were not persistently kept shut, might afford some relief. The very existence of these openings is proof positive of the necessity for them. If fresh air was not needed these windows would not have been put in. In fact they might as well be left out, for they are under the control of the public at large. The dirty passenger, who always feels cold sitting beside a red-hot stove, arises and closes the ventilator directly it is opened. The lady who wears thick clothing, surmounted by a sealskin jacket, orders the brakeman to shut the ventilator at once, and in so far as it was intended to supply a necessity, the end-ventilator is practically useless.

Apart from it, there are in modern American railway cars no devices which we have seen that insure a pure atmosphere at all times. If there were any we should have seen them, for our traveling has exceeded 30,000 miles all over the country for consecutive years. The only provision extant to-day in public use is a number of openings in the roof of the car. These do no good, for the reason that fresh air cannot enter through them and stale air cannot get out. Last month, in an express train on the New York and New Haven Railway, the atmosphere was so foul in one car before it got to Bridgeport—57 miles—that three-fourths of the passengers were asleep at 12 o'clock in the morning. This in itself is conclusive of the presence of carbonic acid, aside from the offensive odor which prevailed.

There is no reason why people should not have pure air to breathe but one, and that is the determination of master car-builders. These gentlemen insist upon retaining holes in the roof and making no other provision for a vital need. The hole is in the wrong place. Foul air is not in the top of the car but at the bottom, where it falls by its superior gravity, and, when they recognize this fact it is easy enough to get rid of it. Air tainted with carbonic acid, which is what mankind exhale, is heavier than common air just in the proportion of its contamination. With sixty pairs of lungs in full blast, saying nothing of stoves and other sources of impurity, it does not take long to burn up the oxygen in the few cubic feet of air contained in a car.

These facts have been urged time and again, yet nothing is done. No car-builder has had the courage to make some simple provision for dumping the dirty air out of the bottom of a car. It would run out, like water from a basin, if it could only find an exit.

Perhaps in some later generation these matters will receive more attention. When some speculator bottles up all the fresh air so that it cannot be had except by paying a premium, mankind will suddenly awaken to a sense of its value, and efforts will be made to provide it.

ENGINEERS' AID SOCIETIES.

A cry goes up from the indefatigable secretary of the National Association of Stationary Engineers, A. M. Davy, in regard to the aid societies of the several associations all over the country. He writes that the interest taken in this line is not so great as he hoped it would be, and he sends a moving appeal to members to bestir themselves energetically in the matter. He also thinks that a committee should have been appointed at the National Convention to further this matter and put it upon a business basis at once.

So far so good. We fully sympathize with Bro. Davy's anxiety and earnest effort, but we do not share his apprehension that aid societies will not amount to much unless prompt measures are taken. It must be remembered that this whole thing is yet in its incipiency, and that it must commend itself to the members through its own intrinsic value. This is to say that in some localities where there are aid societies, and deceased members' families are relieved by them, individuals will see that it is a beneficent plan and generally adopt it as a necessity. The publication of instances, or cases in point, will greatly aid the firmer establishment of such societies, until finally it will become a conviction in the minds of stationary engineers' associations that they are incomplete without them. It can hardly be expected that more rapid progress can be made. If we look back six months we see at that time there was no organization of any kind. It is a great thing to have interested stationary engineers in forming local societies at all, and we sincerely believe that in due time all the anticipations formed will be realized.

IMAGINE ITS CONDITION!

A curious commentary as to the way in which some steam engines are managed, is furnished by an inquiry in a milling paper; it reads as follows:

"Will some engineer tell me the cause of the water from my boiler flowing over into the cylinder. I am running a 50-horse engine, that has been run four years. The first two years no water came over, but for the last year I am compelled to run with the drip cocks open at both ends. The steam pipe into dome is perforated on the top in the middle of the dome; exhausts under cylinder; elbow close up and runs off at right angles; dome connects with boiler by a neck six inches in diameter. For all I can see the conditions are the same as the first two years. I am at my wit's end."

It would seem plain that if the boiler performed properly for two years, that it is not in fault, but that the difficulty lies in the condition of it. Here is a boiler with a dry pipe that foams so badly that the drip-cocks have to be kept open, and the man in charge—we cannot say engineer—writes to a paper to know what is the matter! Doubtless this individual thinks that mechanical papers are worse than useless, and that "book engineering" is a humbug!

SHARP CONTRASTS.

Recently in walking through the Works of a large Company, in the Eastern States, with the President of it, striking evidence was presented of the personal relations existing between employer and employed. The personage named had not been in the Works for a week, owing to illness, and this was his first visit. Upon seeing him approach, men of all grades, from the highest to the lowest, more particularly the latter, left their jobs and came forward with friendly congratulations upon his recovery. Many of them were soiled by labor, but they all put forth their hands, which were grasped as cordially as any one could wish, and it was plain enough that the good will manifested was sincere and personal to the man.

In explanation of the repeated interruptions which occurred to our investigations, the President remarked, casually, that he had just come in, etc., and that was the cause of it.

To us this was a most gratifying incident, for it spoke more forcibly than anything else could, of the perfect harmony existing, and of the absence of any false standard of station or pride of place. The President did not feel that his position put the machinists employed by him outside the pale of recognition, or that they were any the less men because they worked for him. This is one cause for the uniform excellence of the work done in this establishment, which we do not name, for obvious reasons. There is no espionage and no arbitrary system to sap the manhood and good feeling of the workmen. Every man feels that he is recognized for his worth, what he is, and that puts him upon his good behavior at once—if he has any special behavior outside of his daily walk and carriage.

"Why," said the President, in answer to some remarks we made to him of similar purport to those here given, "our men visit my family with their wives and children, and talk over social matters just as any one would; there is no question of station, or any idea of it, upon either side. I have yet to see the first instance where it has been abused."

It is not in every State that this could be said, nor in every workshop, even in the East, but, as a rule, the influence of the social institutions of that section make self-respecting men, whether their relations be that of employer and employed or not.

AN EASY METHOD OF MAKING BOOKS.

What is, in some respects, a ludicrous affair, recently occurred in England, the cause of action being a notice of an alleged mechanical book, which notice was asserted to be libelous. The author, feeling injured in pride and purse, brought suit against the publishers of the paper in which the notice was printed; the case came to trial and the author was non-suited, or rather he lost his case. The examination and cross-examination of the unlucky author is the ludicrous side of this matter, for it appeared he had written a mechanical book, so-called, by "compilations" and "condensation" of standard authorities, without the slightest personal knowledge of the various processes he described. We make a brief quotation of the flaying the author received at the hands of the lawyer.

The plaintiff is on the stand, and the lawyer reviews certain parts of the work.

> Then we come to iron-founding. Did you ever see any iron-founding? Yes.
>
> Where? At Newcastle-on-Tyne, also at some place in Southwark, also at Chertsey. I have frequently seen it. * * *
>
> Look at the paragraph about baked sand, at page 113, near the bottom. Your idea of baked sand is "that which has been already used," I see. Well, this means that either one or the other may be used.
>
> "Baked sand, or that which has been already used, is also employed for making molds." That is the way in which you put it? I think that is the way I put it.
>
> Either baked sand, or that which has been already used? I think that is the way they do it.

Do you know what "baked" sand is? I do not know the technical application of the term.

You do not know really what it means? I do not know practically.

But do you know at all what it means? I do not know it technically.

Baked sand is baked sand. Do you know what "baked sand" means? I presume this baked sand has some peculiarity which I do not know of.

Mr. Justice Stephen: Do you know what "baked sand" is? I do not quite know what it means.

Well, what does it mean? because I do not know the meaning of it the least in the world. I think it is sand which has been subjected to a certain amount of heat, but I am not quite sure whether that is really the technical application of it in this particular art.

Mr. Marshall: Your idea is that "baked sand" is sand which has been baked? Of course, baked sand must be sand which has been baked; but there must be some other technical meaning with which I am not very well acquainted.

But take the first meaning. Your idea is that "baked sand" means sand which has been baked? Baked sand must be sand which has been baked, of course. * * *

and so on for about half an hour.

The method of making books herein exposed is not new in this part of the world, and no one could get a patent on it; if the authors, so-called, were to be put on the stand they would make as sorry an exhibit as the unfortunate here mentioned. Books are made up from technical journals, the matter in which is re-written, copied, sometimes verbatim by whole pages, and then put forward as the experience, observation, and deductions of Mr. Reachrod.

This may be enterprise and versatility, but it seems to us as if the old-fashioned words—barefaced robbery—described it more nearly!

A STRANGE INSTRUMENT.

The indicator is, in some localities, a strange instrument, and its mission is unknown. Witness this letter from an engineer to Secretary Davy, of the National Association:

"Well, mon, here is what the engineers are in this town: I've not found one man who ever used the indicator, and but one who ever saw one. The builders here never use it. I carry one with me, and frequently apply it where parties want it. I was showing it in the hotel office the other night, and a couple of engineers who run near-by came in. They asked me if it was not a new-fashioned lamp; and how did they put oil in the thing!

"There, that's about a sample of 'em! Shades of Watt! Stir up such men? I would as soon stir up a glue factory!"

We have suppressed the locality where this incident occurred, but it is not a thousand miles away. What is said of it may also be said of many other places. The indicator should be in the hands of every engineer, though not all of them can afford to purchase instruments. Steam users should regard the indicator as a friend who is willing to save them a good deal of money, if they will permit it to.

THE NATIONAL EXPOSITION OF RAILWAY APPLIANCES.

We hope that all of our readers who can in any way aid this project, by the exhibition of articles calculated to advance its objects, will take action at once and communicate with the Secretary, Mr. E. H. Talbot, Grand Pacific Hotel, Chicago, Ill., in regard to space. This gentleman writes us that there is very little left, but we presume that prompt measures upon the part of our friends will secure that little.

This is the first exhibition of its kind ever held in this country, and from the energy with which it has been pushed, and also the character of the gentlemen who are sponsors for it, will undoubtedly be a great success.

Everything belonging to the railway service of this country, and others, as far as possible, will be shown. Such an opportunity for spreading a knowledge of improvements is seldom afforded.

An advertisement on the back page gives fuller particulars.

RECKLESS BOILER TENDERS.

We are apt to think, at times, that this country enjoys a monopoly of reckless boiler and engine tenders, but, from reading reports of foreign boiler explosions, it would seem that recklessness is confined to no locality, but thrives wherever it is encouraged.

In England, a traction engine-boiler recently exploded in the highway, and an investigation developed these facts:

"The driver deposed that before the engine was under his charge he remembered on one occasion to have seen the pressure so high that the pointer of the steam gauge was driven round hard against the stop-pin at zero. Another witness said that within a day or two of the explosion he had seen the pointer of the pressure gauge driven right past the last figure, which was 100 lbs., and standing between that and the stop-pin. Even then the steam was not blowing off, so that the valve must have been loaded to a higher pressure still, if not locked fast. The owner stated that he bought the boiler and engine second-hand about twelve years ago. He believed it to be about twenty years old on the day of the explosion. He had not had it inspected. He worked it at a pressure of 100 lbs. on the inch. About seven years ago he went into the field and found the safety valve screwed down and the pointer of the spring balance at the bottom of the slot, so that the valve was locked fast and inoperative. On seeing this he eased the valve, when it took about fifteen minutes to reduce the pressure to 100 lbs., with the engine standing at the time. On looking at the boiler he saw that the stays had begun to leak, when the driver told him that about twenty minutes before, while taking the engine up the field, he had heard cracking sounds. On learning this he lowered the steam pressure and took the engine to a blacksmith's shop, when, on opening the boiler, he found from eleven to thirteen fire-box stays broken. He then gave orders for ferules to be put on the spring balance safety valves to prevent their being overloaded in future, but made the startling statement that he "always found them removed by the drivers."

This would seem to be alarming enough, but it is only one of many similar cases that are in existence to-day, that are waiting to explode.

Parsimony is at the bottom of all this business of exploding boilers.

THE FUTILE FIRE ESCAPE.

The futility of fire-escapes in general was shown recently in this city. A fire broke out in a large building full of workpeople. There were ample fire-escapes attached to the premises that were well known to the operatives, but so soon as the alarm was given they all rushed pell-mell for the roof and went along some distance and descended through another building to the street.

The difficulty in all cases of sudden alarm is to maintain presence of mind and do the correct thing. Imagine a fire-escape outside of a building, and fifty or more excited men and women trying to get down all at once! Imagine the average female descending a ladder at all, some fifty feet, possibly, from the sidewalk! It would be a perilous undertaking for her if she took her own time to perform the feat, but when numbers of others are crying to her to be quick, when perhaps the rungs of the ladder are slippery with frost, it is manifest that the so-called fire-escape is anything but a safe road.

If at a time of general alarm no panic ensued, and men and women did not lose their heads, there would be comparatively few lives lost, even when there was great danger. The mere fact of there being fire-escapes in case of need should conduce to coolness, but oftener than otherwise it is the heedless, "devil take the hindmost" feeling that precipitates disasters; this no fire-escape can prevent. We pointed out some of the disabilities of ordinary fire-escapes in a previous paragraph, but suppose, in addition to them, flames burst out of the windows directly upon the fire-escape, how efficient would it be then? Many of these so-called escapes lead directly from the windows.

The best safeguard against fire seems to us to be a fire-proof staircase of ample width, closed in all around with iron sheathing. Down this numbers could go at one time and with a confidence derived from being upon a natural exit used daily. In external devices, of whatever sort, we have very little confidence.

D. T. Ames, of 205 Broadway, N. Y., issues the "Hand-Book of Artistic Penmanship," which is a valuable guide to all who desire to improve in this art. It is well illustrated with examples of alphabets and lettering useful to draughtsmen and others, and will be sent free by mail for 75 cents.

Amateur Mechanics is the title of a handsomely printed English monthly magazine, intended for a special class of readers—those who do work for the recreation they find in it. The journal is edited by Paul N. Hasluck, and embraces a great variety of topics on subjects germane. In England the amateur class is very large, and it is not without its disciples here. The price of the work is $1.50 per annum. P. N. Hasluck, Clapham, Jeffrey's Road, London, England.

THE PROFESSOR IN THE MACHINE SHOP.—

NO. XXIX.

The repairs at Mr. Blank's works—to his old engine—have interested us very much. For the reason that it has brought us face to face with the past, so to speak, and showed us, by actual example, how great have been the changes in steam engines and engineering practice since this old engine was built.

Paleontologists are scientific sharps who go digging into caves, and exploring mounds, and diving into lakes, to discover traces of ancient man. I could not repress a smile as the thought came over me, while we were at work on this old trap, that Jake and I were paleontologists in an engineering way, and had "unearthed" traces of the handiwork of engineers who were long since dust and ashes!

About this old ruin there was no date; no name cast on the frame; nothing, in fact, to identify its maker, who doubtless felt that he was well enough known to sell all the engines he could make, without any such adventitious aids. The bolt-heads were square and the nuts the same; the washers were immense, and the threads on the bolts of such a character that I thought they must have been cut "hit or miss" with a hand tool, and a chaser, in a lathe, but on looking at the ends I found no centres, so I concluded that some primitive form of stocks and dies had been used to jam a thread on them. Perhaps I fell into a sentimental vein in handling this job, but the contrasts were so strong that I could not avoid comparing these crude threads, winding in some sort of a devious spiral around the bolt, with the sharp, accurate, exact to size, modern machine-made bolts of the best class, such as are cut in the Pratt and Whitney machines. I could not but wonder at the difficulties which beset engineers of the last century, and give them credit for doing as well as they did. No thought of ridiculing them came into my head. They did the best they knew how. Steam itself was a terrible and unknown force at that day, hedged around with all sorts of mysteries and dangers. That men of the old school were able to harness it and make it draw their loads and do their work at all was a wonderful achievement. That we have been able to improve upon their methods is in the natural course of events, and when we are disposed to glorify the present and brag of our great progress, it is just as well to give our great, great grandfathers a little credit for being wise in their generation; but an end to moralizing!

I am looking after this job myself, as Jacob is under the weather for one thing, and for another, has an unaccountable dislike to tinkering up old work. He hates it, in fact, whereas I like it. I would rather take a sick engine any day and put it right, than build the best new engine ever devised. There is more satisfaction in bringing economy out of waste than there is working up new plans from exact drawings, where everything is fore-ordained, and the man who executes does only what is laid down for him. I went over, therefore, to Blank's shop one day to see how the boys were getting along breaking out the old joints.

As I went to the door—before I got to it, in fact—I heard some very audible strong language addressed to the machine, and going in found our young friend, Lamb, attacking the steam-chest joint where it met the face on the seat, with a hammer and chisel. Sweat poured down his face and he looked irritated and out of patience generally.

"Whats the matter, Lamb?" said I.

"The matter is that the —— fool who made this joint must have made it in the foundry, I guess. I have been plugging away at it for ten minutes and I can't budge it."

"Well," said I, "you got it right the first time; the joint was made in the foundry, for the chest and ports are all cast in one piece."

"What's that ledge doing on there, then, if there ain't no joint?" said Lamb.

"That's a false joint, put on to match the bonnet where it laps over the chest on top. There is no joint there. You might have seen that at a glance, by the bolts, if you had looked at them, for they are only tap bolts; they don't go through. Before you undertake to break a joint be sure there is one to break."

Lamb sat quietly taking in this lecture, making no reply; he is a good deal tamer and more docile than he was, having learned that by giving too much "lip" he stood in his own light. "What you want to do," I continued, "is to disconnect the whole engine first. Take off all the rods and lay them down on the floor out of the way; then take off the crosshead and take the piston out. You are all right then, and can break all the joints you want to. Have you got the boring-bar here to bore out the cylinder with?"

"Yes, sir; it's over there on the truck."

I went over and examined it, and found a long bar $1\frac{1}{2}''$ in diameter, with a small head on one end like a cheese, and cutters let into this like the buckets on a paddle-wheel. "Who is the author of this invention?" said I.

"I am," said Lamb.

"Who told you to get such a dingus as that to bore a cylinder with?"

"No one told me, Mr. Moulton. I rigged it up myself out of an old 10-inch piston-spider and bar-iron."

"Well now, Lamb, I don't want to discourage you, but the best thing to do, when you don't know, is to ask. This thing won't bore the cylinder out; it will chatter too much; we couldn't take any cut with it. You should have brought the regular shop boring-bar for this work."

"I thought you were going to bore the cylinder out through the stuffing-box in the front head, Mr. Moulton."

"We can't, for the piston-rod hole is not in the centre, for one thing, and the cylinder is too long, for another."

"How are you going to drive the shop-bar, Mr. Moulton?"

"There is a rig that goes on it for that purpose. We have used it many a time, and made good jobs with it. The front head has to come off any way to be rebored and bushed, so we lose no time in taking it off."

I then showed Lamb, with a piece of chalk, just how the rig was worked, and in a short time thereafter the bar and its belongings came over and we got to work.

Not to be prolix in details and common everyday routine that every one knows of, I will here reproduce the old cylinder and its general proportions and the new attachment we put on in lieu of the old steam-chest. It is the best we could do at short notice and little expense, and, though not what we would like to have done, it was all Mr. Blank was willing to pay for, which was the main point with us.

In making repairs I have frequently found that unless work is done by the day, at day prices, the contractor is out of pocket. This for the reason that he did not remember that repair work is slower than new work, taking just about double the time to do it. A man has to leave the shop for one thing, and go to his work, and that takes time. Often there is no convenience for grinding tools where the repairs are going on, and he has to get all his chisels and drills fixed up before he goes to work; this also takes time. Further, if holes are to be drilled, the ratchet-wrench has to be used, and some rig to hold it must be devised; this is another slow job, and to make the story short, a man who has never done much repair work is very apt to underestimate its cost.

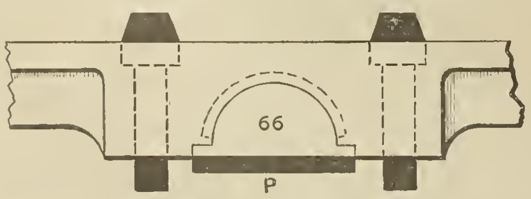
I find that I am so near the limit of space allotted me that I cannot get in the details mentioned previously, and must therefore leave them until another article.

I will present the old cylinder and the new casting we made to go on it. If we could have done the job any cheaper or better, I shall feel under obligation if my readers will say how.

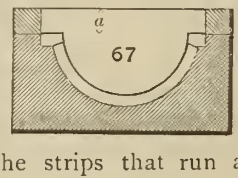
PATTERN MAKING—NO. X.

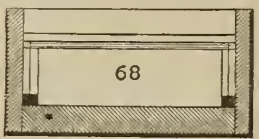
BY A PATTERN MAKER.

Figure 66 is an elevation of a pillow-block pattern, to mold base uppermost and to have the bearing cored out. In this case, the print *P* is affixed at the place where the recess for the cap was cut out in the former case. This print is to be of the same length as the bearing, but its thickness is not arbitrary.



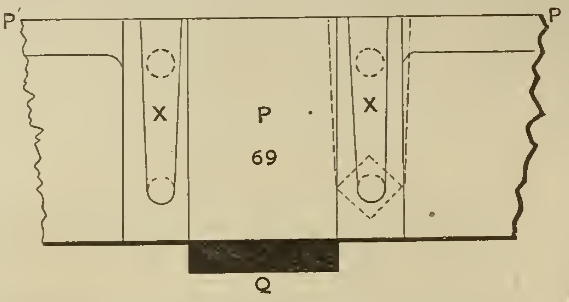
Sections of the required core-box are shown in Figs. 67 and 68. It is a block of rectangular section, in which the recess *a*, equal to the thickness of the print, plus the depth of the recess required in the casting, is sawed out and also a half circle equal to the size of the babbit outside. The half-rings, at each end of the box, need not be carried higher than the underside of the strips that run along it, as the latter will be confined by the ends of the box.





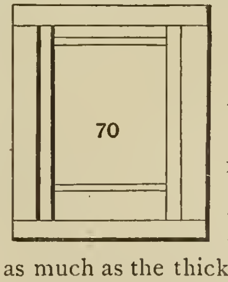
This arrangement makes a stronger and cheaper pattern, in some cases, as once fitting up the core-box will do for any number of bearings of the same size. The drawback is that which is common to all cored work—the castings are born with *fins*.

A *fin* is a piece of metal which has run between the core and the mold, or between any two parts of a mold that do not meet in a perfect joint. When cores are employed an element of uncertainty is introduced. The cores themselves may not perfectly agree with one another; they may not be truly set in the mold, they may be a little out of line, or a little off the square.



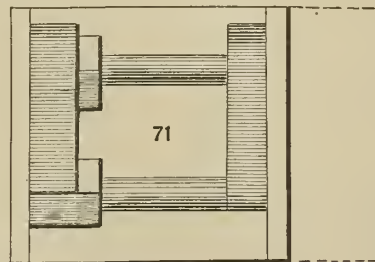
We now take a case in which we have, practically, no choice but to core; it is that in which we are bound to mold the block sideways, because the frame on which it is to be cast molds in that direction. Fig. 69 shows a block which will be wholly in the lower part of the mold (in the "drag," so called), *P′P′* being the line of parting.

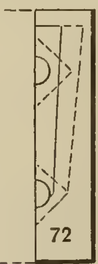
The print *P*, as used in Fig. 66, is also applied in this case; it insures uprightness in the core. In addition to this the print *Q*, cut to the form of the aperture required, is applied to the end of the bearing, forming an additional guide for the core. This is the method ordinarily followed, but if we please, and the exigencies of the work demand it, we may omit either one of these prints. If the print *P*, only, is retained, we should make it much thicker, or the core may not be well placed.



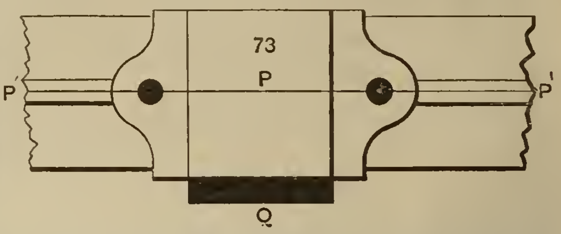
The core-box will be made as shown in plan, Fig. 70. It resembles in section, Figs. 67 and 68, with the exception that it is longer at one end, as much as the thickness of the print *Q*.

It will now be observed that we cannot put on the prints for the bolt-cores as before, or they would lock the pattern in the sand. The prints we shall employ will not only cover the outline of the holes but will be carried up to the parting line of the mold, as at *X* in Fig. 69. In this figure, the prints on the cheeks of the block are shown in full line, and also one of the prints on the base in dotted line. A core-box, in which a core can be made that will fill the spaces left by the prints, and have the holes in the castings, is shown in plan, Fig. 71, Fig. 72 being an end view of the same with one end of the box removed.





The prints employed for the bolt-holes, in this figure, are called long prints; they should have plenty of taper, so the core may be easily lowered into its place. To ordinary prints very littly taper is given, unless the core-box is tapered to match.



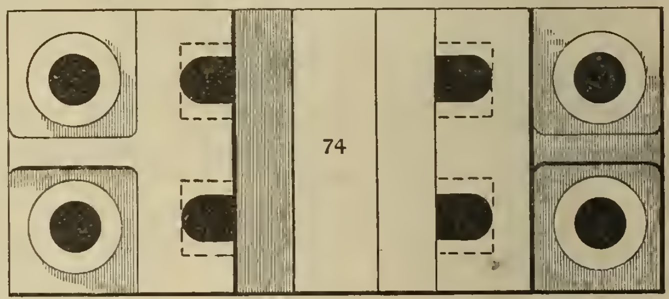
A neater and better plan of making the pattern block to mold sideways, though it cannot always be employed, is shown in Fig. 73. The pattern is made in halves, the parting line of the mold *P′ P′* passing through the centres of the bolt-holes. It will be seen that the bearing, prints, and core-box is similar to Figs. 69, and 70, with the exception that the print *P* is in two pieces.

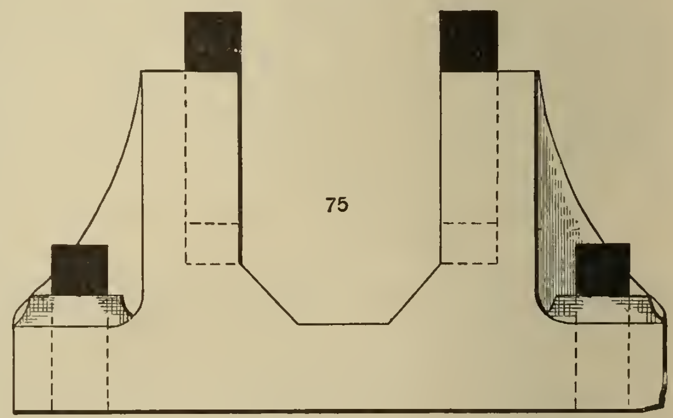
The bolt-hole core-prints are to be as in Fig. 66, but those on the base are not to be made taper.

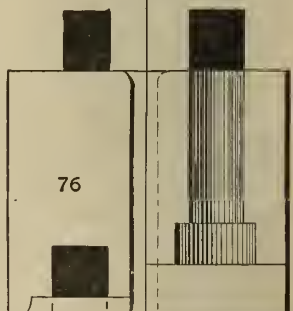
I have now great pleasure in directing the reader's attention to the excellent design of pillow-block given in THE MECHANICAL ENGINEER, Vol. III. No. 2.

When once a design of this kind comes into my possession I never part with it; it is not a picture, but a working drawing; a more perfect specimen I never saw, or one more clearly and intelligibly put upon paper. [As this seems to imply that it originated with us we hasten to disclaim any credit. It was engraved from a series of plates issued by E. & F. N. Spon, N. Y. EDS.]

Our first step is to take, say, the block, and draw it full pattern size, with finishing and shrinkage allowed. We have four views given us, but we can get along very well with two, a plan and an elevation. These are shown in Figs. 74 and 75. I add the end view, Fig. 76, to make the design more clear to those who may not happen to possess the original to which I have referred.





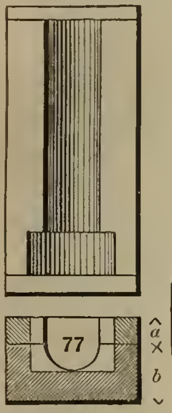


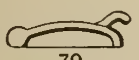
Not being able to show a full-sized drawing of this block, which is for an 8-inch shaft, I repeat the scale of the design $1\frac{1}{2}$ inch = 1 foot.

The base of this block, being $3\frac{1}{2}$ inches thick, we will not make it solid, but like a box without a lid. Take a piece of board the proper length and width, and not less than $1\frac{1}{4}$ inch in thickness; nail strips about $1\frac{1}{2}$ inch wide and of such height as to make $3\frac{1}{2}$ inches around the edge of the board. This completes the base. The molder will fill the box with sand when making his parting, so that the effect will be just the same as if the pattern had a base of solid wood.

The cheek pieces being about 12 inches high, we will give them each not less than $\frac{1}{32}$ inch taper inside and $\frac{3}{32}$ inch outside, the edges to receive each $\frac{1}{16}$ inch. Let these pieces be set to a line, held in that position temporarily by fine nails partially driven and then be very firmly screwed. The brackets, which strengthen the cheeks, may be screwed on next. It is generally allowable to make the base end of the brackets terminate in a small curve instead of a sharp point; this gives the cross-grain a better chance to stand, but if we have to adhere strictly to the design, we can get over the cross-grain difficulty by cutting recesses in the base for the brackets to stand in. Nail and glue in the corner pieces which form a seat for the brass, also the fillets; add the facings or hubs for the holding-down bolts and upon them nail prints. It will be noticed that the cap-bolts do not pass clear through the block, but stop short at the corner pieces; this enables a bolt to be changed without disturbing the block from its foundation. The shape of the prints for the cap-bolts is shown clearly in the plan. They are to be fastened on top of the cheeks. The core-box that agrees with them is shown in plan and section Fig. 77

I should make no remark upon the cap for this pillow-block, feeling convinced that what has been said upon the one is sufficient for both; but on observing the oil-cup with hinge and cover, I think there is room for some further explanation.




79

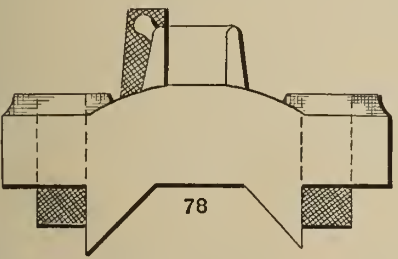

78

Fig. 78 is an elevation of the cap; parts black are prints. I adopt this style of shading, because, in the absence of varnish of two colors, prints on a pattern are usually distinguished by chalk-marks crossed in this manner.

Pattern stores are generally supplied with an assortment of oil-cup patterns, which, as I have stated, may be placed on any cap they suit, not fastened, but merely located by small pegs. In the case before us we have to cast a hinge upon the cup, which hinge is formed of four lugs, two upon the cap and two upon the cover, those upon the cover being wide enough apart to admit of the cup-lugs fitting between them.

It is clear that we could not draw the cup from the mold if the lugs were fastened to it; our plan is, therefore, to fix a print to the cup where a lug is to be cast; make a core-box to match the print and place in it the lug. As the core-box is of the same depth as the lug, the latter will draw out of the box endwise.

The oil-cup cover, Fig. 79, may be molded with the finger-hook downward, the hook being held by a small screw, which is to be taken out after the cope is off; the cover can then be lifted and the hook, by a circular movement, withdrawn from the the mold. It is better to arrange it this way than to make use of a core, which always leaves a mark upon the casting. The hook is well tapered every way, and has rounded edges which enables it to be drawn without difficulty.

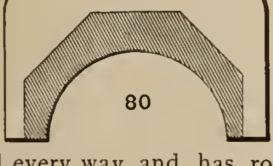

80

Fig. 80 is a section of one of the brasses for this pillow-block; it will mold bearing uppermost, very little draft being given, as the brass-molder's sand is finer, and therfore more tenacious, than that of the iron molder.

Make first the body of the pattern, shaping the outer flat sides only. Fix a flange on each end of the body, and lastly saw the bearing out.

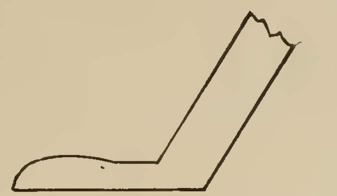
VERNI NOIR.

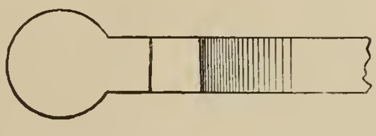
DIES AND DIE-SINKING—NO. VIII.

BY A DIE-SINKER.

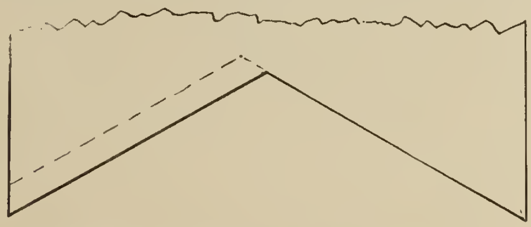
As examples of the difficulty of making simple looking things, when they are required in large numbers, we will take two forgings, differing widely from each other, and yet belonging to the same class. That is to say, they are made on the same principle as the last one we illustrated. Of course the dies are made differently, to suit the job, but the principle of making the faces of the die-blocks follow the shape of the model, is there.

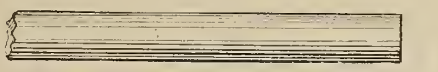
The first is a brace for a Howe sewing-machine stand, the second is a lifter for a Singer sewing-machine. We will make dies for the brace first. There is nothing very particular about it as it has not to fit into jigs, and is finished completely in the die, without any hot or cold trimming tools (if the iron is properly gauged), but it has to be right, and we will be just as careful with it as with others that have to go through many operations.

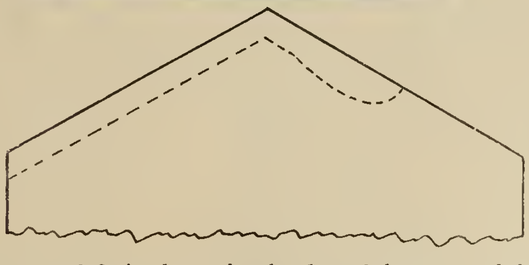




The first thing to do is to make a template for the faces of the die-blocks. Take a piece of sheet-iron, and fit it along the back and bottom of the model, as in the engraving. This is an angle of 135 degrees. Now, make a male template to fit this, and you have the shapes of your die-blocks.





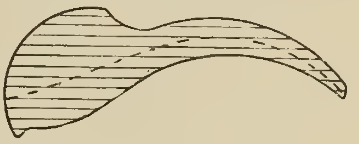


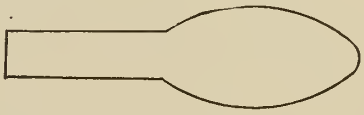
Plane up your blocks to correspond, and fit them together. The next thing to do is to drill a half-inch hole, half in each die-block, from the outside of the blocks, to the apex of the angle, holding before the point of the drill touches the centre. Drilling a hole here, half in each block, is rather difficult, but by having proper arrangements we can do it. It would be easy to shape out one-half the hole in the bottom block, but we could not do so in the top one, therefore we must drill it, and it is the best and quickest way.

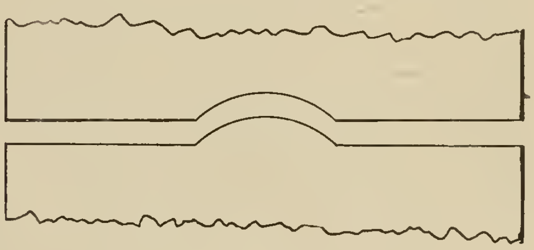
There should be an outline template for this die, too, but I will not describe it. I think the reader will now understand how it should be made. Place it on the dies and, as usual, scribe the outline. Take the centre of the two outlines on the straight part, and draw a line between them, from the outside of the blocks to the centre. Take a diamond-point chisel and cut a groove right along this line, on both blocks. This is to make the drill keep straight. Any one that has ever drilled holes between two pieces of metal, knows how difficult it is to make the drill run exactly one half in each piece (that is in a deep hole). If one die is a little harder than the other, the drill will be sure to run most into the soft one. This cutting of grooves is an effectual remedy, as the point of the drill follows them, but the grooves should be an equal depth. After the grooves are cut, clamp the die-blocks together, and place them in the drill-press, so that the dividing line (on the side we wish to drill) will be perpendicular. This can be done by placing the top die-block underneath and tilting them to the proper angle. When you have drilled them, the worst of the work is done. There is now, on one of the faces of the bottom die-block, a half hole right across it; it is necessary to sink the button or hub-shaped part on the other face of it. This can be done in two ways, either by drilling and chipping it out, and working a drift into it, or it can be made by drilling it with a common drill, large enough, and finishing it with a milling cutter of the proper shape on the point. After this, cut out the part that remains between it and the groove formed by the drill. See engraving. The top-die only requires to have the half hole along one face, so it is finished also.

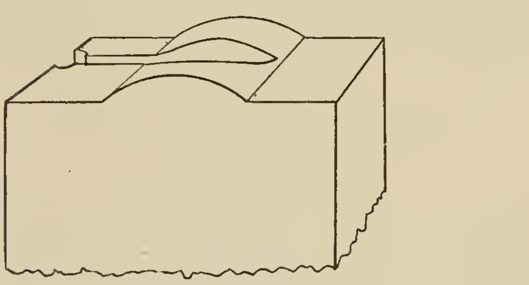
As the actual forging only takes place at the apex of the cone, bending it and forming it into a hub-shape, the iron is only heated a short distance from the point, and as it is placed on the die, in the way shown in the engraving, it is necessary to round, or bevel off, the corners of the groove, very much, toward the outside of the die-blocks, leaving it intact at the apex of the die-block faces. The forger has to be expert for this forging, so that he can place the iron by his eye in such a position that there will be just enough stock to fill the die, so that trimming dies will be unnecessary. He also has to be careful when the drop comes down, to lower his hand with the iron, or he will get a stroke like an electric shock. About 50,000 forgings can be taken from a die like this.

We take now the second subject in this article, it is a lifter for a sewing machine (see engraving).









Its shape is peculiar. How shall we place this in the die-block? If we laid it flat, as in previous articles, we could make it, but you will observe at one part it is wide, at another it is very narrow; consequently we would have to use iron almost wide enough to cover the largest part. This would entail great waste of stock, as all beyond the wide part would have to be cut away with hot trimmers after it got the first blow. This must also be taken into consideration in making the dies, as we want to make as little scrap as possible, which amounts to a great deal when we want hundreds of thousands. We will set it up on edge as represented in Fig. 2, and draw a centre line, as shown by the dotted line; this dotted line will be the shape of the die-blocks on the faces. We will have to make top and bottom drifts, for the parts above and below the centre line marked *a* and *b*. These could be made without, but it is a slouchy way; the other part does not require them, as it will be very shallow and easily worked.

The reader must bear in mind, when I speak of the centre line on a forging, that I do not mean absolutely the centre of the forging, but an imaginary line that will pass through the most convenient points to work from. When we have thought it out, we strike this line and call it our centre-line, when it may be, and is often, all on one side of the forging; but we try to keep as much to the centre as possible. When we have found this line it is our working line, for then we make the faces of the die-blocks the same, and always start from it.

Taking it for granted that the reader is now familiar with the processes of making the drifts and sinking this kind of die, I need not further detail them, but we can go ahead and sink them in a similar manner to others done before. But here I should explain that the clearance for the iron on this die is on the side where it is sunk deepest. It is also advisable to have two impressions, for this is a great saving, even if you have only to use one, for it requires almost as large a die-block for one impression as for two. Therefore you save as much steel as the depth of the die, because it always has to be planed entirely off before you make them again; likewise you save the labor of hardening and annealing.

It is sometimes the custom, when a small number of forgings is required, to put two or three impressions in one die-block, of different forgings, in the same way that a molder has different patterns in the same flask. If these dies are made right they do not require hot trimming, for they can be finished satisfactorily in a cold trimmer; but the trimming dies and punches must have the same profile in either case.

This now finishes the subject of irregular shaped die-blocks, but is by no means the limits of what can be done in them; but I have illustrated the essential features of the principle, and it may, perhaps, suggest to some one the way to get over some difficult problem. In my next article I will commence work on another principle which the reader has not had the slightest hint of yet, and which I think is the most interesting work of the die-sinker. The draughtsman may take a pride in his art, and well he may—would that I possessed a better knowledge of it! The pattern-maker may boast his a trade of endless variety, and think it the most important in the world. The molder, too, may think that no trade requires more knowledge. The blacksmith justly ranks high. But the poor machinist comes last. His is the only trade for which the promoted laborer is thought quite competent. He is only regarded as the finisher of other men's work, when in reality he should possess the knowledge of all combined. Die-sinking is a case in point, where the die-sinker (or machinist to call him his right name) has not only to originate the model, make his own patterns, cut out his own molds—for what are dies but molds of steel?—and design ways and means to make the forgings, but not in the beaten paths of the blacksmith. He must originate hitherto unthought of ones. When the pattern-maker, molder and blacksmith see the results of his work they go and hide their heads for shame!

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MECHANICAL DRAWING—NO. IX.

EDWIN H. MARBLE.

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We have studied the models which have been placed before us as examples of the different classes of objects, and our examination has produced more or less gratifying results. The subject of sections has been studied to a considerable extent, and we must have been somewhat surprised at the numberless variety of forms which appeared to us when we cut one of our common objects by planes, revealing the interior, as well as the shape of the boundary of the cut surface. It has also been our aim to note the shape of the envelope, or covering, of these same models by developing and observing their proportions. All of this has been but a starting in our study of mechanical drawing, and we have as yet taken but a few steps in our elementary walk.

The objects which have been placed before us are common to our every-day life, and, though they appear in many varied forms and positions, they are still pyramids, prisms, cylinders and cones. The position in which we have drawn these same objects has in every case thus far been perpendicular when viewed with reference to our first vertical plane, or, in other words, we have not inclined our object either toward or away from our eye, but simply to the right or left of our line of sight. Often we find an object in other than this position—that is, it is inclined to two, or even three, planes at the same time.

Were we not accustomed to see so many lines perpendicular, one to the other, we should not notice any deviation from this position, as we do now. The very fact of a line or object being other than perpendicular to the ground or some fixed body is enough to draw our attention to it. Examine the room in which you are now located, and note the many lines or parts of the room that come under the head of perpendicular. The walls are perpendicular on to the other. The ceiling and floor, the door-frames, window-casings, and in fact nearly every portion, is in line arrangement. Even the furniture is constructed by this rule. An attempt (oftentimes grotesque) is made to combine a curved form with the above in some cases, yet all obey this almost inflexible rule. The carpenter, mason, mechanic and all other artizans use the plumb and lever or its equivalent for the purpose of obtaining correct results.

The terms *perpendicular* (as compared with any other part of the same object), *square* and *right-angled* are used to a great extent in describing and locating objects or parts of objects.

Before we take up our model, let us study the principles which we must be governed by in this lesson. Every object has three lines, or axes, about which it can be revolved—one is perpendicular to the horizontal plane; one perpendicular to the front vertical, and a third similarly situated with reference to the side vertical. Of these we have had occasion to use but one, and all of our models are, as before mentioned, inclined to our horizontal plane, using the axis perpendicular to our front vertical plane. Though not to examine it fully, yet we have touched upon the first mentioned case in our figures. One point we must remember particularly, when we turn an object about our axis we do not turn our other axes, they must remain perpendicular to our fixed planes.

When we revolve our object, as in Fig. –, about our second axis we found that while the object as shown in the elevation remained the same in outline, the plan was changed materially, and that the elevation was simply altered in position. When using the axis perpendicular to our horizontal plane we had the outline of our object in elevation changed, while our plan was revolved in position. When we examine our third axis, we shall find still further changes. The side elevation will remain unchanged in outline and be revolved into another position, while our plan and elevation will be changed.

Fig. 18 shows a prism of odd construction and well illustrates our principles. As shown in Fig. 1 we have a plan and elevation when the base is resting upon the horizontal plane; Fig. 2 gives us the same object revolved about the front vertical axis, or inclined to the horizontal plane of projection. The diagram, as seen in the elevation, is transferred from Fig. 1, while the method of obtaining the plan was shown in Figs. 14 and 17, and we do not think Fig. 3 is new to us, and in it we have shown the prism revolved about the horizontal axis or inclined a second time so as to place it at an angle to both side vertical and horizontal planes of projection.

The axis about which we have revolved this object would in the plan be shown by a point in the elevation by a line perpendicular to our ground line. If about this axis we revolve our object we will readily observe that the plan will not be changed in outline, but simply revolved until it is at an angle to the front vertical, while the elevation has assumed new shape. Our plan, as shown in Fig. 2, we will now transfer to its new position, at the angle to our front vertical plane which it now makes, and we find the points *a*, *b*, *c* are *f*, *g*, *h*, now in the positions indicated by *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, so far as we have met with no difficulty. The points, as shown in our elevation in Fig. 2, will not be changed in height when in our new position, so know also that we must find them perpendicularly above our points in plan; we can now transfer the same preserving the height the same, and the intersections will give us a'', b'', h'', g'', etc.

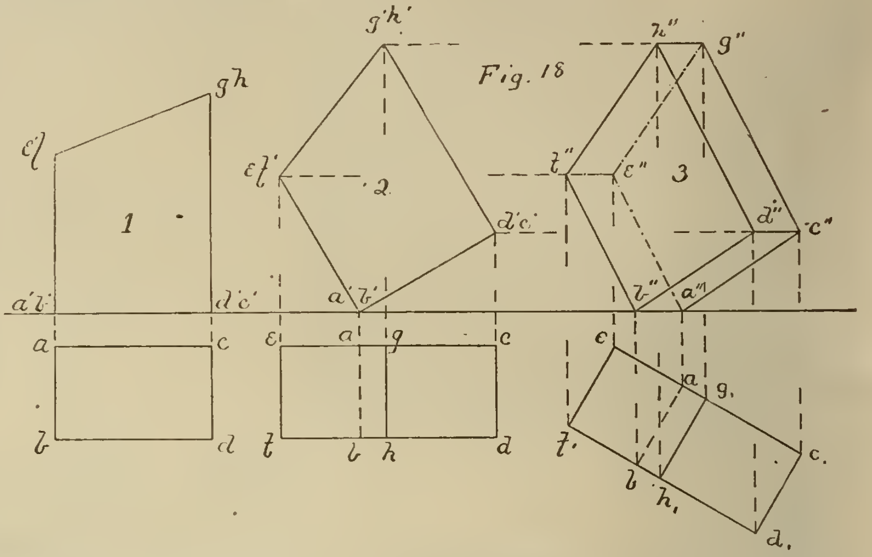


Fig. 18

These points are the intersections of the boundary lines of our prism, and we have but to connect the corresponding points to obtain our complete outline.

In all of the numbers of this figure the side elevations have been omitted, as they were considered of no particular use to demonstrate the principle, yet it would be advisable for the student to construct the figure in full and in different positions from that assumed.

Should we now incline our figure a third time, or revolve it about the axis of the side vertical plane, we should find the side elevation of Fig. 3 unchanged, while the plan and elevation would be revolved about a line shown in both diagrams as parallel to the ground line. Such being the case, it would be an example similar in its details to those already studied, and needing no additional explanation.

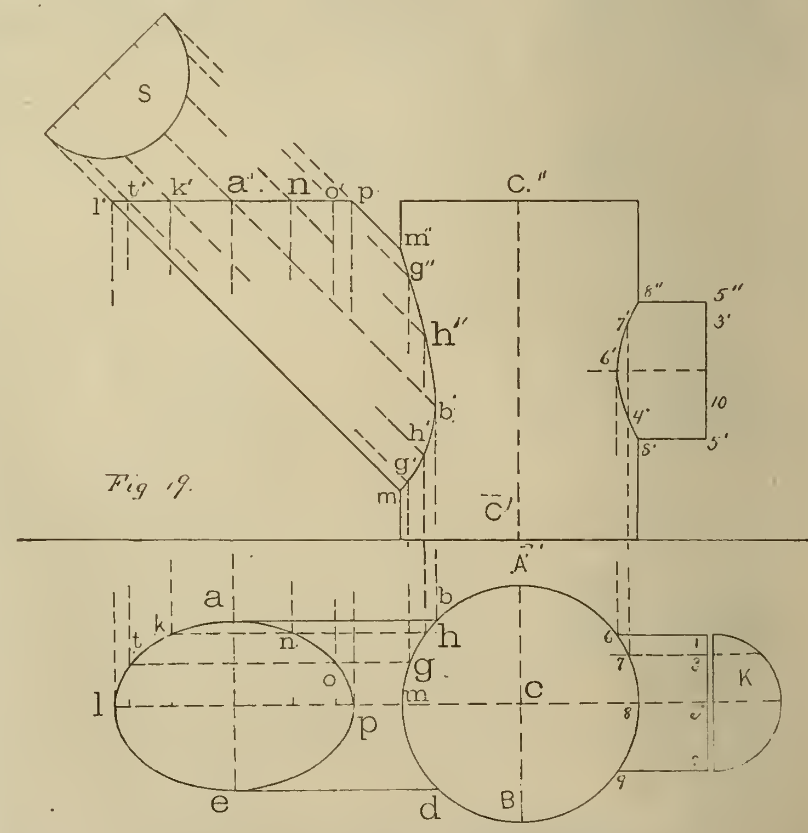


Fig. 9.

With this, Fig. 18, we leave the study of projection as a distinctive study, but shall have occasion to use its principles on every drawing we attempt. These principles are clear, we trust, to all the students who have followed the course thus far, and should there be any points not understood, would be pleased to explain by mail (addressing the author at Worcester, Mass.).

The next principle which we shall study will be that designated as Penetrations and Intersections.

This principle is of great value, and is, perhaps, second only to that of projection. It often becomes necessary to properly represent the curve or line of intersection which one body makes with another, and furthermore, it is very valuable to sheet-iron workers, when the proper curve is required to form a development of an object, as the intersection of two pieces of stove-pipe of different diameters.

Our first study will be a group of three cylinders of different diameters, whose axes intersect; these cylinders we shall place so as to have two at right angles, one to the other, while the third is at an angle of 45° to one of the former. The *plan* and *elevation* of this group we shall have no trouble in drawing in outline. The axis of the cylinders being shown to guide us in our study.

We have already found that the cutting of a cylinder by a plane will be valuable in other examples, in this study it is particularly so, and we will place these cutting planes perpendicular to the horizontal plane of projection. It is evident that when we cut the cylinder K by a plane we shall at the same time cut the cylinder A, B, and if we can obtain a view of our cutting plane in both plan and elevation, we can obtain points in both cylinders, and consequently in their intersection.

Observing first our cylinders K, and A, B, we will cut the first by a plane through $6\ 1$; this plane will be shown in elevation by $6'\ 1'$; now, since the point 6 is also one of the cylinder A, B, it must be at the line of their intersection at $6'$.

In like manner the point 9 appearing on the back of the cylinder will determine a point in the line of intersection. Our next cutting plane will be one through 8, 5. These evil points will be found at $8'\ 5'$ and $8''\ 5''$. The point 8 being also in the cylinder A, B, will determine the points $8''\ 8'$. Taking $3\ 7$ for our next cutting plane we locate $7'$. Selecting other cutting planes and finding the location of the same in *elevation* we are enabled to determine points in the line of intersection, and through these points to draw the curve indicating the line of intersection.

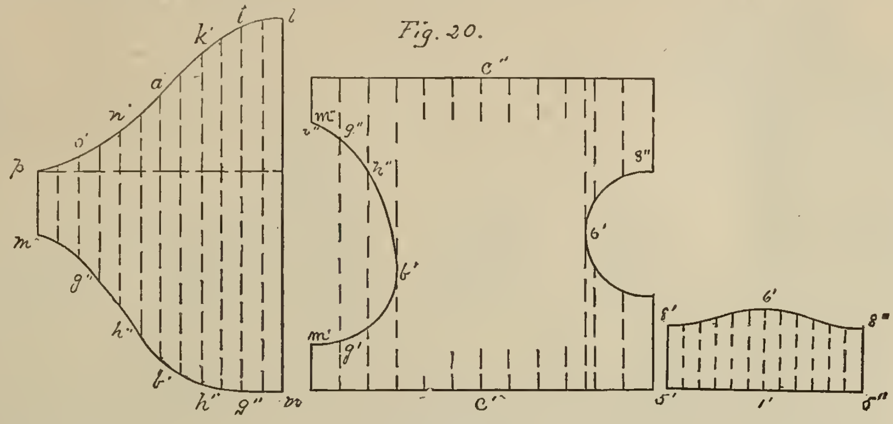
This curve, though in this figure nearly an arc of a circle, will not always so be shown. When the cylinders are of equal size and placed in a similar position to K and A, B. The line from 6′ to 8″ or 8′ will be straight and the point 6′ will be at a point on the cylinder as indicated in plan by A.

The second cylinder which we have shown in our diagram will be treated in the same manner as our first one was to find the curve. The cutting planes will be shown in our elevation by lines running parallel to the axis of the cylinder as in the cylinder K, but we must remember that the axis is not horizontal, but at an angle to the ground line.

The point b is in both cylinders, as shown in plan, and will locate the points b'; m in plan locates $m'\ m''$. The remaining points which determine the curve will be located by the cutting planes $k\ n\ h$, $k'\ n'\ h'\ h''$-determining the position of $h'\ h''$. $f\ o\ g$—$f'\ o'\ g'\ g''$ will give us $g'\ g''$. Other points could be located in the same manner, and enough should be taken to locate the curve without a doubt. In selecting the cutting planes, much unnecessary labor can be avoided by judicious choice. The points should be nearer together at the extremities of the line where we find the more abrupt curve.

It is now our object to view the development of our three cylinders, and as it will show the proportions full as well, and take much less space, we will take but one-half of our model, dividing the plan by a horizontal line and using the portion nearest to us. The centre cylinder will be unrolled, presenting our larger diagrams, the curves cut out by the other two entering cylinders being shown. These curves are obtained by measuring the depth in from the side in our plan, while the width we obtain from the elevation. The cylinder K is not different, with the exception of the base or part which enters the cylinder A,B, the measurement of which we obtain in the same manner as we do the cut-outs in A,B. The third cylinder will present a new feature; and while it is best in all cases to work from a straight line perpendicular to one of our sides or edges of the cylinder, in this we could not do without such aid. Having drawn such a line perpendicular to the side, we will assume that the diagram now represents two cylinders joined at this line, and so considered we have but two representations of the cylinder K in our method of determining the development.

With one more article we shall close, and in that we shall endeavor to introduce as many of the principles as possible in one outline, and at the same time show our method of representing working drawings. In this we shall use a shaft-coupling possessing some valuable points.



CUSHIONING.

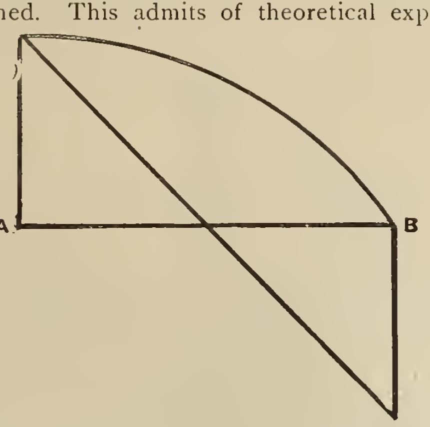
Professor Osborne Reynolds, a noted English observer, writes to the London *Engineer* as follows:

1. Cushioning is supposed to save steam by filling the passages to the ports and other necessary clearance, so that this has not to be filled with fresh steam which does no work in filling them.

2. Cushioning is often supposed, by relieving the crank from the duty of stopping the piston, and so by diminishing the pressure on the crank pin and bearings, to diminish the friction.

3. Cushioning is found by experience to be necessary in the case of all high-speed engines, to prevent a sudden shock attending the admission of steam.

Now, the last of these advantages is a matter of experience, and is alone sufficient to warrant a certain amount of cushioning. If, when running at its greatest speed, an engine knocks or bumps in its bearings, it is a sign that it is insufficiently cushioned. This admits of theoretical explanation. If cushioned, as the piston approaches the end of its stroke A, it will be stopping itself driving the crank, the force arising from inertia being at its greatest. Thus the force will have a tendency to close all the joints between the piston and the bearings in the direction $B\ A$, opening them in the direction $A\ B$. On the admission of the steam, owing to the small clearance to be filled, the pressure suddenly rises to a greater value than the force of inertia, and the piston is, as it were, shot back by the pressure of the steam and the elasticity of the engine against the force of its inertia. The joints thus close toward B with a bump. This bump could not have occurred had not the reversal of the direction of the combined force and inertia been sudden when the joints were open toward A. By cushioning, the pressure of the steam which balances the inertia rises gradually, so that the joints which are at first open toward A close gradually.



As regards the first two advantages, the first of these must be regarded as hypothetical, or rather, as theoretical, and the second as imaginary.

The steam with which the clearance is filled is not all gain. This is well known. The work done in compression has to be deducted from the work done by the forward pressure of the steam, or the power of the engine will be diminished by the power spent in compression, while the entire friction and the losses by condensation remain the same. As these losses appear to be something like 40 per cent. of the theoretical power of the steam as used in the engine, there cannot be much margin for gain of steam. The advantage may be a little one way or the other, but it is not worth mentioning.

The second assumed advantage of cushioning, namely, the diminution of the mean pressure on the engine, vanishes when it is perceived that it is the working pressure of the inertia that is diminished. This assumption amounts to nothing more or less than assuming that the moving energy of the piston might be more efficiently stored and restored by compressing steam than it is by the crank. It has, however, been shown that the crank performs this work in the steam engine with no loss, whereas in compressing steam there will probably be a loss of from 15 to 25 per cent. of the energy stored. This is the loss which has been shown to balance the gain in steam in (1). In respect of (2), therefore, the cushioning is a disadvantage. That this has not been practically perceived is because as long as cushioning is only carried to the extent of filling the necessary clearance, then the loss and the gain, as in (1), are nearly balanced, as has already been shown.

The conclusion is, therefore, that cushioning should not be carried farther than is sufficient to prevent bumping.

WHAT THIRTEEN THOUSAND HORSE-POWER MEANS.

The new steamship for the Guion line, the Oregon, is to have 13,000 horse-power in her. The amount of coal and water needed for this work has been computed by the London *Engineer*, and is here appended.

As the Oregon will burn about 20 pounds of coal per square foot of grate per hour, her consumption in 24 hours will not be much under 300 tons; and, allowing that each ton of coal evaporates 9 tons of water, we find that no less than 2,700 tons of steam will pass through her engines every 24 hours. A tank 100 feet square, to hold 2,700 tons of water, must be nearly 10 feet deep to prevent the water from running over the edge. If the tank were 50 feet square, the water would stand 38 feet 10 inches deep in it. Six thousand tons of air will pass through her furnaces, representing a volume of 174,720,000 cubic feet through a pipe 11 feet 4 inches diameter. This volume of air would flow at the rate of 13.8 miles per hour, a strong breeze to walk against.

The total weight of water evaporated on the run across the Atlantic will not be far short of three times that of the whole ship's cargo, engines and all. We give these figures to enable our readers to form some idea of what 13,000 horse-power means; and we may supplement them by adding that it is equivalent to 191,517 tons lifted a foot high every minute, or the same weight lifted 1,440 feet in 24 hours.

Assuming that she makes 20 knots an hour, or, omitting fractions, 2,028 feet per minute, the force pushing her ahead through the water will amount to over 94 tons, about as much as 20 of the most powerful locomotive engines in England would exert if all were pulling at her together. Among other difficulties, when we have to deal with such enormous powers as these figures represent, we mention that of getting coal to the fires. We see that in the case of the Oregon no less than 300 tons a day, the full load for a coal train of 30 cars will have to be handled every 24 hours. If the ship were at rest, the problem would not be easy of solution, but it becomes very hard indeed to deal with in a rolling and pitching vessel. All is done, of course, that can be done in arranging boilers and bunkers to accommodate each other, but it is evident at a glance that out of a total quantity of, say, 2,500 tons of coal, a great deal must be stowed at a considerable distance from the furnaces. It does not appear that any mechanical device has been hit on in the way of a railway which answers better than the existing arrangements, by which the whole of the work is effected by sheer manual labor.

* * *

Feed pipes to batteries of boilers is exciting much discussion and will be fully illustrated next issue.

A BALLOON MADE OF ALUMINIUM.

A Vienna paper—The *New Free Press*, thus describes a new balloon, the invention of an Italian engineer.

The balloon is adapted for being filled by gas, but is likewise planned with a view to steam being employed in its propulsion. The body of the balloon is in the shape of a fish laid on its side, and is composed of aluminium and strengthened with steel ribs. This form is supposed to cause the least possible resistance of the air during forward motion, and to act in some degree as a parachute. The sheets of aluminium are described as being of dimensions hitherto unknown, being in some cases 39 inches wide, and varying in thickness from .039 of an inch to one-tenth of it. The results obtained are said to indicate that the construction of large bodies out of aluminium is quite practical.

The tests made of its resistance against tearing show that it was stronger in this respect than taffetas silk, although not exceeding that material in weight on account of the extreme thinness of the plates.

The second portion of the balloon is the framework which surrounds the middle portion of the body, which is divided into three parts. This framework is intended to contain the machinery and the apparatus for propulsion, as well as the aeronaut. Experiments proved that hammered and tempered cast-steel, while possessing enormous strength and being ornamental in appearance, was of a lower degree of specific gravity than other substances which were suggested, and which were also in other respects less suitable. The construction of the framework is said to be simple in plan, and to resemble in some respects the best models of bridge building.

The third and most important portion of the machine is the motive apparatus. This consists of ten large screws, four of these effecting the horizontal progression of the balloon, and six its motion in an upward direction. The combination of the balloon is said to be so designed that the entire weight of all the separate parts and of the aeronauts is balanced by the force of the gas within about 220 lbs. This remainder of 220 lbs. absolute weight is overcome by the action of the apparatus for upward motion, and thus ascending motion is rendered possible by this mechanical force. According to the preliminary calculations made, a speed of about eleven yards per second would be obtainable with the nominal horse-power of the machine—10-horse power—the radius of the screws being supposed to be 6.56 feet. The tests made were with screws of half this radius. A combination of three screws—the central one worked direct from the machine, and the others made to rotate by the transmission of force—was the object of much approval, and when the outer screws, or all the screws of each group were put in motion, the apparatus is stated to have risen in an upright position, which was not the case when one or both of the outer screws of each group were not allowed to work.

The engine used is peculiar in its construction. It consists of an upright tubular boiler. The furnace is placed in the centre, and the tubes go upward and downward. The superheated steam formed in the upper part of the boiler is transmitted directly and without loss of heat to the engine. Attention is called to the fact that the weight of the motor is about 12 cwt. or 14 cwt., thus representing about 1¼ cwt. per horse-power. This limit has, it is said, nothing essentially impracticable about it, inasmuch as marine engines have long been constructed in which a minimum weight of about 2 cwt. per horse-power has been arrived at in cases where lightness and power were essential requirements. In conclusion, it is stated that Count Buonaccorsi's invention has, for the reason just alluded to, more elements of merit about it than modern theories as to aërial locomotion, which are based on motors being constructed which only weigh 13 lbs. to 15 lbs. per horse-power.

[As to this latter, doubt seems to be expressed by our foreign contemporary. Marine engines are extant which have exerted a horse-power for each 25 lbs. of weight.—ED. MECHANICAL ENGINEER.]

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RAILROADING IN WINTER OUT WEST.

One week ago, Superintendent Meek, with fifty men, started out of Des Moines to open the track to Jefferson. They had two engines, and the shovelers were increased to eighty men. The cold was intense. The distance to Jefferson is sixty-six miles, and there were not ten clear enough to run the train. Fonda is 114 miles distant. On the level, in places, they found the snow drifted four feet deep, while some of the cuts were eighteen feet deep and had to be "benched" before they could be cleared. By "benching" is meant that the cuts had to be cut down like stair-steps and shoveled out step by step upward. This shoveling was done in the piercing, unobstructed wind and it was only by herculean efforts that the men could keep soul and body together. "At one time," said a man, "there were eight in the caboose with frozen ears, hands and feet, and nothing to ease our sufferings, or even anything to eat." From Tuesday morning until Wednesday afternoon the men had nothing to eat nor any sleep, and at the time mentioned all they could get was a lunch of crackers and cheese. They ate sixteen pounds of crackers and seven pounds of cheese. They reached Jefferson on Thursday morning, and got about three hours sleep, all that they had during their entire absence from Tuesday till Saturday night. Thursday morning came another blizzard, that nearly or quite filled the cuts up again, and the work had to be all done over. The worn-out shovelers were divided and sent each way to re-clear the track, the snow not having packed in so hard again. The water gave out in the tanks and boiler, and all the way, to keep the engines alive, was to melt snow for water. All of the towns they came to were eaten out of food, and many of them had no coal, being obliged to burn their fences and shade-trees. Superintendent Meek found fifty cars of stock along the road at stations, many of the hogs having frozen to death. During the long siege and hard work the men struck three times for sleep and something to eat, but Superintendent Meek buoyed their spirits and kept down mutiny. There are no words befitting this indefatigable railroad man and his brave band of shovelers.—*Des Moines Paper.*

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EXPENSE OF BUILDING AND KEEPING YACHTS.

It costs much more in proportion to build a yacht than it does a vessel of any other description. Not only are the very best of oak and other materials required, but the builders expect better pay for the services of themselves and their workmen. There are yacht builders at various points along the coast, and these men will not build a boat unless they can see their way to making a handsome profit. It would be difficult to have a 70-foot yacht. built in good style for much less than $10,000, while first-class schooner yachts cost all the way from $10,000 to $20,000.

There are a number of schooners of less than 100 tons burden belonging to the New York Yacht Club which cost at least $30,000. In furnishing the cabin of one of these boats a wealthy gentleman recently paid $100 a piece for the curtains of the berths. Steam yachts are more expensive than sailing ones. It would be difficult to have one of the former built for much less than $50,000. For about $60,000 a handsome steam yacht of something over 100 tons, according to the new Government measurement, can be built. One was launched about a year ago, the hull of which, including the engines and boilers, cost $60,000, and, by the time her cabins were fitted up and her spars and rigging put in shape, she had cost her owner over $100,000. She was of about 250 tons burden, according to the new measurement. Some of the larger steam yachts which are now building will cost a fortune apiece. These vessels are in reality steamships, and it is almost as expensive to build one of them as it is a mail steamer registering as many thousands of tons as the former does hundreds.

There are two schools of modelers, the practical and the scientific. The former work by what they term "the rule of thumb," while the latter go by figures. The modelers of both these schools, however, vie with each other in demanding fancy prices for their work. Although the "rule of thumb" men have built some of the swiftest yachts and look down on "them scientific fellers," the latter have a large following who pay them handsomely for their models. There is a yacht-modeler of the "rule of thumb" belief, worth $100,000, which he is said to have made at modeling yachts.

The work of rigging is very expensive. None but the best wire is used in the standing rigging, and the running gear is of the best manila rope. The sail-maker is usually warned that if the sails do not suit in every particular they will not be accepted. The mainsail of a sloop yacht of about 40 tons costs from $125 to $150. A schooner yacht of the ordinary size could not be supplied with a suit of sails for less than $300, and frequently much more than that sum is laid out on canvas.

The expense of maintaining crews is an important item. A sailing-master receives from $100 to $200 per month; a mate receives from $50 to $75 per month; common sailors receive about $30 per month, and they are superior to the ordinary run of seamen; cooks and stewards receive from $60 to $100 per month. The steam yachts usually carry a chief cook at $100 a month, and a second cook at $75.

The officers and men are uniformed at the expense of the owners of the yachts. Each seaman carries the name of his yacht on his blue shirt-front and upon the band of his hat. At the close of the yachting season the sailing-master is left in charge of the boat. The yacht is taken to some out-of-the-way place for the winter. The sailing-master sometimes keeps one or two of the sailors to assist him in watching the yacht. He usually selects some port in which he has friends, whom he frequently entertains in the empty cabin of the yacht, and, in order to do this, he draws largely upon the stores with which he has been supplied by the owner. His pay remains the same the year round.—*New York Times.*

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Fabulous statements of economy in fuel on ocean steamers come from abroad. It is said that a horse-power has been produced from 1.68 lbs. of coal per hour, and this is further diminished by one performance fixed at 1¼ lbs., "for a short time," prudently says the chronicler. These fine figures are doubtless derived from indications and points of cut off, but probably if the vessel were coaled to make a stated distance, with a certain consumption of fuel, the same would be consumed before the vessel reached her port.

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THE MECHANICAL ENGINEER.

New Series. Vol. V.—No. 8.
Enlarged 1883.

New York, April 14, 1883.

Single Copies 8 Cents
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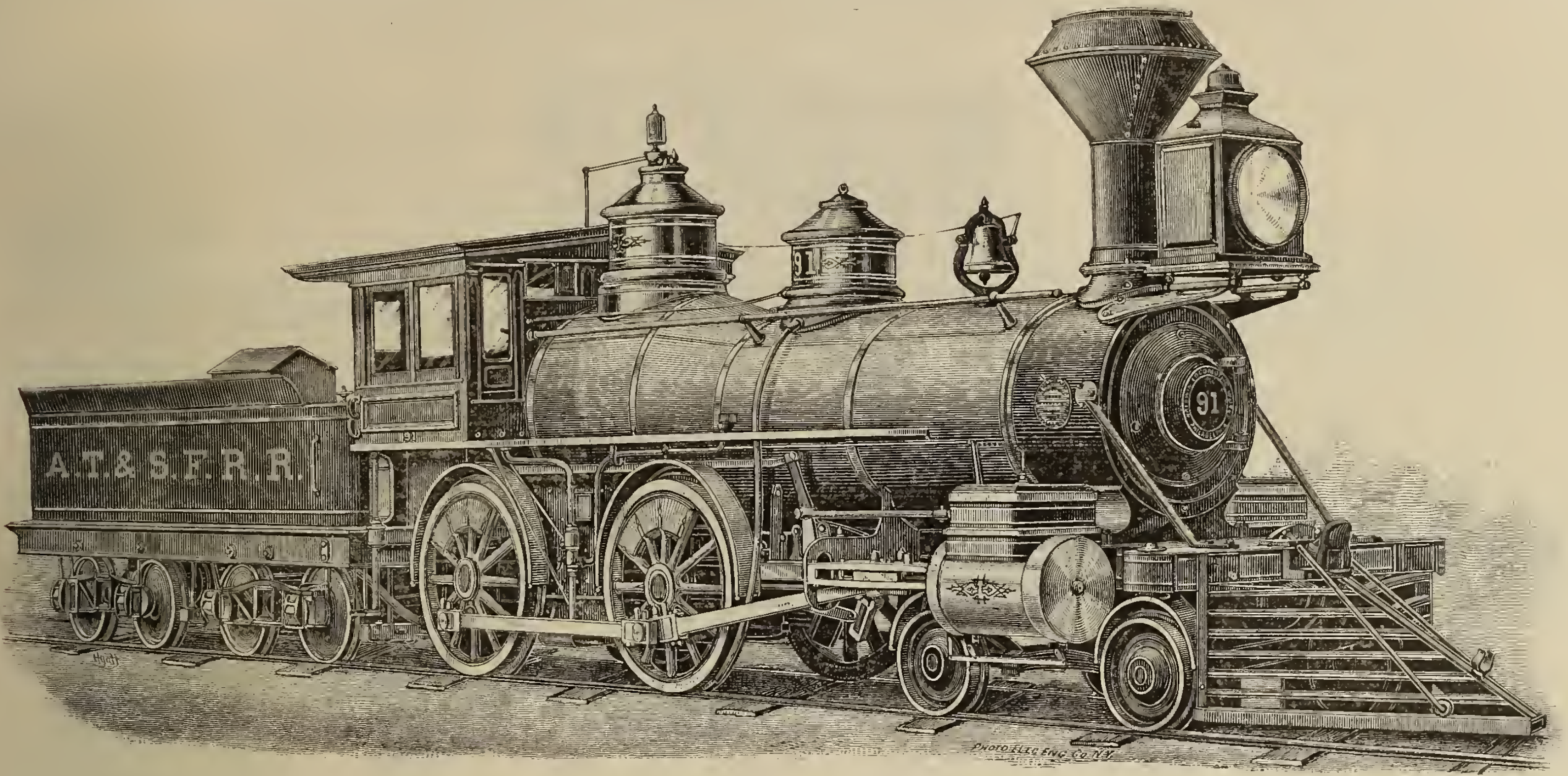
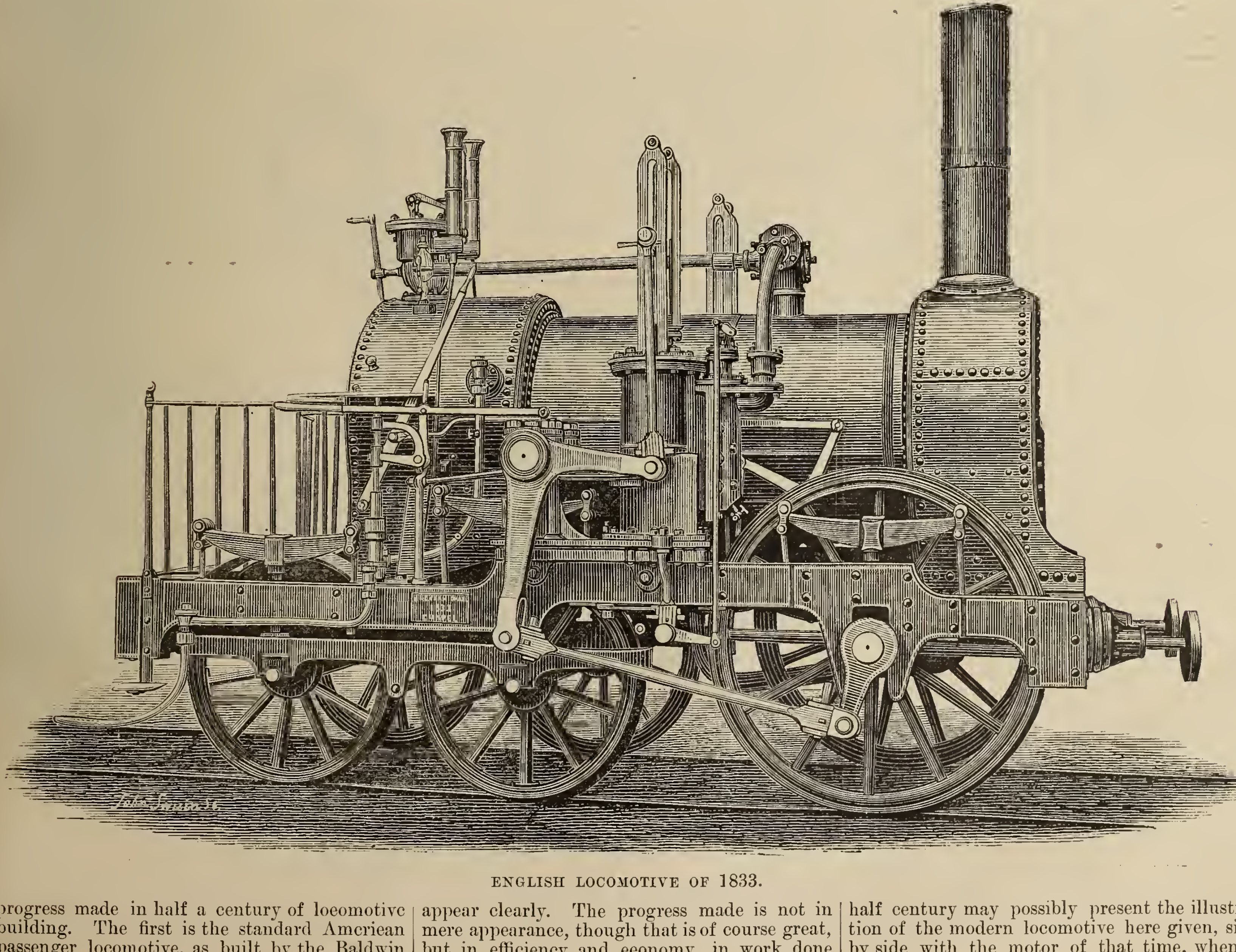
FIFTY YEARS PROGRESS IN LOCOMOTIVE BUILDING.

Our engravings this week represent more forcibly than any essay on the subject, the progress made in half a century of locomotive building. The first is the standard American passenger locomotive, as built by the Baldwin Locomotive Works; the second is the English passenger engine of fifty years ago.

We have placed them one above the other in order that the sharp contrasts they present may appear clearly. The progress made is not in mere appearance, though that is of course great, but in efficiency and economy, in work done for fuel consumed, the changes are radical. In other directions, safety, convenience, and durability of structure, the departures are marked. The end is not yet. Engineers of the future half century may possibly present the illustration of the modern locomotive here given, side by side with the motor of that time, when it


A.T.& S.F.R.R.
91
PHOTO ELEC ENG CO NY

STANDARD AMERICAN PASSENGER LOCOMOTIVE.



ENGLISH LOCOMOTIVE OF 1833.

will have, probably, an equally antiquated appearance.

It is important to note that in all these improvements, "inspirations," or efforts of "genius," have little part. The alterations in details were made only from necessity, and not through notion, or, if we may so express it, deliberate intent; the changes were necessitated through defective action. For example: Of these vertical cylinder locomotives here illustrated, but three were built, on account of the disagreeable pumping motion induced by the position of the cylinders. They were then placed horizontally in England, in which position they have ever since remained.

This English locomotive presents many interesting features of comparison with the engine of to-day, and, so far as detail goes, is clearly shown, but we regret that the dimensions are not given in the *London Engineer*, from which paper we took the engraving. The crank-stroke is longer than the piston-stroke, it will be noticed, for the bell-crank, to which the side rods connect, is longest on its vertical arm. Also, the entire engine sits on the axles, without any equalizing arrangement or caps on the boxes, which are fully exposed to all the flying dust and dirt of the road. All the steam pipes to the cylinders are external, as well as the throttle, and the pump is, apparently, worked by hand.

Of course, by the light of modern practice, and after the fact, it is easy to see these defects, but it is in no critical mood that we mention them. Our readers will notice that the hind wheels are mounted on a truck, while the drivers are in front, so that the engine appears, to American ideas, hind side before, and the boiler wrong end to.

It is impossible to say from the engraving whether the wheels are all flanged, or some of them blind; certainly the drivers are, to all appearance, though how the machine kept the track in this event we cannot say.

As to the American locomotive here shown, its capacity is so well known that we need give no particulars of it.

BALANCING SLIDE VALVES.

There have been many attempts at balancing the ordinary stationary engine valves, but with only partial success. Almost any of the devices offered for this purpose work satisfactorily so long as they are new, but presently become inoperative, if not troublesome. That some devices should work well longer than others is to be expected; but on the whole it is doubtful whether there are any of the so-called balanced valves which work satisfactorily after a year's constant service without repair and adjustment.

The writer has tried several valves of this class and found that three months' constant wear, without attention or adjustment, was the average duration of their practical usefulness. There is a method of balancing sometimes used, which consists of a "bridge" over the valve and through which the valve slides; this "bridge" taking off the pressure from the back of the valve, but in no manner interfering with its action, nor is there any liability for a steam leak through the back of the valve into the exhaust port.

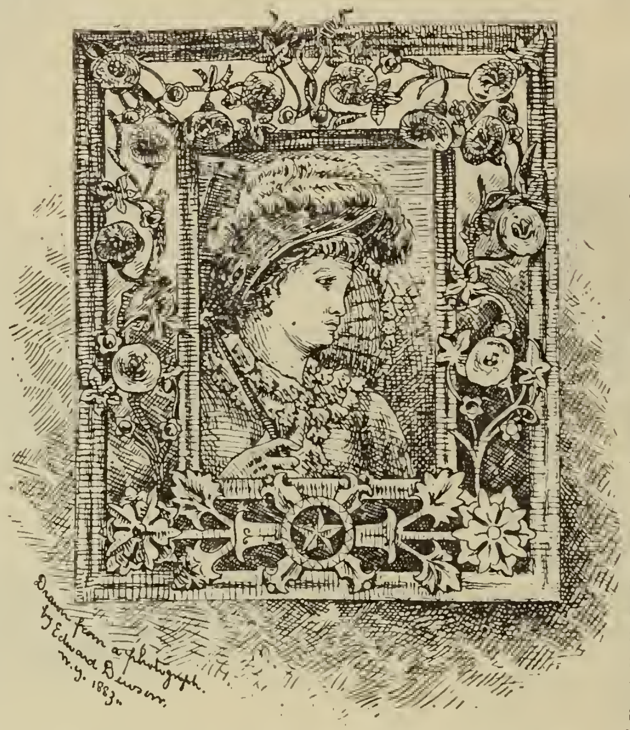
The pressure on the back of a valve may be considerable, but just how much power is absorbed in overcoming the resistance due to the steam pressure through the entire travel of the valve can not be easily determined except by direct experiment with the valve of an engine actually at work. There is no doubt that the power lost in overcoming this resistance has been greatly over-estimated, and many devices have been brought out through an imperfect knowledge of the actual loss occasioned by the use of an unbalanced valve, and disappointment has often been the only reward gained by the inventor and experimenter, who had been led into the belief that at least 25 per cent. of fuel was to be saved by balancing the slide valve.—*Barr.*

[Mr. Barr has the reputation of a close observer, and his deductions are doubtless warranted by his experience. It is a curious fact that exactly the same ground, in almost the same words, is taken by the author of "*In the Round House*," soon to appear in this paper.—Eds.]

AN ART FORGING.

The engraving herewith represents a wrought iron picture-frame forged entirely by hand. It is the work of Ferdinand Bros., Patterson, N. J., and was exhibited by them at the American Institute Fair in 1881. All the leaves, buds, flowers, tendrils, and frame are executed with the hammer only, the young lady is merely a picture inserted to adorn the space.

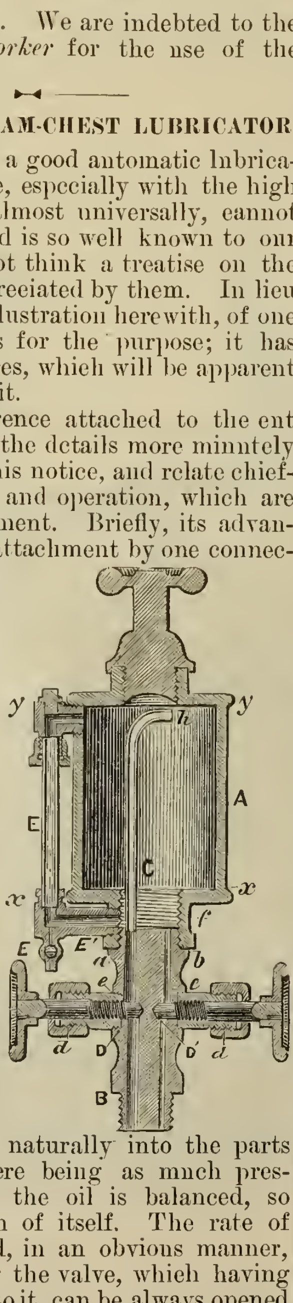
A job like this has interest for our readers, who know something of the difficulties of such work, as shown, and appreciate most fully the skill of the executors. We are indebted to the *Builder and Woodworker* for the use of the block.



THE KEYSTONE STEAM-CHEST LUBRICATOR.

The importance of a good automatic lubricator to a steam engine, especially with the high speeds now adopted almost universally, cannot be over estimated, and is so well known to our readers that we do not think a treatise on the subject would be appreciated by them. In lieu of it we present the illustration herewith, of one of the latest devices for the purpose; it has many excellent features, which will be apparent upon examination of it.

The letters of reference attached to the cut are in explanation of the details more minutely than is necessary in this notice, and relate chiefly to its construction and operation, which are sent with each instrument. Briefly, its advantages are in its ready attachment by one connection only to a chest or steam pipe, its compactness and simplicity of construction; this latter enables any one to regulate its action on short acquaintance. As will be seen the oil is contained in a cup provided with a gauge-glass in front, which shows the amount within at any time. A small steam pipe, *h*, extends from the chest through the oil to the top of the chamber, so that when the hand wheel, *E*, controlling the feed is opened, the oil flows naturally into the parts to be lubricated; there being as much pressure above as below the oil is balanced, so to speak, and runs in of itself. The rate of feed is easily adjusted, in an obvious manner, by opening or closing the valve, which having an indicator attached to it, can be always opened to the same point.

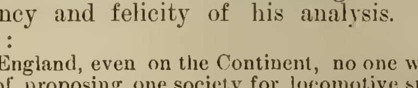


This is a very simple and efficient apparatus for the purpose, and has no small openings to gum up or become dirty. These can be readily blown out at any time, when the cup is empty, by removing the plug on top through which the oil is supplied.

This cup is manufactured by A. P. and F. S. Groves, 34 South Delaware avenue, Philadelphia, Pa., who will supply price lists and circulars. The patent is for sale at a reasonable figure; the proprietors being engaged in other business have no time to prosecute it as it should be. It is entirely free of patent complications or infringements.

A NEW TURN-BUCKLE.

Merrill Bros., Williamsburg, N. Y., have recently perfected a process by which they can make *solid* turn-buckles, that is without a weld anywhere. The importance of this improvement will be seen at once by all engineers and bridge builders. Externally the buckles are very handsome forgings, and are all ready for tapping when delivered, the holes being correct to size, exactly straight with each other, and straight in themselves. They make these goods in large quantities and will furnish price lists upon application.



HOW WE APPEAR TO ENGLISH EYES.

A writer in the *London Engineer* forms a shrewd estimate of the technical societies as they exist in this country, and the spirit animating members. We have been amused at his comments and acknowledge the pertinency and felicity of his analysis. He says:

"In England, even on the Continent, no one would dream of proposing one society for locomotive superintendents and another for carriage superintendents; but in the United States we find the Master Mechanics' Association and the Master Car-builders' Association both in full vigor. Now, it is obvious that, the ground being thus subdivided, each plot can furnish a sufficiency of intellectual food for those concerned in it only by being most diligently cultivated. Add to this that an American engineer believes in theory, believes in practice, believes most of all in going ahead. When a subject is started, he wants to know what everybody thinks about it, and what everybody has been doing with it hitherto, in order that he may strike out something which shall outshine them all. Hence the regular course of things in an American technical society is as follows:—Somebody starts a subject; he suggests, we will say, that it would be well to know something about the best forms of continuous brake for goods trains. In England this would only mean that the secretary would endeavor to get somebody, probably an inventor of goods train brakes, to read a paper upon them, and that paper, if obtained and read, would receive a certain very limited amount of discussion. In America it means something quite different. The society forthwith appoints a committee to deal with the question. This committee sends round to every inventor of such brakes, and to every railway engineer who is known to have tried them, a schedule of questions to elicit his experience and his opinions. They not only send them round, but—*mirabile dictu*—they get answers to them, at least in the majority of cases. Their answers form the basis of a report, which is laid before the society at its next convention. It is needless to state that a number of opinions, obtained independently from different persons, will be found to present very marked discrepancies and even contradictions. Those who have thus put forward opposing views are pretty well bound to maintain them. A good discussion by really capable men—the most difficult thing to insure in such meetings—is thus provided for, and the subject either gets thrashed out completely on the spot, or is referred back to the committee for further inquiries,—further experiments if need be—and for a second report to be presented and considered at the next convention.

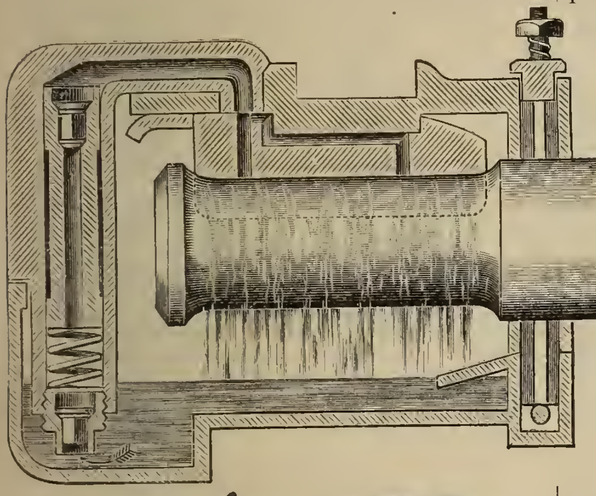
It is difficult to resist the conclusion that much good must result from such thorough and painstaking investigation of a subject. Why such a thing does not exist in England, and whether it could be introduced, are questions we shall not attempt to enter upon here.

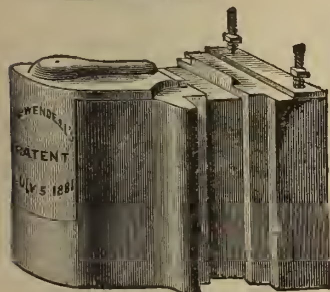
W. P. Davis, North Bloomfield, New York, reports trade active and orders from all parts of the country. Within a few days he has shipped machines to H. B. Smith Machine Co., Aaron Wiseler, G. Westinghouse Co., E. P. Bullard, Enterprise Manufacturing Co., Tish & Bander, J. A Cross, Richmond Machine Works, O. L. Packard, Miller Co., &c., &c., all of which is a fine showing for a young concern.

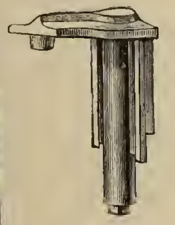
THE WENDELL IMPROVED CAR-AXLE BOX.

What is an exceedingly ingenious system for oiling car-axles is here illustrated. As will be seen, it dispenses wholly with waste or packing, and depends only upon the automatic action of a pump for keeping the journals oiled constantly. This pump is operated by the vertical motion of the car on its springs, or otherwise, the concussion of the wheels on the rails. The details necessary to its operation are simple and clearly shown in the engravings herewith.

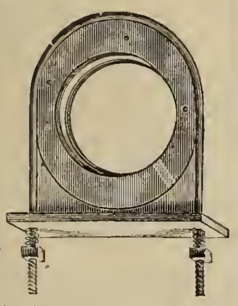
Figure 1 represents a sectional view of the box cut through the center, exposing the pump. This is cast solid on the lid of the box; the pump plunger is hollow with a valve on the upper end. This plunger rests on a small spring, just sensitive enough to render it capable of being acted upon by the concussion of the wheels, as stated. Below this is another valve on which the spring rests, and the apparatus is complete.







Figures 2 and 3 represent the box externally, and the pump detached from it; figure 4 is a view of the packing which goes over the axle to prevent the oil from working out between it and the box; it is easily adjusted and kept in place.



The engravings so clearly show the invention and intent that no further explanation is necessary. The advantages claimed will, we think, be conceded; these are that a very great saving of oil ensues, to say nothing of the better lubrication obtained. The wear of the bearings is greatly decreased, from the fact that no dirt or grit can enter, either with the waste or from the outside; as a consequence, aside from the decreased wear, the danger of hot boxes is greatly lessened, while what is of great importance, the saving in motive power is enormous. The manufacturers assert from data in their possession, that the saving on each car on a railroad amounts to $36 annually.

This apparatus has been tried on several roads and is highly commended; it is not an experiment but a success. Address the American Railway Supply Company, Jas. H. Jacoby Secretary, 310 Chestnut street, Philadelphia, Pa., for price lists and circulars.

* * *

The mesquite wood, of Texas, is a beautiful wood. It does not grow large, is thorny, and produces an abundance of beans. It is sometimes used in wagon hubs, felloes and spokes, put in green, fresh cut, and does not shrink perceptibly. It is often nearly as black as ebony, and quite as hard.

A NEW STEAMSHIP.

The *"Mariposa"* is a new steamer building by Cramp & Son of Philadelphia; she is of the following dimensions: length, 330 feet; breadth, 41 feet; depth of hold, 26 feet; gross tonnage, about 3000 tons.

The propelling machinery will be of the compound, three cylinder type, of about 3000 horsepower; with the high pressure cylinder 43 inch diameter, the two low pressure 61 inch diameter, and all 51 inch stroke of piston. An independent centrifugal pump will be used for circulating water through the condenser, and for freeing the ship in case of a large leak. The engines will be reversed by the steam gear. The propeller will be built up, and made of charcoal iron. Steam of 90 pounds pressure will be supplied by two single ended, and two double ended boilers.

In place of the old-fashioned, dead eye, side-light, square openings of liberal size are cut in the sides, provided with iron shutters on the outside and glazed sash on the inside. This will add vastly to the comfort of the passengers. The incandescent electric light will be fitted all over the ship.

Steam steering gear of approved make will be located in pilot house, with hand power attachment in reserve. Screw gear will be placed aft for additional security. A steam windlass, with capstan, will be arranged forward and two steam capstans aft. A steam deck pump will be provided both forward and aft. There will be steam elevators in each of the main hatches for loading and unloading cargo.

STEEL VS. IRON.

"In advocating the use of high qualities of steel, and enumerating the advantages to be gained by employing it, the fact is frequently lost sight of that this superior metal is made from the highest grades of pig, obtained with the greatest care from the purest ores, and that the succeeding processes are worked out with the aid of the most improved plant. The metal is followed through all details of manipulation with the most thorough inspection and rigid chemical and mechanical tests.

"Material thus obtained is compared with wrought iron made from anything and everything. No chemist mixes the charge or analyzes the product, but a puddler is left to guard the interests at the most vital stage of the process. It is his aim to produce the greatest weight, with the least labor, in as short a time as possible, and with such work no one can blame him. It is not astonishing that under such conditions iron is so much inferior in its physical qualities to steel. Even taking the same grade of pig metal for the manufacture of wrought iron as is now used for steel, the mild grades of the latter suitable for structural purposes, will, no doubt, give higher results by mechanical tests, but the difference between the two will not be as great as many are apt to think." —"Percival Roberts, Jr."

NEW MATERIAL IN TRADE.

Mr. R. W. Rexford, 17 North Seventh street, Philadelphia, is agent for a new line of goods in iron shafting, which seems destined to achieve great results. This shafting is made by the Mahoning Valley Iron Company of Pennsylvania, and has the somewhat remarkable tensile strength of 83,000 lbs. We believe this endurance has never been claimed hitherto, for anything purely iron.

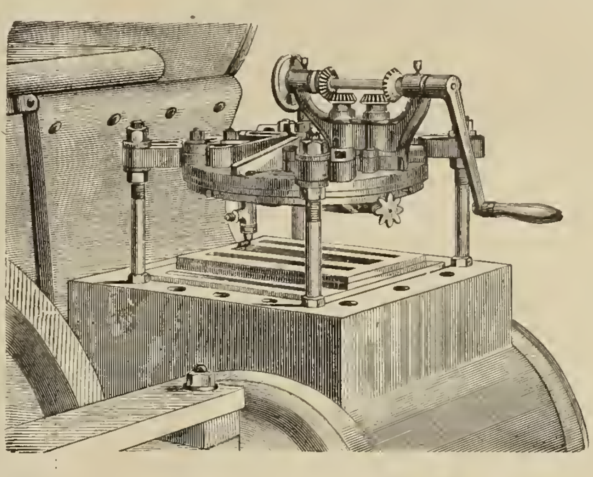
It is asserted that the process by which this shafting is made adds to the original strength of the material, as recent trials in Philadelphia show. A bar of ordinary turned shafting broke at 51,324 lbs., while a bar of cold-drawn iron shafting, drawn once, broke at 69,497 lbs; drawn twice it withstood 83,061 lbs. before breaking.

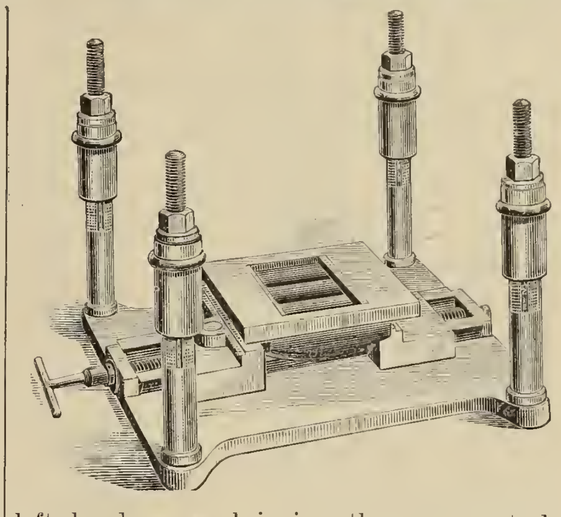
This shafting is round, perfectly straight, and true to size, and can be key-seated, or splined, without buckling. It is made in all lengths from two feet to forty feet. It will doubtless have a wide sale when fully known.

FLANDERS, ROTARY PLANER FOR VALVE SEATS, AND NEW VALVE-CHUCK.

The rotary planer for valve seats, chiefly of locomotives, is well known to our readers through its use in many shops, and we make no apology for its introduction here, other than to say that we reproduce it for the purpose of showing the valve-chuck, which has been recently devised and is intended to be used in connection with it. This latter is here illustrated, and is easily understood from the engraving and a few words of explanation.

The lower plate has dove-tailed slides that carry two movable jaws operated by a right and left hand screw, bringing them up central, firmly clamping the back of the valve, and holding it central for planing. The four uprights at the corners have about two inches of adjustment, with graduations, enabling the machine to be set parallel with the table. With this tool and the valve-seat rotary-planer, the valves can be refaced in the shortest possible time.





These tools are indispensable in most railway repair shops, particularly for short lines and those with scant engine equipment. Circulars and prices can be had from the manufacturers, Pedrick & Ayer, 1025 Hamilton st., Philadelphia, Pa.

* * *

Clem and Morse of Philadelphia, Pa., have a new safety appliance for elevators which is thus described:

"Beneath the elevator is a table of half-inch pine, nicely balanced by light springs. Should the cable break or anything happen to increase the normal speed of the car the pressure of the air on the table forces it upwards. This turns four powerful cams, provided with cog-teeth, into the guide posts at the side, and the fall of the elevator is arrested almost instantly. On a trial the rope was cut twice, the elevator carrying at the time 2,259 pounds of weight (including four men), and the fall was less than a quarter of an inch each time. There was also no jarring. Another novelty is automatic hatches on each floor, which open before, and close immediately after the passage of the elevator.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise. we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

A QUERY ABOUT PISTON RINGS.

Editors Mechanical Engineer:

I would like to have you settle a dispute between myself and a brother machinist. In taking a piston out of an old upright engine it was found to be ¼ of an inch too small for the cylinder, and the rings had about 1-32 play between the piston-head and follower. The rings are of the old style, set out with springs, and were tight. The bore of the cylinder is 9½ in. What we would like to know is this: Would the rings on the up-stroke of the engine lie next to the piston head or would the pressure of steam on the under side of the rings push them next to the follower? By answering this you will greatly oblige an old friend to your paper. I get it from our newsdealer, and have every issue from the first copy, and can safely say that I like it better than any of the others I take. I think "The Professor in the Machine Shop" just right, and know Mr. Moulton will do a good job for Mr. Blank. Please say to Mr. Moulton (for me) to keep right on, and never mind what any one says, we will stand by him. Edward B. Marshall.

Belmont, N. Y.

[As to whether the rings would be blown up against the follower by the pressure of steam or dragged down against the "spider" by friction, depends upon how tight the piston is, and the pressure of the rings against the walls of the cylinder. The ring area exposed to the action of steam when the piston is ¼ in. less than the cylinder-bore (⅛th on a side) is 3·59 inches, which, with 60 pounds pressure in cylinder, would give a pressure of 215 pounds on the rings. This is probably more than the friction of the rings against the bore of the cylinder. So they would lie against the follower, part of the stroke, and against the spider on the latter half, when the steam pressure is removed.—Eds.]

SPEED OF PUMPS IN PIT-SHAFTS.

Editors Mechanical Engineer:

I have worked at places where the boss has come around and said to the engineer:

"You must make that lift travel faster." The engineer answers: "If this lift travels any faster it will smash up;" so this engineer will not run the lift to smash the machinery. He has no rule to show what the lift should do, and the first opportunity he has he quits.

In the case of a 12 in. lift with 6 feet stroke, at 80 yards depth, how many strokes per minute should it travel?

Is there any such thing as suction? How is the water first got to the bucket? Does the bucket draw the air out, or force it out?

I hope this will meet the eye of some practical engineer who has put lifts in pit-shafts, who will know about the best speed for them.

Youngstown, O. J. Davis.

[Properly speaking, there is no such action as "suction" in a pump; the air is exhausted from the supply by the bucket, and water rushes in by atmospheric pressure to fill the vacuum.—Eds.]

FEED PIPES TO BATTERIES OF BOILERS.

Editors Mechanical Engineer:

I send sketch of feed and blow-off pipes, and connections, which we have had in use for nearly seven (7) years, working entirely satisfactory in every respect. It will be seen by referring to sketch that the pipe running beneath the boilers is connected with the injector at one end, and feed pump at the other. With this arrangement, either boiler can be fed independently of the other, which I think is a very important matter, and which cannot be done with the arrangement described by L. O. Danse in the last issue of your paper. John D. Bowne.

Jamesburg, N. J.

[See first engraving on page.—Eds.]

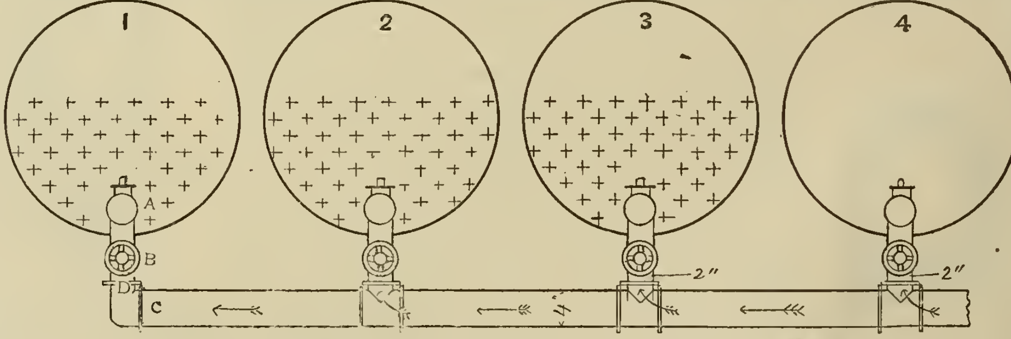
FEED PIPES TO BATTERIES OF BOILERS.

Editors Mechanical Engineer:

In reply to the questions asked by Walter Burdekin, I beg to say that my opinion of regulating the feed to a battery of boilers differs somewhat from that of his friend. He is evidently laboring under the same error that many others are, namely: That water will *always* find its own level. I would, however, say to such believers, first: if water always find its level, the earth must be flat instead of round, as we are taught. Secondly: the law of capillary attraction cannot exist, if the surface of water is, so to speak, *level*. Of course I take the answer of Mr. B.'s friend, as he puts it, namely, that "water will *always* find its level." Here it will be seen that he disregards all surrounding conditions by saying "*always*." In my opinion, water will find its level when the conditions existing are favorable. Although gravity may be an established law, yet this law is itself dependent upon the conditions existing. Therefore, the more favorable the conditions, so much the more we can see of the natural workings of the law itself. And this is precisely the case with Mr. Burdekin's boilers; the conditions are so liable to variation that it would be a failure to connect a battery without regulating valves. If, however, water will naturally find its level, why have we the need of that prominent individual called the "water leveler," (or water tender), who considers himself a part and parcel of a battery both afloat and ashore, and who is seen in all directions at once with his "feeler" touching off the gauges? Mr. Burdekin's remark, however, concerning the boiler nearest the pump taking the most water, is, to my mind, partly correct, for as I have before observed, the conditions are not always favorable. Though the boiler with the coolest fire will generally take the most water, yet there are other causes beyond this one. Concerning the necessity of stop valves, I should say, in the instance of a battery, they were absolutely a necessity, though the check is not.

There are several ways of making connections, but the most preferable way is, of course, the one that is most direct and also with the least fittings. These would be—one main feed pipe with drop T's over each drum in cases where the feed is of any length. It should be some 4 or 5 feet above the mud drum, with drop-pipes to allow for expansion; flange-unions and gate-valves will add to the longevity of the job. It is also better to feed this main-pipe from the centre and not at one end. This will equalize the flow from the pump, and the main feed can be reduced down to 1½″ or 1¼″ pipe to the last boiler, as the case may be. Where the ash doors are not directly over the drum the drop-pipe will of course need a vertical check, but where the ash doors are in the way, the drop should enter the side of drum. This will require the use of one elbow only, and a horizontal check can be used if preferable. I would not advise Mr. Burdekin to depend upon throttling his feed to regulate his supply. If, however, he does, and it gets known around, lots will fall in value in that vicinity pretty considerable!

Chicago. John Erwood.



FEED PIPES TO BATTERIES OF BOILERS.

Editors Mechanical Engineer:

Please allow me space in your valuable paper to answer Walter Burdekin's query in No 6, which I will endeavor to do in my own way. A battery of boilers will not feed regularly all connected together, and feed from one pump. without stop-valves between the main pipe and each boiler. Stop-valves are indispensable where boilers are fed through a main from one pump, as it is almost impossible to regulate the water in any other way. I inclose a sketch of the plan usually adopted here for connecting a battery of boilers together.

For convenience sake we will assume that the main feed-pipe, *C*, runs along the ground, under one end of the boilers, at right angles, having a *T* directly under the center of each boiler, where the connections *d*, *d*, *d*, *d* from the main to the boiler can be made, including check-valves *a*, *a*, *a*, *a* and stop-cock *b*, *b*, *b*, *b*.

Now we will assume the fires to be all started alike, and steam got up to the working pressure; the stop-valves opened and feed-pump started and worked, say five minutes. If the fires are all alike and the water the same temperature in all the boilers, the water will raise equally in each boiler. Then replenish the fires in No. 4 and 2 with fresh coal, and the water will cease to flow into No. 1 and 3, but as soon as the fires in No. 4 and 2 get going good, and the heat is more intense, the water will cease to flow therein, and run up in Nos. 3 and 1, so that it would almost be impossible to feed a battery of boilers without a stop cock on each one. I have tried it and know how it works.

I like your paper very much; it suits me the best of any mechanical paper I have seen yet. It is just the thing for engineers. Geo. L. Simmons.

Detroit, Mich.

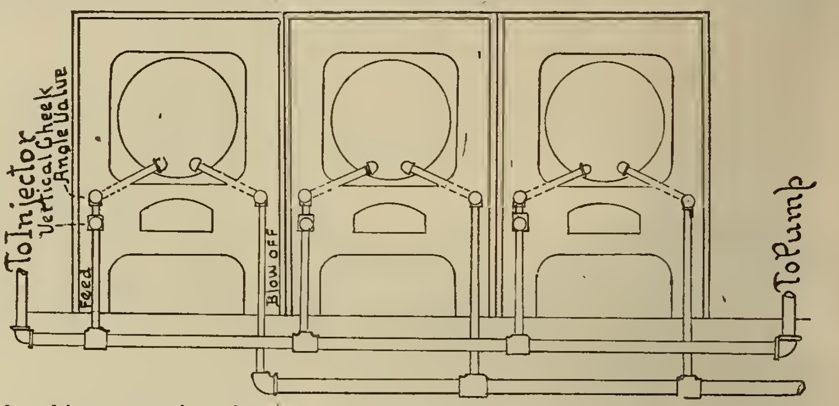
FEED PIPES IN MUD DRUMS.

Editors Mechanical Engineer:

You seem to have misunderstood the remarks accompanying my sketch of feed-pipe connections. The feed pipe enters a *feed-drum*, similar to the mud drum, situated at one-third of the length of the boiler from the back end; but the mud drum is under the middle of the boiler. Each drum, I may add, has a manhole in one end, the stop-valve and check, respectively, occupying the other end. There should be a separate safety-valve for each boiler.

In the instance from which the sketch is taken, there is a single grate for the three boilers, with separate smoke passages for each, from the bridge to the back wall. The return flues discharge their smoke into a common up-take, with a single chimney. The brick-work is built up in a sheet-iron casing.

When separate stop-valves are used on the feed pipe for each boiler, there should be a stop-valve in the steam pipe leading from the boiler to the steam-drum. This arrangement enables the engineer to cut out any one boiler for repairs without stopping the others; but by contracting the connections there is danger of driving the water out of the hottest boiler.



I think "*Feed Pipe's*" arrangement, with the feed pipe above the boiler, and separate stop-valves and checks, inconvenient and dangerous, as compared with mine. L. O. Danse, C. E.

Pittsburgh, Pa.

AN ENGINEER'S HOLIDAY.

An esteemed contributor to The Mechanical Engineer, Mr. Walter Burdekin, writes an account of a visit he recently made to some factories in his section; some points he makes are worthy of notice. We fear if we printed his remarks entire that we should receive some very forcible reminders from other parties! We therefore curtail them slightly.

Next place was a saw-mill. I think the engine must be closely related to Mr. Blank's in "*The Professor in the Machine Shop.*" It was a horizontal engine of 40 H. P., with a common slide-valve and a cut-off on the back. The engine seemed as though it exhausted through the stuffing box, and oh! how it did pound. Everything appeared to be as slack as the main belt. I did not stop long as the boiler looked suspicious.

I then visited another engine, 350 H. P. I could not ask the engineer many questions, as the power, transmitted by gearing, made such a noise that one had to shout to make himself heard. Recently, a tooth broke on one of the large gears that drives the main shafting, and the broken piece fell between two teeth, with the result of breaking the crank shaft, throwing the engine out of line, and losing 700 hands a week's time.

I had a chance to see how the feed-pipes were arranged; there was a three-inch pipe running the entire length of the eight tubular boilers which stood in a row; it was placed between the flue and furnace doors. The pump was kept going all the time; if all the stop valves were closed the water returned from whence it came. There was but one check-valve to all the eight boilers, and that was placed next to the pump. The water is regulated by the stop-valve with which each boiler is provided. I noticed that the height of the water varied in the boilers, and was told that it would rise higher in some than in others, and that it all depended on the attention of the fireman and somewhat on the condition of the fires. The feed pipe entered on top of each boiler, but I presume the pipe was carried below the top tubes. Every boiler had its own water, and pressure gauge, and safety valve, but these valves were out of sight; it would be necessary to climb up to see if they were in working order.

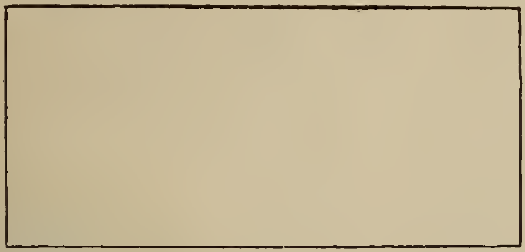
I had time to see one more engine of 30 H. P., which had poppet valves, but the bed and frame were a mass of dirt, unacquainted with waste. The boiler front was also in a filthy condition, and I fancy it represented the state of things inside. The steam gauge was visible, but not so the figures, although the pointer was. I guess the "engineer" went by that old proverb, "A place for everything," and that there was a certain place for the pointer, and a place for the dirt also!

So endeth my excursion. I am sure I gained much information by it.

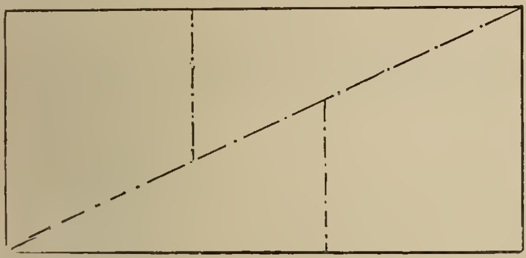
Read the leading article on editorial page, headed "Notice."

AN APPARENT PARADOX.

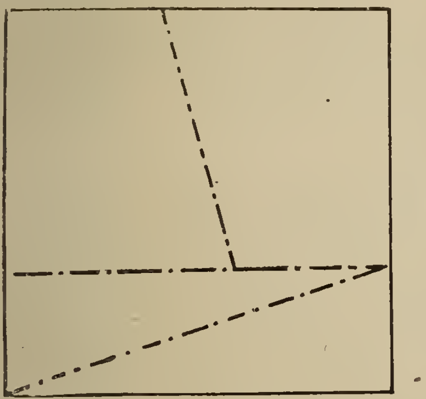
The apparent paradox annexed is worthy of attention :



This illustration represents a parallelogram 13″ × 5″ cut from thin paper or tin. This covers



65 square inches. Now cut into triangles 5″ from base as above, shown by dotted lines, and



re-arrange them as in this figure, when it will appear as a square of 8 inches each side, an area of only 64 square inches. How is this ?

* * *

DRIVING TRACTION ENGINES.

Railroad locomotive driving is, in many respects, "plain sailing" compared with road locomotive driving. The following are some of the difficulties that the traction engine driver has to contend with. There are sharp corners to be turned in narrow lanes, when the wagons, or threshing machine and its elevator have to be disconnected from the engine, subjected to various alterations in lock, and manœuvred in curious fashion in order to get safely round. Soft land has often to be traversed with its many perplexities, with a certainty of one day seeing the engine gently slide into a ditch, or suddenly sink into a swamp, the rest of the day being generally spent by the men in a festive manner with planks, screw-jacks, hurdles, and anything available for the extrication of the engine. According to the law the driver must avoid smoke, and not allow the safety valves to blow steam off, which under many circumstances are impossibilities. Suppose he has just made up the fire so as to have plenty of steam in readiness to mount a steep hill some little distance ahead, when he is obliged to stop for a conveyance to pass. As soon as steam is shut off, how can he prevent the smoke pouring out of the chimney ? It may be that he has gone a little further until the fire has had time to burn up and the pressure to rise, and just at that moment he has again to stop for two or three vehicles to pass, which with some horses is not soon effected. The hand of the pressure-gauge travels round whether he shuts the damper or not, and how can he, under such conditions, prevent steam blowing off ?—*The Mechanical World.*

* * *

A small blowing engine in the Herreshoff-Vedette boats is 2½″ × 5″ in cylinder, and is driven at a speed of 1,000 revolutions, or 833 feet of piston speed per minute. This is a very high velocity for so small an engine.

HINTS ON THE USE OF DRAWING INSTRUMENTS.

The ruling and compass-pens, and pencils are the most important instruments that the draughtsman uses, they require the most care in selection, and, as they are used the most, require the most attention to keep in order. It is a custom with many makers of first-class instruments to hinge one jaw of the ruling pen to the little separating block above the adjusting screw, so that it may be opened after the adjusting screw is removed. In a pen of this kind the joint should be very snug, as the least amount of play will allow the point of one jaw to slip ahead of the other which would destroy the efficiency of the pen. In the opinion of the writer this joint is altogether unnecessary. It increases the first cost as well as complicates the instrument, and if used often, will get out of order, even with the very best workmanship. If used properly the points need never be separated further than the adjusting screw will permit. Many draughtsmen have the hinge joint brazed or soldered so as to fix the movable jaw to the separating block and make it permanent.

The points of a pen should never be separated for sharpening, which is the only purpose for which the hinge is made. To restore it to the proper form the jaws should be closed by the adjusting screw so that the points press gently against each other ; then with a fine oilstone worked with a circular motion on the high corners, it should be ground to shape. The point will then be blunt but will have the proper outline for good working when the sides are reduced, which should be carefully done by laying the side of the pen on the stone at an angle with its surface that will allow the metal to be ground in a straight line to a distance of about one quarter of an inch from the point. The jaws should be opened frequently as the work progresses and the points examined to avoid grinding through the point of one jaw into that of the other. The sides are to be reduced till the points of each jaw are equal and just fine enough to slide smoothly over the paper without producing a cutting or scratching sensation. When the points are not sharp enough to make a clean fine line the blunt part is easily visible with the naked eye, but when it is sufficiently reduced it is hardly possible to see it. The shape of the curves in the sides, or jaws of a pen, is also an important feature. If the pen is too open near the point on account of the jaws being too much curved, it will leave too much space for ink, causing it to dry quickly or to fall out in using.

Wooden handles, though not quite as elegant as bone, are preferable as they are not liable to break when accidentally swept off the drawing-board—an accident that destroys nine tenths of the bone handles.

For spring bow pens and pencil compasses it is advisable to have the spring just strong enough to keep a gentle pressure on the adjusting screw, when the pen or pencil is set to draw its largest circle. When a pen is not too strong in the springs an experienced draughtsman will never change his centres to draw a shade line on one side of the circle, as this may be easily accomplished by springing the pen gently toward the side to be shaded, as he continues the movement of drawing the circle. The pivot, or needle point should always be adjustable. When it is made solid with the leg of the instrument it is generally shaped like the point of a sewing needle, and will pierce a large hole through the paper or tracing cloth with the slightest pressure, if used several times in the same centre ; and should a small piece be accidentally broken off the point the pen will be useless, unless a similar amount can be ground off the pen.

A very common source of annoyance in nearly all spring bow pencils and pencil compasses, is found in the eye or socket, provided for the pencil. In many places it is too large to hold the ordinary naked lead, and too small for those covered with wood. Frequently we see draughtsmen overcoming this difficulty by the clumsy makeshift of reducing the wood till it fits the socket.

Sometimes a small bushing is provided with the compass, that will fit into the eye and hold the lead. This is unsatisfactory as the pencil cannot be readily adjusted as the point wears away. The most effective treatment an instrument of this kind can have is to file away the metal in the parting or "split" of the socket and close in its sides so as to reduce the eye sufficiently to grasp the hexagon lead of an ordinary six H pencil ; this makes the pencil-holder very convenient as well as economical, the butts of old pencils may be stripped of their wood and the leads used in the compass.

Among the other tools provided for the draughtsman may be found some that possess various degrees, and some no merit at all. Some of the devices that have been invented for making broken, or dotted lines may be classed among the latter. The proportional compass or divider is a very good tool to have in stock, but it should never be used for transferring drawings from one scale to another when accuracy is required. Not only is the instrument liable to be in error, but if there should be any mistakes in measurement in the original drawing they will be transferred to the new.

A much more effective and convenient pointer than that usually found in sets of instruments may be made on one end of a six H pencil by reducing it to a fine point. The dot or point left by it, indicating the dimension is always easily found, and as the other end of the pencil may be made "chisel shaped" or flat, for drawing lines the operation of laying off dimentions and drawing the lines may be carried on without changing tools and losing time. For sharpening pencils, it is very convenient to have a fine file, attached by a string to the under side of the drawing-board, or what is still better, as the file very soon gets dull, a piece of wood made about the shape of a small flat file with a piece of emery cloth glued to each side ; in using, the pencil should be rubbed on the emery.—*James MacDonald in Builder and Worker.*

* * *

The new Guion steamer *Oregon* is to have engines of 12,000 I.H.P.; they are compound, having three inverted cylinders, one high-pressure, 70 in. diameter, and two low-pressure, each 104 in. diameter. The high-pressure cylinder is placed between the two low-pressure cylinders, and all are adapted for a stroke of 6 ft. The valves, which are of the equilibrium piston type, are placed between the cylinders, the high-pressure cylinder having one single piston valve, while each of the low-pressure cylinders have two piston valves connected by a crosshead. The valves are worked by the usual eccentrics and link motion. The reversing of the engines is effected by a steam and hydraulic reversing engine. The crank shaft is built and made of Vicker's crucible cast steel. The diameter of the journals is 24½ inches.

* * *

Rufus Brown, an unsophisticated Vermonter accidentally broke the griddle on which flap-jacks for the family were baked. He got a two-inch board and marked out the size of the broken utensil and sent it to a foundry to have one made, supposing they would "thin it down." When he went to get it, he was amazed to find it weighed 60 pounds.—*Am. Machinist.*

Well, Rufus was all right, if he had only known it. Pancake griddles 1½ in. thick are better than thin ones, for they hold the heat steadily. In large hotels the griddles are 1½ and 2 inches thick, permanent fixtures on the ranges. Keep your griddle Rufus ! don't plane it down.

* * *

The engineers on the Pennsylvania road receive $3.80 a day, or $115 a month. A round trip from the Broad street station to Jersey City and back, 182 miles, is considered a day's work. Every third day they have off. Some engineers get through their day's work in less time than others. For example, engineer Larrison leaves Broad street with the 7.30 express in the morning and gets back to Broad street at 2.20 in the afternoon. He takes his engine out to Powelton avenue to the round-house, and then his day's work is done, and he is free until 7.30 the next morning.—*Philadelphia Press.*

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

In our last issue we announced the discontinuance of The Egbert P. Watson Company as owners of this paper, and advised our friends of our resumption of it in our own name and right. Such particulars of our reasons for this course as can be publicly stated are appended.

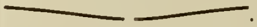
In merging this paper in a stock company, as we announced some weeks since, we supposed that we were doing a good thing for all concerned. Events of the past few weeks have proved that our judgment was defective, and that we did a very foolish thing. The parties with whom we associated had peculiar ideas as to what constituted a mechanical paper, and proposed to undo the work we had already accomplished, and do it over again in their own fashion. When it is added that subordinates in the company's employ proposed to carry out "improvements" upon our plans, and remodel the paper to suit their whims, it will be seen that we had to take prompt measures for the protection of our subscribers or abandon the enterprise wholly. We have therefore purchased the entire stock and resumed in our own name. We have chosen the latter course with all its disabilities, and have consequently to make this announcement:

One of the results of this alliance is that we are pledged to a weekly issue after July 1st; a course earnestly protested against by us while the Company owned the paper. We have to recall this for ourselves, and state that *we do not intend to publish a weekly paper after July 1st.* All persons who have recently subscribed, with the expectation, and upon the belief, that they would receive the paper weekly, as stated, are requested to advise us at once of this fact, and we will continue their subscriptions for a period equivalent to a weekly issue.

We have here given a few only of the bare facts in the case, which it is essential that our friends should know, and we are satisfied that they will approve of our action.

We repeat that THE MECHANICAL ENGINEER is owned by EGBERT P. WATSON & SON, solely, and that no person or persons have any liens, claims, or rights in or against it, of any sort or description, outside of them.

BEARINGS OF COMPOUND-ENGINES.

An engineer of a large ocean steamship recently said to us that he had had a curious experience, in one particular, and this was the wear of some of his main bearings. His engines are compound, and he had observed that the main bearings on the high-pressure side were worn down on the inside next the cranks thus, . He seemed to think that the bearings sprung in some way, though he was loth to express such an opinion—particularly as they were some eighteen inches diameter—how to account for the wear otherwise puzzled him. The fact itself was unquestioned and occurred after several refittings of the brasses. In the course of a long experience our informant had never seen a similar case.

We have been minute in these details for the reason that it shows several things, one of which is that the engineer was a very careful and observant man, and another that a cause exists for the evil mentioned, which very probably occurs in many compound-engines, but has hitherto escaped notice. This is the unequal distribution of power. It is one of the greatest defects --hereditary—of the compound-engine, and is liable to happen—if we may so express ourselves —to any engine not carefully watched as to its performances and intelligently handled. Even if it is properly made in the shop and the proportions as to cylinders correct, a compound-engine may wear its bearings unequally if the cut-off and steam pressure are tampered with for any cause.

It is very easy to see how this may happen, and we will illustrate it by a simple example. Suppose that for a given pressure and cut-off, (ascertained and provided for by the designer of the engines) the cylinders of a compound-engine give out equal power. Let us further suppose that with a given load the engines perform satisfactorily, and the indicator shows that practically the same amount of work is done in each cylinder. Under such circumstances we have an engine that will wear and work satisfactorily.

Now take these same engines with a heavier load, or a lighter load; the engineer fancies he can save money by changing the cut-off at haphazard, so to speak, and without indicating the result at once. It will be seen upon reflection that if the engines are so worked for any length of time they will be injured, and this for the reason that the distribution of power is unequal in the two cylinders. If the steam carried is changed from the figure originally fixed, the same disability is incurred, and if both the change of cut-off and pressure are altered at the same time, the results are likely to be very injurious.

Perhaps we are needlessly prolix in this matter, but we do not remember to have seen the points here advanced made prominently before, and that they have an important bearing upon the practical management of compound-engines, we think no engineer of experience will be disposed to deny.

HOLLOW SEATS ON SLIDE VALVES.

Some few weeks ago a contemporary illustrated a slide valve which was worn in a peculiar way; the seat was hollow, as if it had been struck from a center—say four feet above the seat. This is not an unusual exhibit, for we have seen the same thing before in our experience. It is often attributed to cocking of the valve on its seat, from one cause or another, binding of the yoke, where one is used, etc., etc. Possibly it may be due to none of these, but a defective construction of the valve itself. Where compression of the exhaust is great, that end of the valve is almost, if not wholly, balanced by the pressure underneath. It may even be lifted off its seat. The other end, however, is under boiler pressure. So between the two forces, one bearing down and the other pushing up, a slide valve may travel through an arc of a circle of great radius, on its seat. The result is of course a scooping motion, which soon wears the seat hollow.

SYSTEM!

We have recently had some experience with system. This is supposed to be routine, whereby business is expedited through intelligent supervision of detail, and the elimination of useless work; thus, also, reducing expense. These are praiseworthy objects and if rightly carried out, are legitimate, but if through so-called system more labor is entailed than is saved there is palpably no profit. In the system we criticise, certain goods are labeled to designate them. Before the goods can be used the labels have to be destroyed, therefore all the labor of marking them is a useless expense. The labels are not needed, for the case is the same as that a farmer having a heap of potatoes in plain sight, should put up a large sign stating that fact.

Certain crotchets, and whimsical turns men become possessed of, they are pleased to call system, when the routine demanded and the time consumed, amounts to a positive dead-lock, and is far more expensive than a common sense course. Precedent is a god to such men and they are bound hand and foot by it; they cannot stir a step without some law to guide them, and they are lost in a wilderness of doubt, fear and dismay, so soon as occasion arises for action in an emergency unprovided for by their statute.

OUR PERSONAL ACKNOWLEDGMENT.

Nearly every mail brings us enthusiastic letters from unknown friends all over the United States respecting THE MECHANICAL ENGINEER, its contents, and tone. These letters are all of the same tenor, and we need not say that every one of them is appreciated by us. Very many of them are, apparently, intended for publication, and while we have at times inserted many such compliments from our friends, the increase in them is so great that we should have very little room for anything else if we printed all that now come to hand. We therefore hope that our correspondents will not feel that their favors are slighted or overlooked if they do not get into print. We have, in our journey through life, been connected with many journals of this class, but in no one of them has the correspondence assumed so *friendly* a tone as our own connection.

IN THE ROUND HOUSE.

The series of articles upon locomotives and locomotive-work, announced under this title in our prospectus, will commence in an early issue of this paper, and we think they will be found of surpassing interest and great practical utility. The opening numbers are by a Master Mechanic now upon a Southern Railroad; unfortunately his duties preclude the possibility of his completing them, he having been suddenly called to the post he filled while writing them. Another writer, familiar to our readers by long association, Mr. L. O. Danse, will take up the subject and carry it through. We have the matter now in hand; it will be fully illustrated. We mention the fact of the double authorship in the interests of all concerned. Our readers will, we think, concede that our efforts to supply fresh matter on subjects unhackneyed, and not stale from being muddled over by incompetent persons, is deserving of their support. While we have a large number of railway subscribers, so to speak, we have room for more, and those interested will confer a favor by spreading a knowledge of the article in question among their immediate connection.

POLITICS IN PROFESSIONS.

The baleful effects of political interference with departments connected with the government of a city are wide spread, and tend directly to public injury. This is nowhere better shown than in a recent instance, which occurred in Philadelphia, in connection with the appointment of a Chief Engineer to the Water Department. Mr. Thomas Shaw, an engineer by profession and by *trade*, a manufacturer of Engineers' goods, who is practically familiar with the business at the post named in all its details, was defeated as a candidate for this important position, solely upon political grounds. When it is added that the person elected, is, to the best of our information, not an engineer, it will be seen that an injustice has been done the public interest, and that a man of sterling integrity and fitness has been set aside because he would not stoop to the tricks of petty politicians.

If Mr. Shaw needed any consolation he could reflect that, in this case, he has received a high compliment, and that his defeat upon the grounds in question, is a tacit admission of his personal worth. His friends at least will so regard it.

HOW SHALL WE FEED BOILERS.

An intelligent engineer in charge of one of the largest establishments in the country, was recently in our office when a question arose as to the proper place to introduce the feed for a boiler. This is a fit subject for discussion and we shall be glad to have the views of our friends upon it. The point was made, during the interview mentioned, that the front end was the best, in a horizontal boiler, for the reason that it keeps the boiler cleaner; the current induced by the feed sweeping all sediment before it. It also benefits the steaming capacity by artificial circulation. Our informant stated that his boilers were perfectly clean, with not the best water; what sediment collected being always found at the back end within easy reach of the hand-hole.

There is certainly reason for his belief and his practice, and we cannot see any disadvantage likely to ensue from feeding at the forward end of the boiler. We do see some great objections to feeding at the back end, and these are a comparatively sluggish circulation, caused by the incoming feed opposing the natural flow (repulsion) of heated water from the front end. Also bagging of the furnace plates may occur from the sediment being forced directly over them by the feed.

Feeding through a mud-drum, a plan very generally practiced in many parts of the country, seems to us indefensible from any aspect. Aside from the inaccessibility of the joint for repairs, and the fact that the joint is in an unhandy place, there remains the great evil of keeping the contents of the mud-drum in a continual state of agitation, instead of allowing them to subside and be removed. If there are any benefits from feeding through the mud-drum we are so obtuse as not to see them.

We shall be glad to publish communications upon this subject.

The Jarvis Furnace Company, Boston, Mass., have been setting a number of their furnaces under steam boilers in the West Indies, to burn wet begasse, or sugar cane "trash," without drying. Their system has proved successful, and they have received, this week, orders for a large amount of work, to commence when the present shop is completed.

Among the sugar estates that are now using these furnaces are the Ingeno "Matilde," of Don Jose N. Baro; Ingeno "Los Hermanos," of Don Alberto Jorrin; Ingeno "Santa Barbara," of Don Napoleon Davis; Ingeno "El Senedo," of Heyos de Sanchez Dolz. This company have orders to start work on the islands of Santo Domingo, Porto Rico, Sandwich Islands, British Honduras and Java.

The next issue of this paper will contain a handsome illustration of a pair of new compound engines, by the Globe Iron Works, Cleveland, O.

THE VALUE OF COMMUNICATIONS.

We have no doubt but that all our readers will agree with us when we say, that the letters to the Editor, upon trade subjects, are of the greatest value to them in their businesses. We find them of great interest, for they reflect, as in a mirror, the trade-practice upon any given detail.

Some one asks for information upon a certain point, and straightway it is volunteered from many different sources, all over the country. In this way one obtains a knowledge of contemporary engineering everywhere. In itself this is a means of education and one not to be despised, for it tells us what is going on in engine rooms far and near. An individual feels, perhaps, that his steam plant is as well arranged as it could be, but he has reason to change his mind after seeing the engravings of other systems.

In a sense, we are all dependent on one another in this world, to the extent at least, of good will and kindly service, where it can be done without too great sacrifice, and we see in these communications far more than the mere words. We "read between the lines" as the saying goes, and feel the fraternal spirit and good will, which prompts them. For ourselves we have to thank our correspondents, all over, for their prompt responses to our requests, and trust we shall hear more and more frequently.

THE MECHANICAL ENGINEER'S department of *Letters to the Editor* is a vast debating club, wherein every man has the floor at once, so to speak, and all have equal rights. We shall be glad to have queries propounded on subjects of interest and will devote all the space possible to them.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.

In connection with the series on Pattern Making, this branch of which will close in a few more issues, we shall present the series on Foundry practice, which will deal with an entirely new subject, from a wholly original point of view and style of treatment. It will treat of moulding various heavy works, such as large band-wheels, heavy cylinders, light armed pulleys, etc., etc., in great variety. The author is Mr. J. P. Mullin now employed in an engineering establishment and a thorough workman.

It is not intended to discontinue the series on Pattern Making wholly, but to resume it later in the year in another line.

TO CIVIL, MECHANICAL, HYDRAULIC AND MINING ENGINEERS.

The Commissioners of the National Exposition of Railway Appliances invite your attention to the proposed tests of the strength and quality of substances used in general construction, to be made during the Exposition, from May 24 to June 23, 1883.

That these tests may be full and complete, and of an extended and varied character, engineers who contemplate visiting the Exposition, are solicited to bring or send specimens of useful substances for the purpose. A record of these tests will be faithfully kept and afterwards published. It is to be hoped that all who can, will avail themselves of this opportunity to learn the quality and strength of the material used in their respective localities, without expense to themselves.

Suggestions from Engineers or others, which will promote the efficiency of these tests, are respectfully solicited. Special working forms of iron and steel are solicited, especially those which are subjected to constant or severe strains or blows.

A first-class prize will be given to the manufacturer producing, by actual test, the best and strongest upset eyebar, and upset rod for threading.

Specimens of stone should be in cubes of two inches. Stone cubes from old structures which have been exposed to unusually deleterious influences are requested.

Specimens of useful wood, of which no tests have been recorded, are requested.

A written description of each specimen sent for testing, including a full account of the mode of manufacture, must accompany it; otherwise no test will be made. If the specimen is of metal, name the ore it is made from and describe its manufacture and purpose.

If a stone specimen, give the date when quarried (unless from an old structure and not known), kind of stone, and the location of quarry, naming the town, county and state.

If a wood specimen, give the date of felling the tree of which it is a part, the common name of the wood, also botanical name if known, the average diameter and height of the species; state whether it is deciduous or perennial, and what, if any, useful purpose it has served in its native region.

All wood specimens should be of the following dimensions: For tensile strength two by two inches by three feet long. For compressive strength, six by eight inches by one foot long.

Specimens of rope made from steel or iron, or from manilla, hemp or any vegetable substance, also of belting of every description, are solicited.

WM. SOOY SMITH, C. E.
K. F. BOOTH, C. E.
W. F. GOODHUE, C. E.
WM. H. LOTZ, M. E.
CHESTER B. DAVIS, Hydraulic Engineer.
WM. SOOY SMITH, *Chairman*. *Committee.*

Address all correspondence, specimens, etc, to
E H, TALBOTT, Secretary,
Grand Pacific Hotel, Chicago.

WONDERS OF MODERN DWELLING PLACES.

The modern dwelling place of high cost is no longer a mere house, or even a mansion—it is a palace, and the last one designed strives to out-do its predecessors in lavish appointment, and all the luxury of surroundings and accessories that talent can devise or whim suggest.

Old world tales of ivory staircases, malachite doors and mantels, marble floors and halls, are insignificant by the side of the modern millionaire's palace. The wonders of Vanderbilt's vast pile surpass imagination, the fabled Aladdin's palace being mean in comparison.

Even houses made for sale partake of this universal demand for splendor of adornment. Witness this paragraph from *The Builder and Woodworker*:

> "An intimate acquaintance with every detail of the business, coupled with culture enhanced by foreign travel and close study of the masterpieces of famous masonry in Europe have enabled our architects to present superb edifices for millionaires to rejoice in. These houses have been visited by sundry eminent Scotch and English builders, who have been warm in admiration at the luxuries now considered as essential by modern householders The cabinet-work is something exquisite, with a large variety of choice hardwoods in every room, and some of the loveliest carving ever executed—to our taste, by no means inferior to, in some cases even surpassing the famous work of Grinling-Gibbons, that distinguished *protégé* of Sir Christopher Wren, Evelyn, and King Charles the Second of England. The hardware, the grates with their marvelous handiwork and tiles, the immense sheets of flawless glass in doors and windows, and the beautiful specimens of the beveled glass in mantels and sideboards, the plumbing, everything, in fact, is perfect.'

And the rent! Our contemporary is silent on this point, but it closes with this item:

> "The houses are worth taking a journey to see; they have only one drawback: If families that can afford to live in them were to meet a reverse of fortune it would almost be enough to break their hearts to have to leave them."

Post Office authorities in Washington have nothing better to do, apparently, than to make absurd and needless regulations, involving bother and fuss to business men. The latest order is to sign postal orders and indorse them with the name of the person who collects them. This person has also to sign his name on the order, which rigmarole necesitates a vast amount of useless exertion and wasted time.

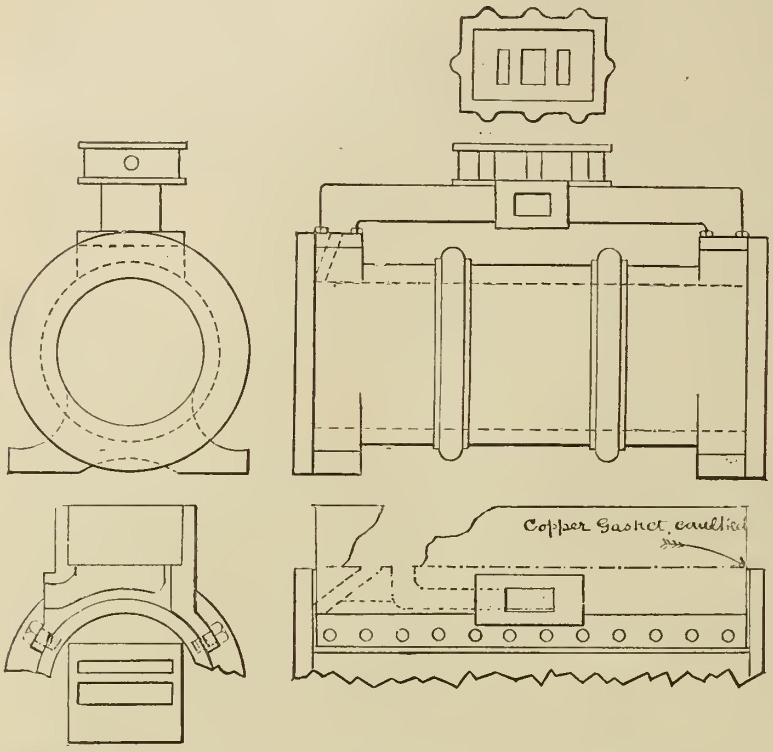
Further than this, if the collector chooses to be dishonest no action could lie against him, for the reason that the order is indorsed to him. If only one postal order per day came to hand it would not matter so much, but where they come in dozens it makes a difference.

There was no trouble under the old system of simply signing the name of the firm.

THE PROFESSOR IN THE MACHINE SHOP.—No. XXX.

In pursuance of my promise in the last issue of this paper I present herewith the old cylinder and the attachment, or change we made in it to render it less extravagant in the use of steam.

Any engineer who has done similar work knows that it is not a very easy job to make parts harmonize that are not designed as a whole. When you put a piece on, it is a patch, and that is all you can make of it; so our long, flat, steam chest does not look very well, stuck on top of the beads around the old cylinder, but as this is of no importance to the working of the engine, no harm is done.



The scale of the sketch is $\frac{3}{4}$ths of an inch to the foot, and, to save my readers the bother of measuring, I will say that the cylinder is $12\frac{1}{4}''$ dia., and the stroke 36″. The old ports were 3″ × 1″. The new ports are 9″ × $\frac{3}{4}$ths″. The old valve was a dead open and shut arrangement; that is, it *did* close one port in time to open the other, and that was about all. The new valve cuts off at $\frac{5}{8}$ths of the stroke, and is merely a long, double D valve of the usual kind. There is a raised seat in the chest for the valve, which does not show in the drawing.

We took off the old steam chest and chipped the nozzles off round with the cylinder, so that there was only an opening right through it; then we put the new one on with tap bolts, as shown, cut with a brass thread, made a hard putty joint, and let it stand three or four days before we put steam on it. It was as tight as a solid casting. Where the end of the new steam chest butted against the cylinder-flange I knew we might have a leak, for the reason that there is no chance to bring the two surfaces iron and iron without a great deal of labor, which means expense, so I just had it trued up square in the shop (the chest), dressed up the inside of the flange on the cylinder, and put in a copper gasket $\frac{1}{16}$th of an inch thick. This we caulked up with a chisel, and made a steam-tight joint with very little expense.

These are all the radical changes we made in this old engine, and I do not claim it was any great engineering feat, or an achievement, but simply an every-day job, that may be done by any one. I am of the opinion that there are a good many such engines scattered around the country that would bear a similar overhauling. I said these were all the radical changes that we made, but of course the whole engine was renewed as to bearings and connecting rod. For this latter, we threw away the heavy, ungainly, wooden arrangement and put in an iron one; also we put in a modern governor.

The result of all this surprised Mr. Blank; in fact he was astonished. He could not understand how it was possible to run the engine on so little coal, compared to what he had been burning before, but the only thing that surprised us was, that he should have been so long finding out the need for repairs!

I have traveled ahead of my story somewhat, in order to keep the engine repairs by themselves, but in connection with them an incident occurred which is, perhaps, trivial in itself and perhaps is not; at any rate there is a lesson in it for those who have any call to learn it. I do not think any readers of The Mechanical Engineer have, but it is well enough sometimes to expose a charlatan when you can do it without more work than the matter is worth. This is the incident referred to:

While we were connecting up the engine, and before we had steam on her, a young man appeared in the doorway of the premises and stood looking in upon us with undisguised contempt. How long he had been there I cannot say; my attention was first called to him by Jake—who had come over to see how we were getting on—giving me a dig in the side with his elbow, and telling me to look over in the doorway. I did so, and that was the first intimation I had of his presence. He seemed, at a hasty glance, about 21 or 22 years of age, and was apparently a mechanic, or, as that is saying a good deal more than is warranted by the circumstances, he was a workman after his kind. Our operations appeared to afford a great deal of amusement to the person mentioned, for he made no secret of that fact in his countenance, and after a while strolled in for a nearer inspection. Perhaps we were not altogether fit for a drawing room in appearance. Lamb—for some reason best known to himself—had donned one of Blank's high white hats, of last season, he had found kicking around the place. In the top of it he had cut several holes as ventilators, about two inches down from the crown; the brim he had painted a bright red, with red lead, and he had also put on a band of the same color an inch wide all round the crown. He had also marked on the hat-body—12″ × 36″—which, it is supposed, had some remote reference to the job he was at work upon. If I add to this that he had very dirty face, hands and arms, the reader will see that he looked more like a savage on the war-path than a white man. The rest of us, barring Jacob, who was neatly dressed, were not much better off, as regards appearances—with the exception of hats after Lamb's pattern! Jacob was evidently taken for the boss of the works by the young man I have spoken of, and he was accosted in the following words, uttered in a sneering sort of way, that would have exasperated some:

"Fixing your old trap up?"

"Yes," said Jake, "just a little; but what makes you call it an old trap; Ain't it a good engine"?

The young man burst into a loud guffaw; the question, and the innocence with which Jake made the remark were too much for him. "Good engine," said he; "its a scrap heap!"

Jacob pretended to look stupified. "Is that so?" said he, "why we think up here in the country that it is a pretty fair sort of an engine. It is a little old fashioned compared to some, but it aint a bad machine after all. What do you see the matter with it?" said Jacob.

"Matter with it" said the young man: "every thing is the matter with it. Its nothing but a rattle-trap!"

"Well, I don't know much about an engine" said Jacob, "and if we are doing ourselves an injury by keeping it going I would like to know it."

"You the boss?" said the young man.

"Yes" said Jacob "I am the boss: you are an engineer I suppose?"

"Well you can't tell me nothing about an engine that I don't know, I have been all through it. I can make an engine myself, from first to last, with my own hands!"

"Is *that* so?" said Jacob, in a tone of admiration, *not* unmixed with irony. "It was a lucky wind that blew you in the door. I don't know but mighty little about an engine myself, and I would like to have you instruct me some; if you won't charge us too much we will pay you for your information."

"Oh I won't charge you anything" said the young man, swelling with the idea of teaching countrymen a trick or two about a steam engine, "what do you want to know?"

"A good many things" said Jake, "I am afraid these men here are swindling me with the kind of work they do, and I would like your opinion as to whether it is ship-shape or not!"

At this the young man put on an air of wisdom and peered all round here and there, until he finally came to the steam chest and saw the valves, which were not scraped, but merely planed true.

Then he began to let out. "These valves ain't fit to run," said he, "they ought to be scraped down to a bearing."

"What is scraping?" said Jacob (than whom a better and quicker scraper never stood in shoe-leather.)

"Why its a kind of fancy finish they put on the seats in big shops, to make them smoother and run easier," was the answer.

"Won't these valves run easy without it?" said Jake.

"No, they won't run at all; the engine will get steam both ways at once."

"And what will that result in?" said Jake.

"Why it stops the engine," said the young man, "you can't run without you grind those valves down."

"Well, I'm glad you came in" said Jacob, "now there is one other thing—how shall we set this valve to have it come right? It don't seem to act just right, and these men here are so ignorant they don't know how to set a valve. It's a good thing you came in. You seem to be a smart kind of a fellow; now just tell these men what the matter is in that steam chest. They have been fooling there long enough. That young man in the red hat is the foreman, and he will take it kindly of you if you will give him some advice."

This was Lamb, and as I didn't want any harm to come to the coxcomb, I sent Lamb out quietly. To Jacob's apparent surprise, the young man fought shy of the steam chest, but Jake took him by the arm and led him right up to it. "Here," said Jake, "what's the matter with this valve?" The bold young man called out: "I don't see anything the matter with it, except the seat."

"Don't you?" said Jake, "well, we do; either the piston is in the wrong place in the cylinder, or else the valve is wrong somehow; darned if I see how. You look now, when I turn her over," said Jake, suiting the action to the word; "look at that! when the piston gets to the end of the stroke the valve is shut, ain't it? Look in there and see!"

"Yes," said the young man, "you want more lead."

"What's that?" said Jacob.

"Why, it's letting the steam in a little before the end of the stroke," said the young man.

"Well, now look at the other end," said Jake, "that's worse yet. The valve is wide open before the piston gets to the end of the stroke. Must be the piston rod is too long or too short, or something, ain't it?" said Jake.

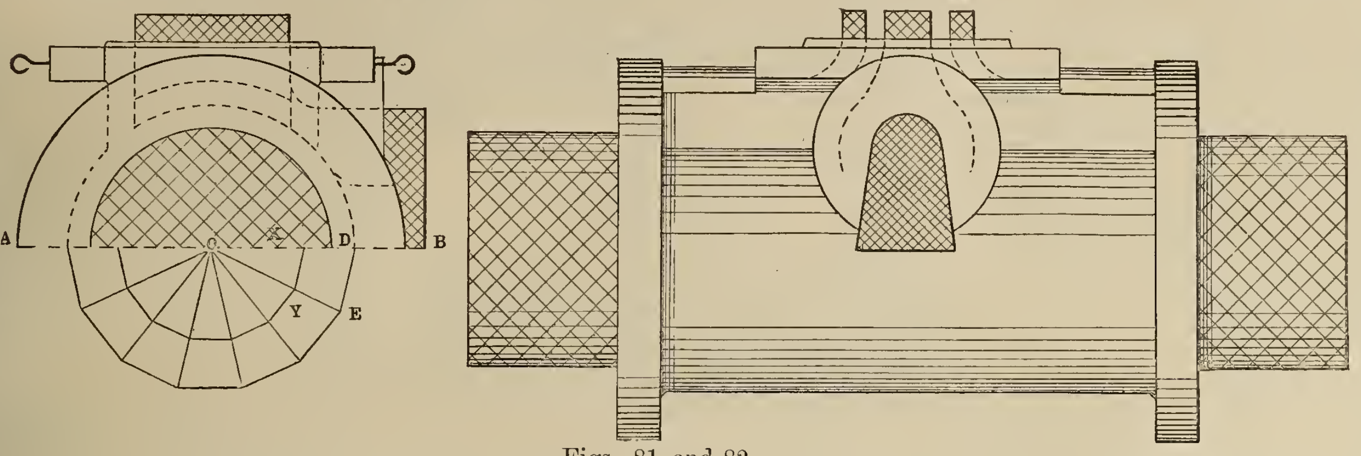
"No," said the young man reflectively, "I don't believe it is;" then he added, as an inspiration, "the eccentric is out of place; 'taint set right," but somehow his arrogance and freshness had all oozed out, and he was rather timid than otherwise.

"Oh, that's it! well, we thought it was curious, for we have had it all over the shaft, and it don't seem to have any place—not regular it don't. I am real glad you got us out of this fix. Show us where the eccentric ought to be."

The young man approached the fixture in question and pointed out a spot exactly opposite to where it should have been, and said that was where it should be.

All of a sudden Jake's manner changed; he turned on the visitor and asked him if he had ever set a valve in his life, or seen one set? To this last he answered boldly: "Yes; hundreds of them." "Where?" said Jake. "In the shop I worked in," was the answer.

"If you ever saw a valve set, or knew anything about it, you would see at once what the matter was in that chest; but you evidently don't know the first thing about an engine. Your conceit is far greater than your information. The place you pointed out for the eccentric has no relation to the true one. You came in here and saw an old engine in a country place, and jumped to the conclusion that we were a set of countrymen you could teach something that you didn't know yourself! You are a young man yet, and the first thing you want to do is to find out how little you know, not how much. Then you won't make a show of yourself. Now come here, and I will tell you what is the matter in this chest. Do you see that rod!"—pointing to the valve stem—"well, that is too short; that's all the trouble with it. The valve don't run square, and has'nt been adjusted yet. Any man 'with common sense would have seen that at a glance, but you had neither experience nor common sense, and you showed it first pop. Now you know more than you did when you came in here in a good many ways, and if you will go about your business you will do us a favor."



Figs. 81 and 82.

The young man sneaked out the door, but Lamb was ahead of him, and as he climbed the fence—the shortest way to the depot—he called out to him: "Here you, Mr. Man, come back and show us how to set the valves on this pump!"

When Lamb returned, flushed with his own cuteness at the parting salute above mentioned, I called him over and said: "It is all right, Lamb, to 'speed the parting guest,' but look out that you do not fall into the same hole yourself some day. You are learning the trade, and will be learning it all your life long. As you get older you will be surprised to find out how much you have learned that is wrong; how much you have obstinately clung to in the belief that it was right, when it was far away from that. What a man believes is vastly different from what he knows can be demonstrated. There are many things that we have to take upon trust, simply because they cannot be proved; but take care that you do not insist upon the truth of them. Of all the boys or men in the world, the most intensely disagreeable are those who are so puffed up with their attainments that they cannot be told anything. That always seems to me the surest sign of superficiality. There is Professor Rhombus, for instance: he is a man of high attainments, but he is one of the most unassuming, willing-to learn men in the world. That is why he has acquired so much—he wants to learn, and he does. On the other hand, the man who has 'been at a feast of knowledge and stolen the scraps'—to paraphrase Shakespeare—is simply insufferable. Whatever you do, Lamb, don't know it all, and, for mercy's sake, put that red hat under the boiler; you will have us all classed with you otherwise!"

PATTERN MAKING, No. 11.

BY A PATTERN MAKER.

As there are an almost infinite number of different designs of steam engines, to suit the varied purposes of man, so we may expect the cylinders of those engines to differ in their construction. While this is the case, there are certain essentials in all steam cylinders and where points of difference exist, they will be found in the methods adopted to fix them, or in provision for the attachment of other parts of the engine to them. For instance, the cylinders of some horizontal engines are cast with flanges to act as feet, by which the cylinder is bolted to the bed-plate or foundation; others are made to suit the curve of a boiler. Certain types of vertical engines have a provision made upon the cylinder for bolting the guides to, and so on.

The example, of which two views are given in figs. 81 and 82, is a pattern for a vertical cylinder of the ordinary slide-valve class, and is of the simplest kind; its position on the engine is on top of a standard, or column, which latter serves as a cover for that end of the cylinder which is bolted to it.

Steam cylinders, of this description, are molded valve-face downwards. By this is insured sound metal in the valve-face; it is also easier to fix the cores in that position. The pattern is always made in halves, which meet at the line, *A B*. There not being below the line, *A B*, any additions to the simple contour of the cylinder, it has not been thought necessary to draw the end view in full.

Having drawn the proposed pattern in its natural size, as in the figures, we proceed to make the cylinder-body which, unless of very small size, is done by what is called staving, or lagging, which is performed as follows:

As in fig. 82, lower part, draw a semi-circle a little larger than the intended body of the cylinder; divide it into as many equal parts as there are to be staves in half the pattern; draw radial lines through the points of division. We have now to circumscribe the semi-circle with a rectilinear figure, having as many sides as the semi-circle has been divided into parts, if we wish to present a perfect view of the body when staved together. The usual practice, however, is to show but one stave. To do this, set a bevel with its back to the line, *A B*, and let its blade coincide with the points, *D* and *E*. If, with the bevel so set, we were to draw a line from the extreme point of the semi-circle to the first divisional point, that line would fall within the circle, thereby cutting off what we had allowed for turning, therefore move the bevel outwards, until even with the circle, and draw a line from *D* to *E*.

NOTE.—It is not convenient, in so small a figure, to show any difference in position between the lines that fall within and without the circle.

Move the bevel inwards until sufficient stock for a stave is shown within the line of the core-print; draw the line, *X Y*, parallel to *D E*.

With centre, *O*, and distance, *O X*, describe a semi-circle; join the intersections of the radial lines with the circle, and we have the size and shape to cut out the heads. Heads, or pieces to which the staves are fixed, are sawed out of lumber sufficiently thick to stand the nails, or screws, which hold the staves. The number of heads depends on the length of the pattern and the strength of the staves—say from 15 to 18 inches apart.

It is a good plan, where admissible, to provide a center-bar in each of the halves of the pattern. In rapping, the molder will strike them instead of the staves, which are liable to be loosened at the joints. But where fixings have to be placed on the outside, held by screws driven from the inside, the bars will be in the way of the screw driver.

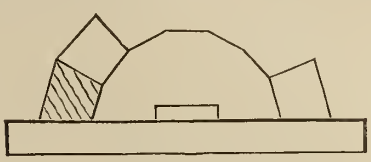


Fig. 83.

In this case we shall have but one screw to put in from the inside, viz.: that which is to hold the exhaust-steam outlet. This must be screwed, as it will be necessary to leave it in the mold when the pattern is being withdrawn. If we should fasten the piece in which the passages are supposed to be with screws, the bar will not be very much in the way, therefore let us decide upon center-bars.

In fig. 83 the end of the bar is shown as cut into the head. This figure is introduced to show the method of building up the pattern. The heads are screwed to the bars, in their proper places, and those with bar, which are to form half a pattern, are placed upon a flat surface and held temporarily. In that position all is ready for the addition of the staves. It is convenient to put the pegs, which keep the two parts of the pattern in place in the center-bars. In the absence of bars the pegs are usually inserted in the heads which form the ends of the pattern.

Staves are usually cut off about ½ inch or so longer than the finished pattern, the excess being easily turned off in the lathe. Fig. 84 shows the method of preparing them rapidly. Upon the saw-table, *A B*, rig up an inclined platform, *D*; the angle made by the platform and the circular saw, *C*, to be that required for the staves. The gauge, *E*, can be adjusted to the correct width. Each time a stave is sawn the board is reversed; this method is not only quick, but entails no loss of lumber. We used to saw them square and bevel them with the draw-knife and jack-plane, but that was in "Ye goode old time."

In building the pattern, the staves at the parting are put on first, and afterwards a stave on each side alternately, each stave glued to its fellow and to the heads, to which latter they are also nailed.

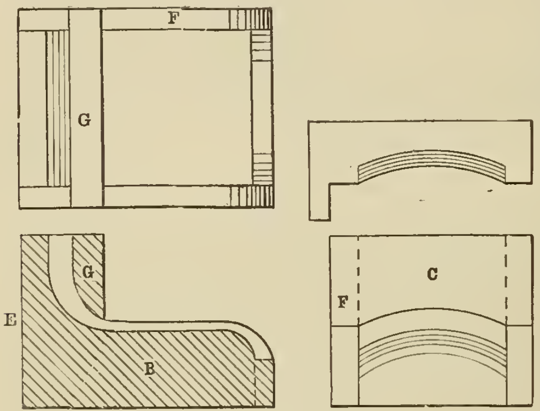
The two parts of the pattern having been built, they are to be held firmly together by square staples—dogs, so called. The pattern is then put into the lathe and turned as one piece. The body of the cylinder is to be cut to the distance between the flanges; that is, from where the fillet begins on one flange to where it begins on the other, for the fillets must be on the flanges to avoid cross-grain. The flanges are simply two rings, in halves, sawed out with the band saw to fit over the prints, and are cut a little larger in diameter to allow for turning. The thickness of the stuff must be sufficient to allow for truing up the flange and turning the fillet. The flanges are now to be nailed or screwed to their places. The parting in the flanges must necessarily agree with the parting of the pattern.

The flanges being turned, and a center line being scribed between them on the body of the cylinder, it can be removed from the lathe and the parts separated. That part into which the pegs are driven will be the part molded in the cope; therefore, to the other part the valve-seat and passages will be attached. This latter is not a very important point, but it saves making holes in the bottom board of the mold, and if this were a pattern to be molded in the floor, a pipe, for instance, the pegs would impede the passage of a straight-edge in striking a parting.

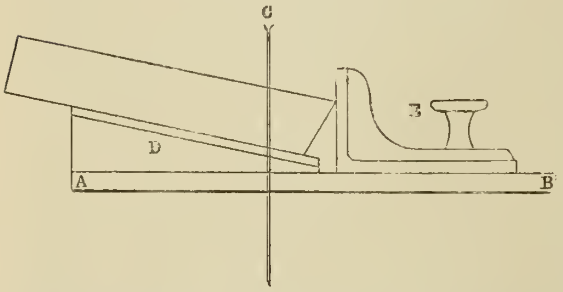
The dotted line in fig. 82 indicates the form of the piece to contain the steam passages, which piece is to be fixed in the position also shown in that view. The flanges for the steam-chest to rest on, with valve-seat to be added, is shown in the figures. It will be seen that if the flanges here mentioned were fixed to the pattern, the pattern would not draw; hence they are shown held in position by wires, which can readily be withdrawn after sufficient sand has been rammed into the flask to keep them in their places.

After the pattern has been taken out, these flanges will be drawn towards the center. The same arrangement is made with the exhaust outlet, wires not being shown in this case because a screw, inserted from the inside of the pattern, would be preferred.

The core-box for the passages, or *S* core-box, is shown in figures 84, 85 and 86; figure 87 is a view of the strike used in connection with it.

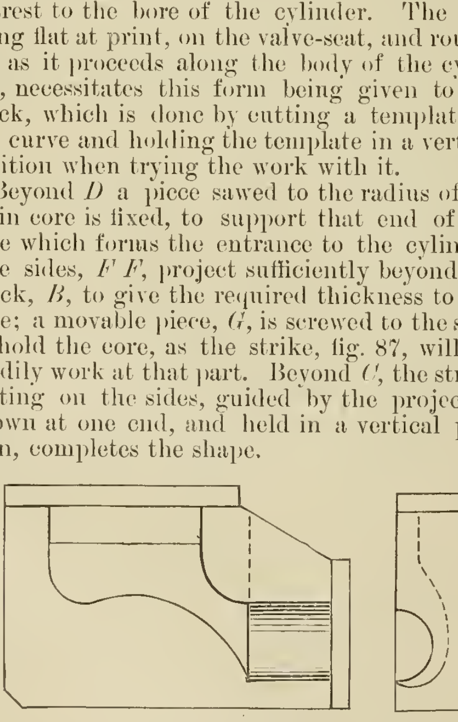


Figs. 84, 85, 86 and 87.



To make this core-box, we require a block *B* equal in length to *D* and in width to *C*; *E* being the height. This block is to form the bottom of the *S*, or that part of the core which is nearest to the bore of the cylinder. The core being flat at print, on the valve-seat, and rounding as it proceeds along the body of the cylinder, necessitates this form being given to the block, which is done by cutting a template to the curve and holding the template in a vertical position when trying the work with it.

Beyond *D* a piece sawed to the radius of the main core is fixed, to support that end of the core which forms the entrance to the cylinder. The sides, *F F*, project sufficiently beyond the block, *B*, to give the required thickness to the core; a movable piece, *G*, is screwed to the sides to hold the core, as the strike, fig. 87, will not readily work at that part. Beyond *C*, the strike, resting on the sides, guided by the projection shown at one end, and held in a vertical position, completes the shape.



Figs. 88 and 89.

Two half-boxes, figs. 88 and 89, are used to make the exhaust-core. They are generally made each in two pieces, the half-round recess cut out in one and that peculiar shape which connects the half-round with the rectangular opening in the valve-seat, is cut out in the other piece marked *O*. The shape of this recess, agrees with half of the exhaust-print for a certain distance below the print, when its form resembles a dovetail which is carried along until it meets the half round. Two half-boxes are necessary, because one is left and the other right-handed.

The main cores for cylinders are generally turned upon a core-bar, and we have nothing to prepare for them, other than a straight piece of board about 20 inches longer than the core is to be.

In small cylinders, the ports being so close together, green sand will not stand between them; therefore, one print only is used for the valve-seat, in which case the exhaust core-box must be cut deeper, at the part corresponding to the print, by an amount equal to the space between the prints. VERNI NOIR.

MECHANICAL DRAWING—ARTICLE X.

BY EDWIN H MARBLE.

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Before we take up the study of Working Drawings there remains one or two points in the study of intersections and penetrations, which it might be well to examine. In figure 20 we have shown the method of finding the line of intersection between a cylinder and cone, or the frustrum of a cone.

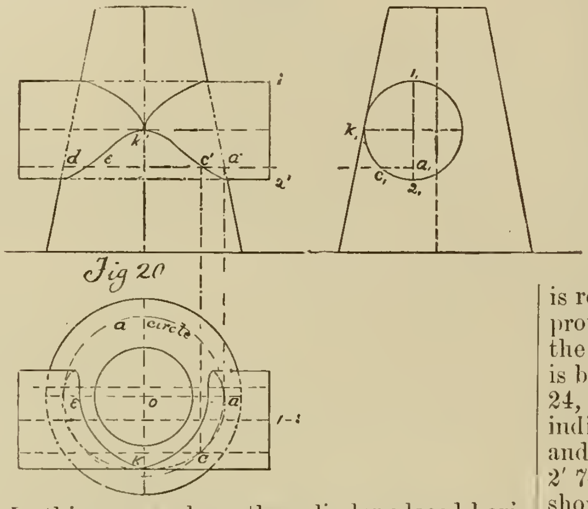


Fig 20

In this case we have the cylinder placed horizontally, the cone upright, or vertical, and the axes not intersecting, though in planes, at right angles one to the other. Our method of finding this line of intersection is as follows: Having drawn the outlines of our model, as seen in plan, elevation, and side elevation, we will cut through the model by a horizontal plane at the point *a*, as seen in the side elevation. This plane will cut in the cone a circle of the diameter of the cone at that height from the base line. This circle we find by projecting horizontally across to the elevation at *a' c' d'*, and then to the plan at *a a*. This circle, which we have marked *a circle*, will be cut by the cylinder at *c*, in the side *elevation*, which point is at a distance to the left of the vertical line through the center, 1 2, equal to *a c*. As shown in plan, we have the points, *c*, *e*, the same distance below the center line. These points we know are points in the intersecting line, and must be shown in elevation by *c' e'*. The point *K*, we can find by the same method, giving us a circle of the radius, *K O*, and the projected point, *K'*. One great disadvantage all of these problems in intersection and penetration have, is, that to properly show the whole process a great many lines are necessary, and if all were represented we should have a very confused diagram. All these points are obtained by the same method, and in this case, though seemingly a most intricate arrangement, it will suffice to show these two points, to enable all students to properly draw any similar intersecting curve.

To apply this same method to any irregular body, as for instance, the joining of the round stem of a connection rod with its rectangular end, we have but to imagine the different cuts that the tools make in turning the same, and carefully follow the path around the body.

In many other cases the same plan can be followed, and the result easily obtained. The intersection of a cylinder and a ring gives us another good example for study, and this will be seen in common shop practice by the insertion of a handle in the body, or rim of a hand-wheel on the tail-screw of a lathe.

Before I close this series of articles, as stated in the last issue, it is the purpose of the writer to add a few remarks upon making working drawings. In the first place working drawings are not pictures, but rather diagrams of mechanical work which show the proper relation of its component parts, without any undue attempt at ornamentation.

In making working drawings the following precautions should be taken :—

First. Represent the object by lines so arranged and located as to show the exact position of any point, when taken in connection with the remaining parts of the machine or model.

Second. Do not add to the diagram any lines, which are merely for ornament; have a practical use for every line.

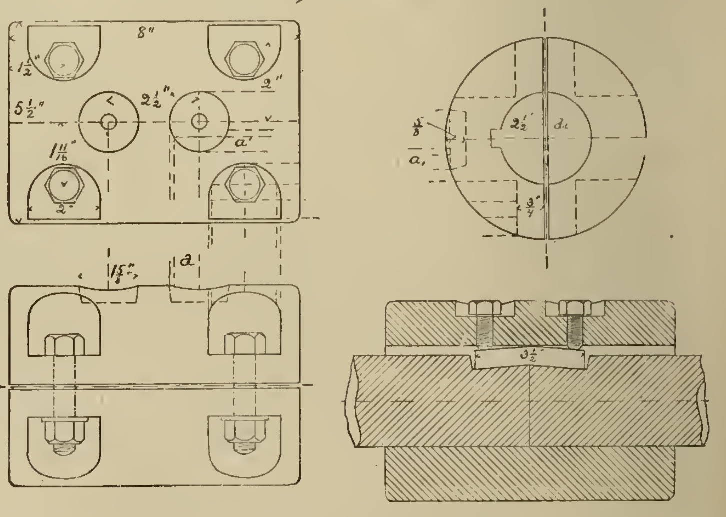
Third. Do not leave any part to be understood. If a body is round, square, elliptic, or any other shape, make it so and do not depend on imagination or thought, to fill up the gap.

Fourth. Express all dimensions in feet and inches, so that the mechanic who has occasion to refer to the drawing, need have no excuse for placing a dirty hand, or greasy rule, upon the paper.

When such a practice of marking dimensions is in use the whole responsibility rests upon the draughtsman, and he only is responsible for mistakes in the construction, providing, of course, that the work is made to the drawing. In so expressing measurements it is best to use inches in measurements from 1 to 24, and the sign ″ is the easiest and best to so indicate the same. Above 24″ use "ft."; or ′ and ″. Thus, 13½″ not 1 ft. 1½″; 2 ft., 7¼″, or 2′ 7¼″. Fractions, in all cases, place as here shown, not as is often seen $\frac{13}{16}''$; when carelessly written this can be read as $1\frac{3}{16}''$ or $\frac{13}{16}''$.

To the use of the terms feet and inches, as here applied, some will object, and ask why 1 ft. 1½″ is not as good as 13½″? To this I would reply, the common two-foot jointed rule, or its equivalent, is in the hands of every artisan and he is supposed to know how to use it. It is much easier to read the printed or stamped figures 13½″, than to mentally calculate 1′ 1½″.

Fifth. In making dimensions upon the drawing, place them so as to read either from the bottom or right hand of the drawing thus: 1′ 5¼″ or 5¼″. This will be readily seen in the coupling-drawing here shown. Furthermore, place these dimensions so as to be readily seen, and where they would naturally be looked for. If necessary place the same dimension on two different views, though not often is it desired to do so. Should we wish to place a dimension where it would show on a cross-lined body, leave a blank space all about it.



The use of shade lines will aid to a great extent in the distinctness of a drawing and add to its readableness, if such a term can be applied to drawings. It is best in nearly every case to make a separate drawing for each individual piece rather than to attempt to show too much at one time. This adds also to the same property as the shade lines—being easily read. The last direction which I will give is this, make the diagrams so that they fill all the requirements desired, and feel perfectly satisfied with them yourself, being sure that they contain all the information necessary, to enable one wholly unacquainted with the matter, to understand them.

In figure 22 we have four views of a shaft coupling that might be called top view, side view, end view and section. The terms, plan and elevation, will hardly apply in this case, owing to the shape of the object. In the top view we see the length of the coupling, the position of the bolts that hold it together, the set screws that hold the key in place, and the general outline of the recesses for the bolts. The end view is necessary to show that it is a cylinder, as well as the key-way and shaft. The side view shows the depth of the recess, and the proper shape of both; while to the *section* we must turn to find the position of the key and the internal arrangement of the different parts.

I will now explain the construction of this coupling. The length is 8″; the diameter $5\frac{1}{2}''$. The two screws, at each end of the key are situated centrally $2\frac{1}{2}''$ apart, while the bolts which clamp the halves together and grip the shaft are $1\frac{1}{2}''$ in from the end and $3\frac{3}{8}''$ apart, or $1\frac{1}{16}''$ from center. The center of the recess, however, is 2″ from the center and is a 2″ counterbore. The counterbore for the two set screws is $1\frac{5}{8}''$ diameter. From the end view we find the halves do not come together by $\frac{1}{8}''$. The shaft is $2\frac{1}{2}''$ dia.; the key way is $\frac{1}{4}''$ deep, and $\frac{1}{2}''$ wide. The set-screw recesses are $\frac{5}{8}''$ deep, while we have $\frac{3}{4}''$ stock between the bottom of the bolt counterbore and the inside of the coupling. From the side view in addition to the former measurements we obtain a description of the bolts; these are $2\frac{1}{2}''$ long, $\frac{9}{16}''$ dia., 14 threads to the inch, with hexagon heads and nuts. We also have the shape of both recess and counterbore in the end view. The section adds to our previous knowledge several points. The key-way in the coupling is shown to be the entire length, while the key-ways in the ends of the shafts are shown to be cut deeper at the inner end. These key-ways are $3\frac{3}{4}''$ long. The key is $3\frac{1}{2}''$ in length. The set-screws are $\frac{7}{16}''$ diameter, 1″ long, with hexagon heads, rounded points, and cut 16 threads to the inch.

Having set off the center lines and the location of the centers we will draw the cylinder of the proper dimensions. Upon this cylinder we will locate the different points already mentioned, as indicated in the diagram. The intersection of one of the counterbores with the cylinder, we shall find shown at *a*, *a'*, *a*, while the lines necessary to procure the line of intersection of the bolt-counterbore with the cylinder, as well as the first mentioned ones, are also shown.

The remainder of the diagram will, I think, need no further explanation, and the coupling, as completed, affords us a good example of a working drawing. The construction lines should be erased in the drawing—in this they were left for better explanation. It will be noticed, however, that several of the dimensions are not shown. This was unavoidable, on account of the necessary reduction in the drawing to suit the columns of THE MECHANICAL ENGINEER. They should be shown in a working drawing.

With this example I close my connection as instructor and student. To those who have aided me in my labor by letters of appreciation and kindness, I return thanks, and trust the articles have awakened a desire, with some, at least, for a more thorough knowledge of the science so feebly represented by me.

To all students wishing any further aid in this study of Mechanical Drawing, I shall be happy to greet them, either personally or otherwise.

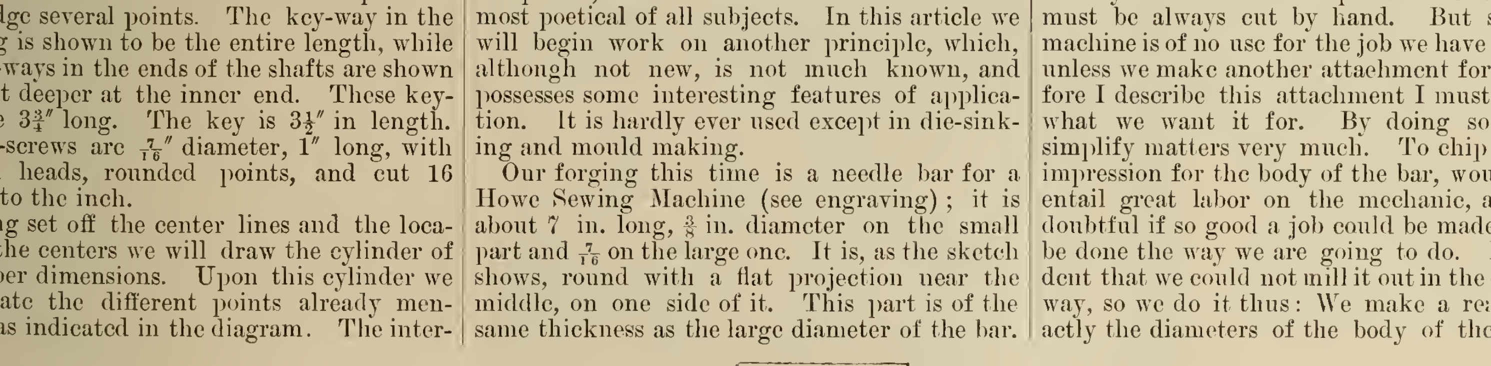
[THE END.]

DIES AND DIE SINKING—No. IX.

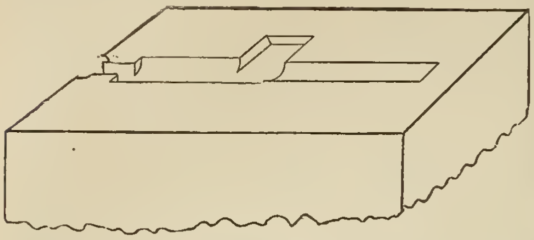
BY A DIE SINKER.

In my last article I closed with some remarks about my fellow-craftsmen "of the allied arts," which I hope will not be taken as derogatory, they were not written with that intention, but rather to stimulate a little rivalry between them. It is a good thing to see this pride of trade among mechanics for it tends to make them better workmen. A mechanic who has no pride in his trade or abilities, is never a very good one. And why should they not be proud? The poet, painter and sculptor are proud of their creations, and all of them have a decided repugnance to things mechanical, yet it is clear that the best of them possessed great mechanical dexterity. Where would a painter be without an ability to draw, or a sculptor, unable to handle his tools? And in the lines of the greatest poets there is a mechanical jingle which makes them pleasing to the ear. We should take pride in our callings; for it is the mechanic who has built up this Great Republic and made it a shining light among the nations of the world.

The reader will now think I am growing poetical so I had better stick to my text and try to describe how difficulties may be met and conquered, which to the true mechanic is the most poetical of all subjects. In this article we will begin work on another principle, which, although not new, is not much known, and possesses some interesting features of application. It is hardly ever used except in die-sinking and mould making.



Our forging this time is a needle bar for a Howe Sewing Machine (see engraving); it is about 7 in. long, $\frac{3}{8}$ in. diameter on the small part and $\frac{7}{16}$ on the large one. It is, as the sketch shows, round with a flat projection near the middle, on one side of it. This part is of the same thickness as the large diameter of the bar. It is intended for connection to the needle lever, and the connection is made by a small pin, termed a piston, which is attached to it and slides back and forth in the needle-lever twice in every stroke. Hitherto we have always used the same steel for our die-blocks, but it is now clear that we must make a change. Our forging is 7 inches long, so we get a bar of steel 3 ″×6 ″ and cut off two pieces 9 in. long for our die-blocks. We do not set these up on den in the drop-hammer, but place them on their narrow sides, and plane dovetails on them. It is not necessary to plane them all over, in fact it is a deal better to leave the sides black, as it comes to the shop, for this makes it stronger and keeps it from bulging out, with the repeated blows; but, of course, we plane top and bottom and the front and back. We have now two blocks 9 inches long, and 3 inches wide. We put the forging, of course, lengthwise into the block, so we have an inch at each end to spare, and we put one-half the forging in each die-block. The reader now knows that templates are necessary but I need not describe them. We do not use them much except to make a drift or force, for the square projection in the centre, which drift is rounded off on one side to the radius of the bar. The other, or flat sides, are tapered a little to make the forging come out easy. We also use the template to lay out this square part, but not until we have the body of the forging sunk. This we do in an entirely different manner to anything previously. We want to sink this cylindrical part perfectly round and have exactly one-half the circle in each die. If we do not it is obvious that the forging must stick in the side that has the greatest part of the circle. The reader can see that it would be impractical to make a drift and cut this out as we have done others, so we must now bring machinery to our aid. In previous articles we got along very well with a vice, cutting block, lathe and shaper, but now we want a die-sinking machine. This is a high-sounding name, some readers will, perhaps, imagine it is some automatic machine that leaves nothing to be done by the mechanic. It is not. It is, to describe it, simply nothing more than a drill-press on a vertical milling machine with a fixed spindle, having the table fixed also, so that it can only move up or down; with a convenient wheel for raising or lowering it (the table) rapidly. On this table is a compound slide rest with a handy vice for holding dies. The spindle has the Morse taper for milling cutters, drills and chucks. By means of milling cutters of the proper shape, in combination with the compound slide rest on the table, very irregular shapes can be cut out in dies that are large enough to admit cutters, but it will be understood you cannot touch square corners. These must be always cut by hand. But still this machine is of no use for the job we have in hand, unless we make another attachment for it. Before I describe this attachment I must explain what we want it for. By doing so it will simplify matters very much. To chip out this impression for the body of the bar, would be to entail great labor on the mechanic, and it is doubtful if so good a job could be made as can be done the way we are going to do. It is evident that we could not mill it out in the ordinary way, so we do it thus: We make a reamer exactly the diameters of the body of the forging (you will observe there are two diameters). The shank of this reamer is made to fit the spindle of the die-sinking machine. The cutting part of the reamer is exactly the length of the forging with the largest diameter next to the shank. Between the cutting part of the reamer and the taper part of the shank, it is reduced to $\frac{5}{16}$ diameter about $\frac{1}{2}$ inch of its length. As we are engaged in sinking dies it will not do for us to make these reamers, or we would never get our own work done. So we give these instructions to the tool-maker and we can attend to our own business.



We will suppose we have this reamer made, so we get our die-blocks and draw a center line along the length of their faces. We then take a diamond-point chisel and cut a groove along these lines, about $\frac{1}{8}$ deep and $1\frac{1}{2}$ inches long, make these grooves exactly the same depth, for we drill a $\frac{5}{16}$ hole here one half in each block, for the shank of the reamer, and we want to have the holes exactly equal halves. If the grooves are not cut exactly the same the hole will follow the grooves. We take our outline template and lay out the body of the forging upon the die-block, then take some round nose chisels and rough out the body, leaving enough to clear up with the reamers. It is not necessary to put off much time smoothing up after you have chipped, for the reamer will make that all right, but they must be cut exactly the same depth, and the more you can take out of them with the chisel the less you will have to take out with the reamer, which is necessarily a slow operation owing to the small diameter of the shank. This is but $\frac{5}{16}$, while the large cutting diameter is $\frac{7}{16}$, and the small one $\frac{3}{8}$, while the length of cutting part is 7 inches. To some this may seem impossible, that a shank only $\frac{5}{16}$ diameter could stand such a strain. but they must bear in mind that the cut that is put on, is very little at a time, and that little very gradual. Now we want to put our die-block in the die-sinking machine, so that we can ream it out and in such a manner that we can feed up very carefully to the reamer, and it is for this purpose that we require the attachment that I spoke of. To make it clear to the reader what we want, I here give an illustration of the two die-blocks, with the milling cutter or reamer between them in the position in which it has to be, but the blocks have to be so arranged that they close simultaneously on the reamer. The reader will now, I think, see what I am trying to get at, which, to put it simply, is this: We want a vice, or machine, which will hold each of these die-blocks separately face to face, (much as they will be in the drop hammer) except that they will be placed horizontally. The jaws of this vice are to open and shut equally, that is both jaws are to move towards, or away from each other according as you turn the screw. This is accomplished by having a right and left hand screw.

Perhaps I have gone a round-about way in describing this. If so, I ask indulgence from the reader. If they are mechanics I know they will sympathize with me in my endeavor to make things clear to them. If there are readers, others than mechanics, who have had the advantage of a better education than mechanics can possibly have, they too will excuse errors of diction or other shortcomings on my part. If some one that has had the advantage of a college education, wrote up this subject it might present a better appearance, but at the same time it would be sure to lack in most of the details that I may consider necessary to point out.

In my own reading I have read up eminent writers, men who are considered great authorities and to me much of it was incomprehensible. Take from Bourne's Catechism of the Steam Engine, for example his method of setting a slide valve! I have assisted in that operation many times on many classes of work, among men of different nationalities, and never yet saw anything like his method. I have also studied it up for hours trying to see how it could be done his way and had to give it up. And I never yet came across a machinist that could make head or tail of it. It is for this reason I try like Othello to "a round unvarnished tale unfold." But, unlike him I find it difficult from its very plainness. It may be that the shop has made its impress on me and that the habits we there learn of never beginning a job until we understand exactly what it is we want to do, may have its influence on me in writing these articles. Be that as it may, it will always be my endeavor to so word them that every one can understand them, and if there is but one person can say that he has got any information from them, I will then feel that I have not written in vain. As I want the reader to understand clearly how this attachment for the die-sinking machine in made and the principle upon which we use it, it is better to take another article to illustrate it and show its uses.

MODERN MACHINE TOOLS.

In that class of metal manufacture that may be called machine-making, it may be roughly estimated that the costs of labor and material are equal, and that these constitute four-fifths of the prime cost. It must be difficult to determine how far the efficiency of labor and the cost of material is affected by machine tools. The importance of this manufacture is attested by the fact that in all countries the foremost engineers and mechanics have been makers of such machinery. For a long time, and until within twenty years past, machine tool manufacture and machine tool improvement were almost confined to English makers. The principal improvements, or, as we might say, the development of tool-making, took place about forty years ago, when there were laid down certain principles and methods of construction which have not been materially departed from since. In searches to determine the novelty of alleged new inventions, the principal references are found previous to the year 1860, and most copiously ten years earlier. These facts are deemed of some importance here, because in the present series of articles there will be various comments upon the tendency of machine-tool practice to adhere to particular types and methods.

The main "divergence" from what may be called the Manchester type, has been made in America during twenty years past. These improvements in America have been promoted by a great advance in the manufacture of small tools and implements for machine and hand use. These in nearly all cases bear the stamp of practical experiment and are, for the most part, the invention of intelligent workmen.

It is difficult to speak fairly and in general terms of either American or Continental forms of practice, because of their diversity. This is especially true of America, where, in a few works devoted to machine tool making, there have been the utmost care and study given to proportions and fitting as well as general design. In Great Britain there is more uniformity, especially of proportions and arrangement.

The contract system has been extensively applied in America, particular workmen agreeing to execute some special work for a stipulated price. The English system, based upon estimates, demands an acquaintance with the cost of work that cannot exist except in an extensive manufacture, and when apprentices and clerks are trained in "taking out quantities." Workmen will not accept estimates unless based upon well-known rules. There must be "constants" for bored, turned, planed, or fitted surfaces, and these constants, as before remarked, can be derived only from an extensive manufacture, carried on with considerable uniformity. The effect of this system is seen in the fact that the wages of first-class workmen is as much in England as in America, and much more than on the Continent; the hours of work are 10 per cent. less, while the market value of the product is in respect to America, nearly as two to one at the present time. There is, of course, quite a difference in the amount of wages paid to second and third class workmen, such wages being much higher in America; but allowing this to be compensated by one-tenth gain in time, there remains much to be accounted for in "first cost."

There is in England a considerable amount of such data, otherwise estimates for the piece-work system would be impossible, but such data are far from complete, and are not generally available.

Planing and turning can certainly be reduced to some kind of standard that would admit of comparison at least. The classification would have to include dimensions and area, the kind of material, rigidity, and accessibility, the degree of truth and finish, and so on. The value of such data is suggested by the question what is the time and cost of planing one foot square? or, what is the cost of turning one square foot of area? the kind of material and general dimensions being given. Such questions have to be answered or guessed at in estimating. The efficiency of planing machines might be measured by some kind of co-efficient, such as planing at two or three cuts a flat plate of cast iron, having a given area. This as a test would be uniform or nearly so in all cases. A similar test for lathes might be an iron shaft of certain dimensions to be finished at once going over.

As before remarked, the efforts of the best engineers and mechanics in all countries have not been enough to keep this branch of manufacture abreast with many others that might be named; with steam engineering for example. Under these circumstances no fault should be found with opinions derived empirically. This method must precede a scientific one, and until the latter is in some degree attained, we must expect a wide diversity of both opinions and practice.—*J. Richards in Engineering.*

COKE FOR STEAM PURPOSES.

A superintendent of a gas company near Boston, finding that his coke was accumulating on his hands, has induced several of the manufacturers in his neighborhood to try coke as a substitute for coal, to use under their steam boilers. Several different parties made the experiment, but the most successful result was accomplished in a mill that had in use then boilers set with the Jarvis Furnace.

The coke was wet down thoroughly, all the water was put on that it would absorb. In burning the wet coke the moisture was converted into *hydrogen* gas, and thus joining with the hot air *oxygen*, furnished through the perforated plates of the Jarvis furnace, made an immense flame. Usually coke is burnt without any flame. The result at this mill was an economy of fifty per cent. over their neighbors, using the same fuel, and an actual saving at this mill over burning soft coal with ordinary setting, of $60 per month.

COKE.

A correspondent in another part of this issue mentions an accident which happened in a factory recently where, through the breaking of a tooth in one of the main driving gears, a vast amount of damage ensued. The engine-shaft was broken, the engine thrown out of line, and 700 hands lost a week's labor while repairs were made. Such accidents as this are by no means uncommon, and are liable to happen at any time where gearing is employed as a driver. Aside from the obvious inconveniences of noise and loss of power, the chances of the casualty mentioned, should be considered in determining upon the use of gearing; that it is by no means remote the records of the past show.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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New York, April 28, 1883.
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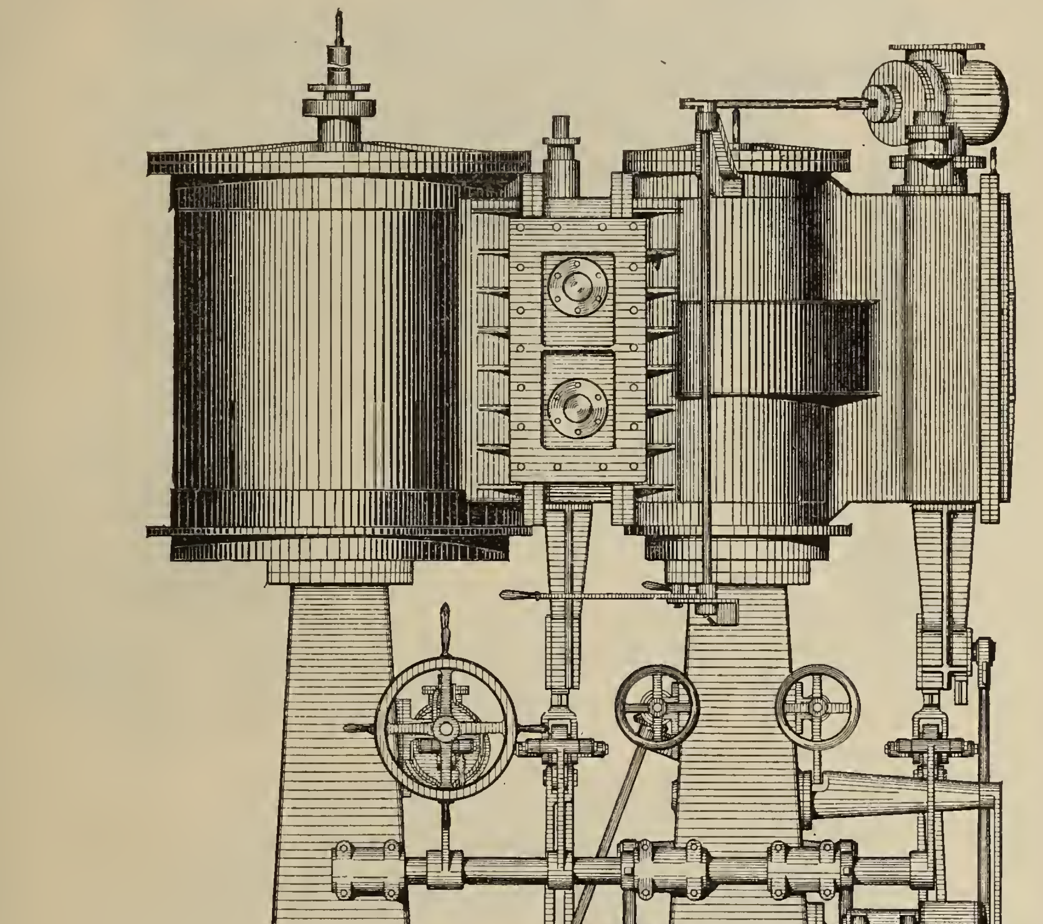
Our engravings represent a pair of engines built by the above firm, which have given good satisfaction in all particulars; showing a very low water consumption—18 lbs. per horse power—for engines, which were not intended for show-work, so to speak, or competitive economy.

The high pressure cylinder is 28″ diameter, low pressure 50″ by 48″ stroke. The cut-off in the high pressure cylinder is effected by a slide on the back of the main valve, regulated by a sword-arm, and in the low pressure by lap. The reversing can be done both by hand and by steam; the former being applied for use in an emergency only, which, we may add, has never yet arisen.

To engineers on the seaboard these machines will appear long-geared in comparison with those upon ocean steamers, but this is an advantage they can appreciate in the greater ease of working and decreased liability of heating bearings, through the lessened angle of side-throw of a heavy connecting rod at high speeds.

The condenser, it will be observed, is of the jet type—the ship running in fresh water—and this involves some peculiarities in the framing, no support for the cylinders being obtained from the condenser itself. The design of the engines, although similar in some respects to those in sea-going vessels is peculiar on the lakes; there being, we are informed, none similar at the time these were built. They are very popular with the engineers in charge, who find them easily handled in all respects.


COMPOUND ENGINES OF THE TAHOMA S. S. AMERICAN MARINE ENGINES NO. 8.

NATIONAL RAILWAY EXPOSITION ITEMS.

Several papers, both East and West, have erroneously published March 24, as the opening day of the National Exposition of Railway Appliances.

The right date is *May* 24, and newspapers throughout the country are requested to aid in correcting this error by calling attention to it. Already a number of persons have taken long journeys to Chicago, expecting to be present at the opening, and in several places excursions have been prematurely organized as a consequence.

Everything will be in readiness on May 24, for the opening of this, the most unique, interesting and (except the Centennial) the largest exposition ever held on this continent. Some weeks since it was decided to increase the floor capacity by about 200,000 feet. Now the plans have been changed still further, making an addition of 300,000 in all. This is absolutely necessary to accommodate all who have applied for space.

◆

William T. Waters, of Toronto, Ont., writes to the *Railway Age* that his grandfather, Thomas Waters, invented the locomotive, and not George Stephenson, and he supports his statements by dates. In 1813 Waters' locomotive worked on a smooth rail, drawing four wagons at four miles an hour; but it was not until 1814 that Stephenson tried his engine at Killingworth. Coming down to 1829, he says:

> "During all these years Hedley & Waters' engine was working economically and well, having the great essential so long neglected and vainly sought by Stephenson, namely steam blast and return tube boiler.
>
> These are as near the facts of the invention of the locomotive as I can give. George Stephenson was never the man to acknowledge my grandfathers, Thomas Waters' priority of invention. At the best he was from the year 1814 to the year 1829 in finding out what was in the second Wylam engine, and I do not think he would have found it out then had he not lived near Wylam. His cottage still stands, and the Wylam wagon way passed the door. He would have the chance of examining my grandfather's engine."

◆

An exchange says: "Several years ago a company of razor grinders who went to America took a barrel of Sheffield water with them; but the barrel, of course, could not last forever. Whatever the cause, the making of razors remains a specialty of Sheffield manufacturers, and almost a monopoly."

The cause is plain enough, and is that razor makers in England work for less money than razor makers in this country; that is the monopoly of it.

Hon. Joseph Nimmo, Jr., Chief of the Bureau of Statistics, has issued a statement, which shows the quantities of iron and steel imported into the United States from all countries in the first nine months of 1882, to be 959,809 gross tons, valued at $53,918,028, an increase over the corresponding period of 1881, of 61,043 tons, representing a value of over $7,000,000.

We have therefore been drawing on foreign countries at the rate of over 100,000 gross tons of iron and steel monthly, and paying for it fully $200,000 per day.

At this rate of importation the pig iron, castings, bar, hoop, sheet, and plate iron, brought into the country, represent an amount of pig metal greater than the output of all the charcoal blast furnaces in the United States, and yet these items cover but one-half of the quantity imported.

In almost every variety of coal there may be observed thin layers or patches of a dull black granular, or silky fibrous substance running between the laminæ or along the planes of bedding of the coal. This material is commonly known as *mineral charcoal*, from its resemblance in outward appearance to ordinary charcoal. It has in all probability been derived from the leaves or leaf-stalks of the coal-forming plants; and it differs very much in composition from the adjoining bituminoid portions of the coal, the proportion of volatile matter being much less.

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The need of a little practical common sense in technical matters is well shown in a recent paragraph in the *Iron Age*, which suggests the use of an engineer's transit for erecting engines on board ship. Inasmuch as this instrument depends for its accuracy upon a spirit level it will be seen that the suggestion is an amazing one.

WHAT ENGLISH TOOL BUILDERS ARE DOING.

Among other work in hand is a large planing machine, which Messrs. Hetherington and Co. are constructing. This machine was for planing 10 ft. square by 30 ft. long, and was also provided with a cross-planing motion. The class of work for which it is specially designed is the planing of engine beds, and by the introduction of the cross-cutting motion, when the engine bed has been planed longitudinally it can be planed perfectly square with the longitudinal part of the work. In connection with the cross planing arrangement the table is provided with a longitudinal feed motion. The bed is 52 ft. over all, and is made in three sections, the center portion carrying the standards and gearing, and the table is constructed in two sections jointed down the center. The machine is self-acting in all its cuts, both for the longitudinal and cross planing, and when complete will weigh about 100 tons.

Other special machines in hand included a 12 in. shafting lathe, arranged with two duplex carriages, the front rest carrying two tools and the back rest one tool, in each case. The bed of this machine is 36 ft. long, and is provided with an 18 in. headstock on the outer end, so that when both the carriages are not in use for sliding the shafting, one can be employed in conjunction with the headstock as a face lathe. The same firm has in hand a drilling and tapping machine for pipe sockets up to 4½ in. diameter, in which double guide screws, with the same pitch as the taps, are introduced on the top frames to insure accuracy in the tapping, while a foot treadle is provided to assist the workmen in lifting the taps out of the sockets; also a milling machine for grooving locomotive coupling rods, constructed for operating upon two rods simultaneously, each cutter removing 3 in. by $\frac{9}{16}$ in. at one operation. In this machine the cutters are brought down to the required depth, then a longitudinal feed motion is put on which traverses to the length required, leaving the groove-ends with a good radial finish. This motion is also adapted for general purposes, and the machine, which is powerfully geared, is 10 ft. long and 3 ft. between the standards.

* * *

The Cleveland Twist Drill is a great success. The company write us that they have more orders on hand than they can fill. This does not mean they will not fill all that are sent, however!

* * *

Persons using compressed air as a motive power, will find the catalogue issued by Grayon & Denton Mfg. Co., Jersey City, N. J., of great value to them. It contains a large amount of valuable information in this line.

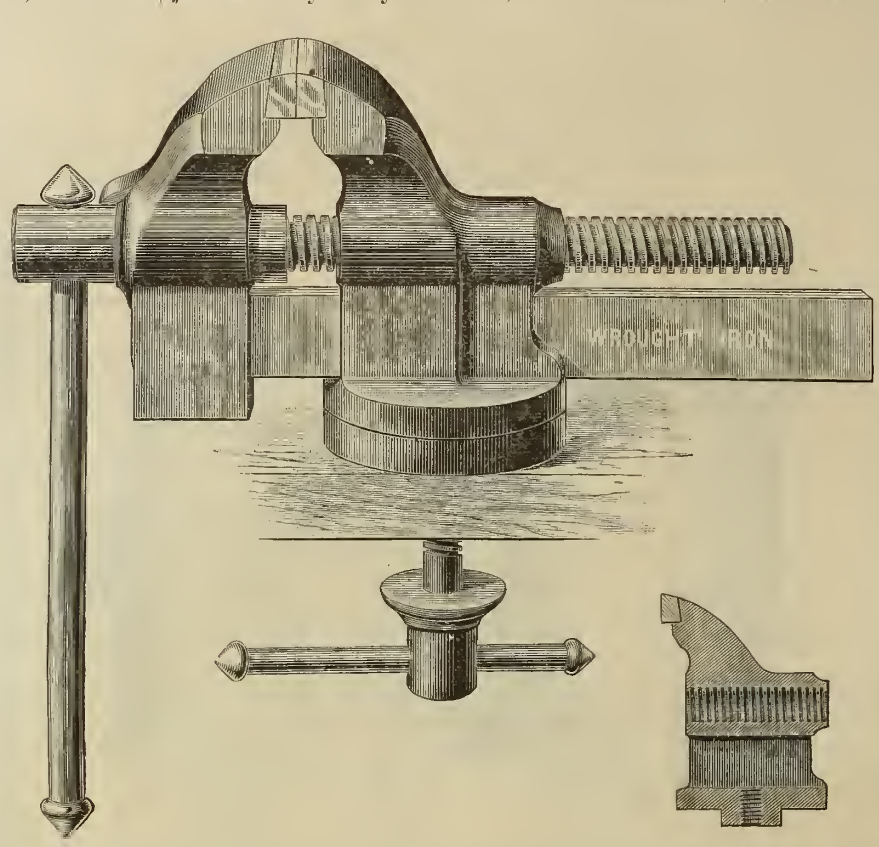
* * *

John Becker, 28 Oliver street, Boston, makes a specialty of name plates of superior quality. He has issued a calendar and attached a sample of his work to it, the result being a marked increase in orders.

A. L. Wright, Lowell, Mass., has put in a new boiler and engine and about doubled his capacity. He is getting out patterns for 16, 17, 22 and 24-inch lathes.

The *Chemiker Zeitung* quotes from a German journal devoted to the sugar industry, an advertisement asking for the services of an "academically educated chemist, fully acquainted with the manufacture of sugar, who can undertake in summer the coppersmith's work, or the oversight of the teams of draught oxen." This is a little worse than an American ironmaster, who wanted a chemist capable of keeping a watch on his phosphorus and teaching the cornet for laborer's wages.—*Engineer.*

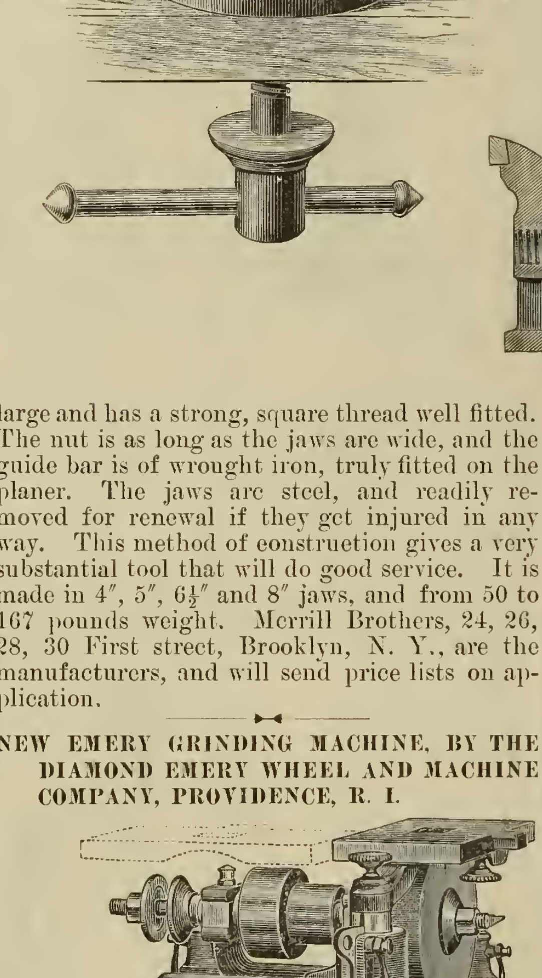
MERRILL'S NEW PARALLEL SWIVEL VISE.



Our engraving represents a new vise for bench work, which has some excellent features about it, not the least of which is its solidity. As may be seen from the engraving, it is very substantial and well fitted to stand hard and heavy work. It is of the parallel, swiveling type, found so convenient for general purposes; the jaws are very heavy and solid, and the screw is large and has a strong, square thread well fitted. The nut is as long as the jaws are wide, and the guide bar is of wrought iron, truly fitted on the planer. The jaws are steel, and readily removed for renewal if they get injured in any way. This method of construction gives a very substantial tool that will do good service. It is made in 4″, 5″, 6½″ and 8″ jaws, and from 50 to 167 pounds weight. Merrill Brothers, 24, 26, 28, 30 First street, Brooklyn, N. Y., are the manufacturers, and will send price lists on application.

* * *

NEW EMERY GRINDING MACHINE, BY THE DIAMOND EMERY WHEEL AND MACHINE COMPANY, PROVIDENCE, R. I.



The machine shown in the accompanying engraving has been constructed with the view of furnishing to mechanics and manufacturers a tool that will grind metal surfaces straight and true, that heretofore were done on a planer or milling machine. It is claimed that this machine, which is accurately built and provided with new improvements for the purpose designed, will do a large range of work that cannot be as well, or economically done by filing, or by more expensive tools.

Figure 1 shows a No. 6 grinding machine, with surface table attachment over the wheel. It has fastened to the arms a new design (patent applied for), of table attachment for surface work, with facilities adapted to grinding dies, or any work required to be straight. A certain class of work done upon the planer, milling machine, or with files, can be placed upon this tool and done at small cost.

The machine is designed to use wheels 16 inches in diameter, but the attachment will admit of using any thickness of emery wheel, from ½ to 3 inches, by an arrangement, leaving no open space either side of the wheel.

The iron table has a corrugated surface, into which the emery dust falls and is led from the machine. This device always gives a true surface, free from dust, to work upon.

The screw and nut by which the table is raised from, or brought to the emery wheel, is entirely inclosed in the hollow spindle of the casting, thus wholly excluding the emery dust.

The hollow cast iron spindle to which the surface table is fastened is fitted to the stand that receives it, enabling it to revolve and be turned away from the emery wheel when not in use. To turn it out of the way the table must be raised by the screw to clear the wheel, the latch shown having a spring attached (which is in the groove cut to receive it) pulled away, and the screw holding it in place eased up, when it may be revolved around to any position. To replace it over the wheel, swing the table back, the spring latch meets the groove cut to receive it, bringing and holding it in its proper place. Prices furnished upon application.

* * *

Many persons have puzzled over the diagram in the last issue entitled "An Apparent Paradox," without result, some readers, however, have correctly solved it. The "missing inch" is all in the second figure, or square formed by the dismembered portions, but it is in fractional parts of an inch, and liable to be overlooked by hasty measurers. It is a good example of the ease with which a large amount of space can be lost by neglecting infinitesimal parts, and as such is useful to workmen as a reminder to be careful.

* * *

The Ferracute Machine Company, of Bridgeton, N. J., have sent us a handsome catalogue of their manufactures, which are chiefly presses, dies, etc., for sheet-metal goods. In addition to its list of prices it contains a great deal of information in its specialty, which will be found interesting to the class to whom it is addressed.

* * *

A correspondent of a contemporary gives this rule for finding the length of a belt to connect two shafts having unequal pulleys: Add the diameter of the two pulleys together, divide the result by two and multiply by 3¼. Add the product to twice the distance between the centers of shafts, and you have the length required.

Yes; while you are measuring the distance between centers of shafts, you might just as well throw a tape line over the pulleys, and get the length at once, without any adding or dividing.

* * *

A contemporary says: "Professor Blank's lecture on *The Growth of the Locomotive Engine*, deserves more than the mere mention made of it. His treatment of it was such as to make it interesting to all. The Professor's appreciation of the humorous side of things, and his original way of putting them, would make even the metallurgy of lead enjoyable.

The subject is certainly distinctly humorous.—Eds.

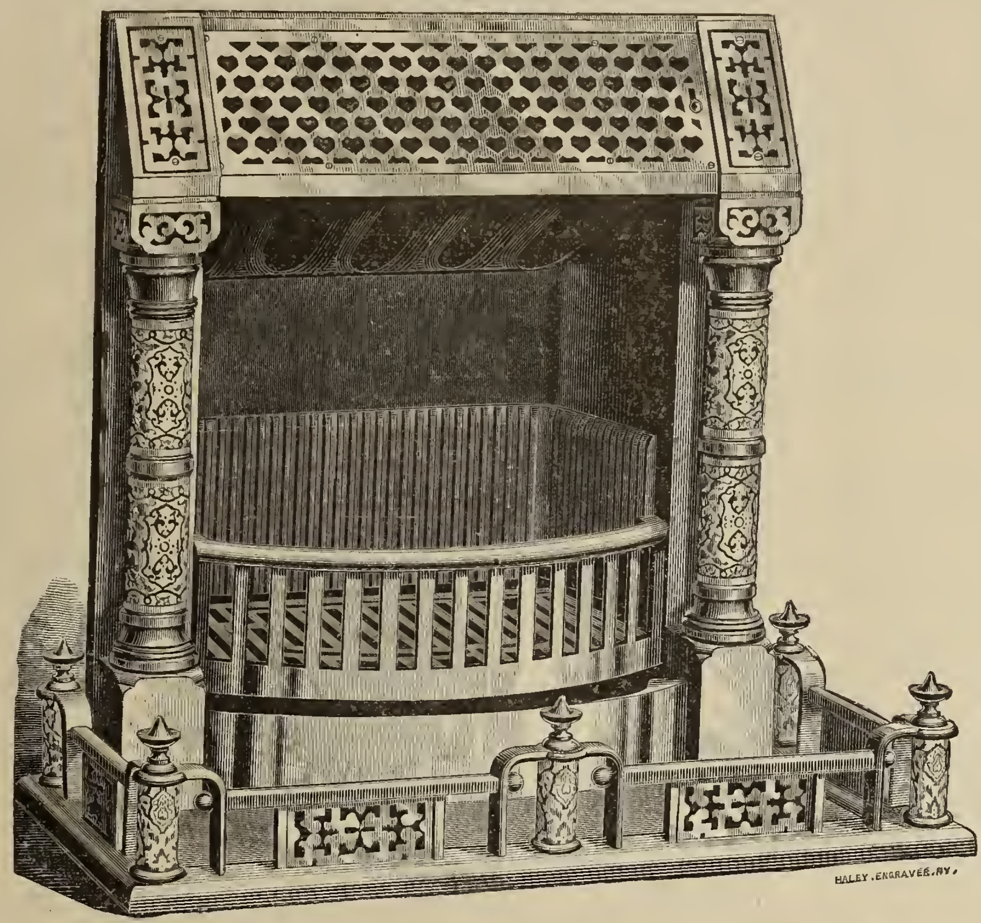
AN OPEN FIRE-PLACE AND HEATER.

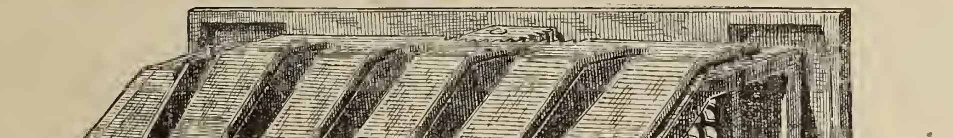
Although the season for open fires is rapidly departing from this latitude, we deem it not inappropriate to present here an engraving of a grate for this purpose, which has some new features, and is, moreover, a very beautiful piece of workmanship of its class. At this season also, we have vividly in mind the defects of whatever apparatus has been in use during the past winter, and are in a frame of mind to appreciate something better; often the only warmth derived from stoves is that entailed by the physical exercise necessary to keep them going. Regarding this grate the manufacturers say:

"In the ordinary grate no provision is made for introducing fresh air into the room to supply the place of that exhausted through the flue, hence *cold* and often impure air is drawn in through crevices about the windows and around the doors, causing draughts, and chilling the air of the room. With this grate the room is kept constantly filled with pure, warm air, in every sense conducive to health and comfort; its atmosphere is kept at an equable temperature in all its parts, and a very large percentage of the heat that is usually lost in the brick-work of the fire-place, and which is equal to nearly three times that of the direct radiation of the ordinary grate, is arrested and utilized by its addition to the radiant heat of the grate. See sectional view below.

"This shows the construction of the heat-saving chambers in the Jackson fire-place, the outer shell being in part broken away. Pure air from outdoors is admitted through the opening shown in the base of the cut, and is distributed by the heated spurs there represented, to the chambers directly back of, and on the sides of the fire. From these chambers the now partially-heated air enters the chamber shown at the top of the cut, through which the four smoke flues pass. These also imparting a large portion of their heat to the passing current, its temperature is raised to 150° or 200° (according to the intensity of the fire), and it now sends a volume of pure air either directly into the room through the opening shown in the frieze of the grate, or, at the option of the owner, up the pipe (a section of which is shown in the cut with its valve opened) to a room on the floor above. In these chambers there are 15⅔ square feet of radiating surface. The chambers are separated from the fire by a cast iron shell that has no joints for leaking gas. The upper chamber, with its tubes, being cast solid, in one piece, and this shell, surrounded as it is by air chambers, can never become intensely heated, and thus liable to burn out. The grate will accomplish as much heating as three ordinary grates; will thoroughly heat large rooms, and will ventilate them perfectly."

We think these positions well taken. Edwin A. Jackson & Bros., 77 Beekman street, New York, are the manufacturers.


HALEY. ENGRAVER, N.Y.



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A party who tested glue melted with skim milk instead of water, says it is a humbug, and not so good as that made in the ordinary way. It was asserted that skim milk made a water-proof cement out of common glue!

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The amount of light given out by a gas flame depends upon the temperature to which the particles of solid carbon in the flame are raised, and Dr. Tyndall has shown that of the radiant energy set up in such a flame, only the $\frac{1}{25}$th part is luminous; the hot products of combustion carry off at least four times as much energy as is radiated, so that not more than one-hundredth part of the heat evolved in combustion is converted into light.

GAS IN A PISTON.

A correspondent of *Engineering* writes as follows:

"A very curious incident took place on board one of the steamers of the Wilson Line. A workman was employed doing some repairs to a low pressure piston, and happened to break one of the junk-ring studs, and of course had to drill the broken end out. After getting a hole through the stump of the stud and chipping the remaining part of the screw out, the man took a lamp to see if he had injured the thread in the hole, and immediately an explosion of gas occurred, the flame rushing with great violence from the hole, stunning the man and slightly burning his face and singeing his eyelids.

I may add that there was not the least chance of any paraffine or other inflammable oil getting near the plaee where the explosion took place."

If mineral oil was used for lubricating the cylinders it might, perhaps, be a cause.

As the spring advances our readers should not forget to beautify their homes. Where there are facilities for gardening, a flower-plot is an agreeable relaxation from the sterner cares of life, and to the children it is a means of cultivation and refinement. Those who have not already done so should send for Vick's catalogue of seeds and plants, it contains many valuable hints for the successful cultivation of them. Address James Vick, Rochester, New York.

An engineer, friend of our earlier days, recently favored us with a personal visit, and was kind enough to say that one ground of his liking for our paper was its hostility to humbugs. "Never a one raises its head anywhere but it catches a crack right on top of it," was his expression.

It strikes us that he has some ground for his views!

What may be called a feat of endurance was recently performed in this city by the Armington and Sims engine, used for driving an electro-dynamo. It ran 17 days at 350 revolutions per minute without stopping during that time.

The firm of Kelly and Ludwig, of Philadelphia, Pa., dealers in engineers' supplies, dissolved some time since, and Mr. Daniel Kelly, a former member, succeeds to the business at 49 North 7th St., Philadelphia.

The amount of water present in freshly cut wood is very different, as is shown by the following table by Scheubler and Hartig:

Hornbeam contains 18·6 per cent. of water, willow, 26·0 per cent., ash, 28·7 per cent., birch, 30·8 per cent., oak, 34·7 per cent., pine, 39·7 per cent., red beech, 39·7 per cent., elm 44·5 per cent., larch, 48·6 per cent. and white poplar, 50·6 per cent.

Wood when dried at 266 F., at which temperature all of the hygroscopic water is expelled, is composed of 50 parts carbon (inclusive of one part of ash), and 50 parts of chemically combined water.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise. we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

AN INTERESTING LETTER.

Editors Mechanical Engineer:

In looking over your paper of April 14th, 1883, I read your "Notice" carefully, of the discontinuance of the stock company. This pleased me more than anything I have read in your paper for a long time. I have seen some very good things in your paper, and have benefited a great deal from some articles read in it, and this announcement gives me the impression that we engineers will have at last *one* paper we can rely upon for both sides of a question; and if there is anything I can do to assist, in the interest of engineers, I am at your service at any time.

I have made up one club for your paper, and will shortly have another one full; and I would state that the Keystone Council of Engineers have adopted your paper as their advertising medium, and we shall advocate the same to all other societies.

Mr. Editor, in reading your article on "Bearings of Compound Engines," page 90, cur. vol., and the reasoning to account for the unequal wear of them, allow me to mention a few facts which are not known to engineers in general.

First: There is but one side of a journal in a steam engine that wears oval, and one side of a crank pin. This is due to the thrust always being in the same direction, and at one point on bearing. As the shaft follows the crank, the piston being on the pull or the push, there is but one side of the crank pin and shaft receiving the thrust. As it is my business to overhaul engines, indicating engines, setting valves, and lining engines, I have, on several occasions, had to take out the shaft and true it up, and put new crank pins in before the engine could be put in any respectable repair, from this cause alone. I have an engine at the present time (a 24x48 Corliss) which I am going to take the shaft out of, for no other purpose than to true it up. The engine has been running about 13 years. The shaft is 3-16 of an inch out of round—flattened on one side.

The reason or cause for the flattening is particles of grit, or dirt, getting pounded or forced into the soft metal; these act as little cutters on the harder metal, on the same principle as a lead wheel with emery and wax, or emery and oil will cut the hardest piece of steel, without affecting the lead. The softest metal in a journal, or box, will receive dirt and wear the hardest metal away. For this reason alone, all journal boxes should be harder than the journal, for the boxes are easier to repair than the journals and less expensive.

Flattening of the shaft always occurs with babbitted boxes, and all others which are softer than the shaft. A box that is harder than the iron of the shaft will wear away, while the shaft will remain round. Soft metal in journal boxes tends to flatten the shaft very rapidly, particularly so in engines working expansively, and especially so when the valves are late. Shafts sometimes become high in the center of bearings, from the boxes being too light, or not having bearings in the center of the pedestals, and of course spring in the pedestals, allowing each end of the journal to receive the most thrust.

Now, Mr. Editor, if you will allow me to ventilate the subject of indicator cards, the handling of the indicator, and the detection of "doctored" cards, I will give my word I will not display any "doctored" material, nor will I represent any cards with the back pressure line running on the atmospheric line, and a straight steam line, and call it a correct card—*vide* a contemporary in your city. I will not send you any cards, representing them as beautiful, with over 50 per cent. of leak in them, and then make a statement that they are going to bore out the valve chambers, put in new valves and piston, after which they will show us some cards!

Neither will I try to teach your readers how to calculate the cards by subtracting the back pressure above the atmospheric, from the mean effective indicated pressure, and tell them it is the correct way to calculate the horse power developed by an indicator; and I have not had "20 years' experience with an indicator," either. Mr. Editor, I don't know a great deal. and I am willing to learn. What I do know I am willing to impart to those that don't know, as it is only by comparing notes that we become intelligent on this very important subject of steam engineering. I would like to say more on this subject, and with your permission I will on another occasion.

N. W. Williames.

President of Keystone Council, No. 1, Stationary Engineers of Penna., Branch of National Stationary Engineers Assoc'n.

Philadelphia, Pa.

[We shall always be glad to hear from Mr. Williames, especially when he has so much to say that is interesting to our readers. As to other matters alluded to in his communication, which appear to have a bearing on articles in other papers, which our readers may not have seen, we can only say that this department of The Mechanical Engineer is always open to parties to express their views in their own way. We do not accuse our correspondents of duplicity or double dealing, and have always observed the principle to treat all men honorably until they proved to be untrustworthy.

Correspondents may rely upon an honest representation. We have no hobbies to ride, neither do we intimate that every one who holds views different from ours is an ass!—Eds.]

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LAST OF THE CYLINDER-HEAD QUESTION.

Editors Mechanical Engineer:

As the subject, "Stress on Cylinder-head Bolts," has received so much attention and occupied so much space in your paper, I am inclined to think that you are ready to cry "hold! enough!" But as Mr. Sperry has a question in your issue of March 17th he wishes answered, I venture to intrude once more, but will promise not to come again upon that subject. I am gratified to see that you have correspondents that are capable of treating the subject much more ably than myself.

The article and illustration by "Triangle" I think cannot be improved upon. But to Mr. Sperry's question:

Let us suppose that we have a cylinder-head fitted with a ground joint, so that when placed in position it will remain simply by atmospheric pressure, equal to 14 7-10ths pounds to the inch. Let us further imagine that the area of the cylinder flange equals the area of the piston. If steam be admitted to the cylinder to the amount, of say ten pounds by the steam gauge, will the head leave the cylinder in the least? I think not, as there is still a surplus of four and one-half pounds, which will make just as good a joint as before, and the pressure can be raised until a trifle in excess of the atmospheric pressure before the distance between the flange and head will be increased.

If your correspondents who criticised Prof. Marks will read his article carefully I think they will see that they misconstrue his meaning.

In conclusion, allow me to make a statement with regard to a peculiarity of valve movement, which I think is common to all engines using a connecting rod, and worked by the ordinary slide-valve, and which I think will not be gainsayed by any one familiar with the mathematics of the subject.

If a valve is set so as to take steam evenly for both strokes, the cut-off will *not* take place at the same distance from the beginning of both strokes, varying materially, according to the size of the engine. I have never seen an explanation of this. Will you, or some of your correspondents, give the reason why?

Ravenna, Ohio. W. M. Chapman.

[In his last question our correspondent has introduced rather an abstruse subject, which it is difficult to state tersely here, involving, as it does, some knowledge of geometry and the higher mathematics to understand the explanation. Briefly, the cause of irregular action is due to the angle of the connecting rod. and the variation in different engines. of the times of cut-off, is owing to the varying proportions of connecting rods, with reference to the piston strokes of said engines. This matter is most ably treated in "Auchincloss on the Slide-valve and Link Motion;" the work is elaborate in all its considerations of the subject, and no engineer should be without it. Some portions of it are intricate to those who have never given the matter attention. but this is a very good reason for studying it.—Eds.]

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HOW TO ACT IN AN EMERGENCY.

Editors Mechanical Engineer:

On attempting to shut down the engine at noon, I found I could not do so, by the stop-valve on the engine. I had to run to the boiler and use the stop-valve on it; it took three minutes to stop by this method.

During the dinner hour I took the valve apart, and found that the rubber disc had broken, leaving only a small portion under the nut which secures the disc to the stem; of course it was easily renewed, as I had a few extra discs on hand. The one that broke had been in use over two years, and was perfectly steam tight till it broke. I never got caught like this before.

There is nothing extraordinary in this breakage, only it set me thinking. Now suppose that the governor on a large engine (one of 350 horse-power with a 24-foot fly-wheel, like one I saw a few weeks ago) got out of order, and allowed the engine to run away, and that the engineer tried to stop but found the valve was broken; before he could get round to the boiler to shut off steam by the stop-valve the engine would have increased in speed and probably be a wreck. Of course all engine stop-valves are not made with composition discs. I like them better than the ordinary globe-valves with metal seats, which I never could grind successfully, while with the others, new discs can be put in if the valve leaks; but let the disc go, here is another case.

I had the care of a 25 horse-power engine in Canada at one time, and on going to shut down once, the hand-wheel slipped on the valve spindle, the key having worked out, as I could not find it, I threw off the governor belt and quickly raised the balls, thus stopping the engine.

A person might think that being unable to stop an engine was of little account, but is it? Not only is there danger of wrecking the engine, but the machinery in the shop. A sudden increase of speed means great danger. Only a few days ago I read an account of an engine running away, and a number of grindstones were burst by it and several workmen killed.

Would it not be a good plan besides having a stop-valve on the boilers (which are often a good distance from the engine-room) to have two valves on the steam-pipe, close to the engine, so in case one failed, as mine did, the other could be used. I know it is objectionable to have a tortuous steam-pipe, but why not put in a couple of gate-valves?

I wish engineers would give their experience in such matters; they may think it will not interest others, but I know it will.

Walter Burdekin.

STRESS ON CYLINDER-HEAD BOLTS.

Editors Mechanical Engineer:

A safety-valve can be used to illustrate the stress on cylinder bolts. It is true that the weight of ball, multiplied by length of long arm of lever. is equal to area of valve multiplied by steam pressure, and by length of short arm of lever, less the product of weight of valve and stem, multiplied by length of short arm of lever, and the product of weight of long arm of lever multiplied by half its length.

This is applicable to the top cylinder head of an upright engine, the head being held down by a lever and balls instead of bolts. Make a calculation with a steam pressure of 90 pounds to square inch on cylinder head. It is evident that the cylinder-head will not lift up until the pressure in cylinder is equal to that which holds it down. Put a spring balance on end of lever instead of a ball, screw it down until it is equal to weight of ball, and let steam into the cylinder. There will be no more strain on the spring at 80 pound pressure than there will be if no steam is on. Suppose there is more strain on spring when steam is on, how would a *ball* hold the lever down until the pressure is reached, for which the calculation is made? The ball can't get heavier.

Kentucky. R. L. S.

[This question, first propounded by Prof. W. D. Marks, casually, in a series—"Talks on the Steam Engine"—has excited wide discussion and interest, and in so far as it has turned thought into a new channel, has great value. We think, however, that our friends have given the subject all the attention it needs; let some one start another similar. It is greatly to the credit of working engineers that they have written so clearly upon it.—Eds.]

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A LAND OF DARKNESS.

Editors Mechanical Engineer:

Your valuable paper comes regularly to hand once a fortnight, and is read with great interest. If I am not an intruder I would like to sketch the situation here, as regards engineering. In this part of the world we have no boiler inspector, and therefore every (supposed) engineer has to judge for himself as to the safety of his apparatus. Doubtless your own long experience tells you that many great risks are run.

This part of the country is filled up with so-called "self-made men," who think that a man who reads mechanical papers and books is a dangerous person to have around! So he is, unless he has had some practical experience, but with study and practice all things are possible!

There are all kinds of engines here, and many of them are badly managed, as you can imagine when I tell you that there is not an indicator in the place, and but few who would know one if they saw it. Steam users will not pay first-class engineers, and the man who will take the chances for the least money is the one who pulls through the work.

I wish we had an engineers' society here to bring us together and help support our interests! In another letter I will give you details of some fearful accidents which have happened here.

Chico, Cal. W. D. L.

[Our correspondent should endeavor to get his friends' interest enlisted and start a society of engineers himself. Write to A. M. Davy, Secretary, 175 Elmwood avenue, Detroit, Mich., for particulars.—Eds.]

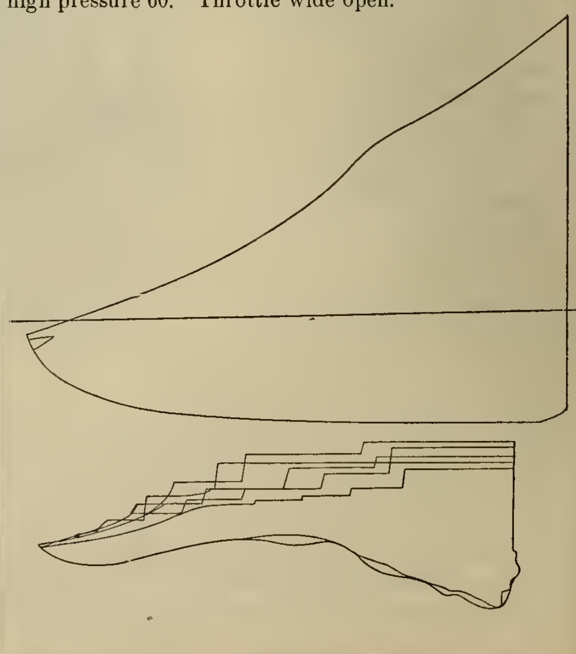
◆

VERY PECULIAR CARDS FROM A COMPOUND ENGINE.

Editors Mechanical Engineer:

Please find with this a pair of cards from a small compound engine which has been doing hard work for three years without having been repaired. The piston and valves have never had a drop of lubrication, (other than the steam) of any kind.

The details of the card are here appended. High pressure 7¼"×15", l.p. 15"×15"; cut off in h.p. ½ stroke, do. do. low pressure; revolutions 110; boiler pressure 90 lbs.; scale of low pressure diagram 20; of high pressure 60. Throttle wide open.



The low pressure is good enough, but the high pressure shows five diagrams, all of which have the exhaust line very nearly alike. The steam line, however, shows great differences in each.

In regard to the indicator with which these cards were taken, I will say that I changed the instruments and also the springs. I cleaned both instruments thoroughly, but could not get any better exhibit than these sent.

I shall be glad to have you, or some of your readers say what, in their opinion, causes this irregular action of the pencil. For my own part, I can see but one reason, and that is unequal expansion between the piston and cylinder. The latter being more exposed to the action of the atmosphere does not expand so much as the piston, which causes the latter to stop a moment; as the pressure diminishes it will drop and stop again. I am led to believe that expansion has something to do with it, from the fact that at 85 pounds pressure the steam line is better. At 75 pounds I could not notice any irregularity of the pencil. The engineer in charge is an old and careful man, and he says the piston and valves are in good condition, which also strengthens my opinion. Right or wrong, I would like opinions.

Troy, N. Y. Caution.

[We shall be glad to publish correspondents' views upon these cards, which are certainly peculiar in the high pressure cylinder. Perhaps the engineer may be in error as to the piston being in good condition.—Eds.]

FEED PIPE CONNECTIONS.

Editors Mechanical Engineer:

As there has been a good deal said about the best way to pipe the feed to boilers, allow me to mention my plan. I have been running boilers and engines for fourteen years, and I think the best way is to run the feed in at the front end of the tube-sheet, and connect the blow-off in the center of the shell on the bottom, about 8 inches from the back end. The boilers should incline a full inch toward the back end, then, as the dirt settles in the quietest place, it can be blown out.

During fourteen years experience, I have never had an accident, nor a single break-down. I always have things repaired as soon as possible. I do not say "it will go awhile longer," I believe in the motto: "Eternal vigilance is the price of safety." I have been a constant reader of your valuable paper since your first issue.

Haverhill, Mass. A. W. Simonds.

[Our friend is fortunate in having his own way in repairs. Too many of us can tell of other experiences. Twenty-five years ago, we ran an Adams press in a newspaper office. The whole affair had become so shaky that we brought the proprietors to see the condition of things, and declared we would not run it for another issue. "Don't you think you can run off another issue," said one of the proprietors, and before the words were out of his mouth, the roller frame caught in the ways, and in its headlong flight over the form, smashed a whole page of type, and took everything else it could get hold of, in its haste, along with it.

"There's your answer," was all we said. Some proprietors are so "penny wise and pound foolish" that they stand in their own light.

In engineering matters "an ounce of prevention is worth a pound of cure." We shall be glad to have Mr. Simonds give us some more of his experience. In 14 years a man can acquire a great deal.—Eds.]

THE MECHANICAL ENGINEER NOT WANTED WEEKLY.

Editors Mechanical Engineer :

In The Mechanical Engineer of March 31st I was glad to read a paragraph rather opposing a weekly issue, and I say amen to it. Some of my reasons are that it just *gluts* a mechanic, or in other words, he can find but little time for other reading matter, and a mechanic certainly ought to read up *some* of the political situation of his country. Still more, he certainly ought to have more or less religious reading, and have some time for good, profitable books. Fortnightly for a mechanical paper is, in my opinion, as often as it should appear, to be profitable for its readers, and for a price that its proprietors can give a first-class paper. The ——— ——— I stopped on account of its becoming a weekly; it was a good paper, but there was too much of it. The Mechanical Engineer, as it now is, is a tip-top mechanical paper, but if it becomes a weekly I rather think I shall have to cross it off, as it will use up too much of my spare time for reading.

I hope mechanics through the country will give expression of their views, as regards a weekly mechanical paper, in your columns. Again I will say I like the paper as it now is, very much.

Sedalia, Missouri. L. O. Chapin.

[There are two sides to all questions, and it may be that others think differently. We can only say that the announcement of the weekly edition which we intended to publish made no perceptible difference in the regular subscription receipts, nor did any great number express their satisfaction at it. Mr. Chapin adduces good reasons for his views, and we shall be glad to hear both sides.—Eds.]

ABOUT VALVES AND SETTING THEM.

Editors Mechanical Engineer :

Seeing your answer to Mr. Marshall about piston-rings, I would like to have you decide this question; a shop-mate and myself cannot agree upon it. He says that if an eccentric is not set exactly right on the shaft that he can set the valve all right by simply lengthening or shortening the stem. Of course he means a trifle one way or the other.

I claim that it is not so. I believe, I may say I *know*, without giving offence, I hope, to Mr. Moulton, who exposed that fraud so well in his last article about "The Professor in the Machine Shop;" that no valve can be set in this way. I say a valve is set from the eccentric, and not from the valve itself. Will you please say which of us is right?

Brooklyn, N. Y. L Tapman.

[You are right. Correcting a valve in the way your shop-mate mentions is wrong, for the reason that it simply opens one port more than the other in one complete revolution of the shaft. Consequently the steam is cut off sooner on one end of the cylinder than the other. The eccentric has a positive position on the shaft, with reference to the crank-pin; in any other place it is out of time.—Eds.]

THE INDICATOR.

Editors Mechanical Engineer:

Seeing the letter to A. M. Davy in your issue of March 31st concerning indicators, I think I can beat it. The incident I relate happened in a large city about six years ago. I was cleaning my instrument, when the proprietor of a large machine shop came in, who had built in twenty years more than 100 engines. Some of which would work up to 500 horse-power. This person asked me what sort of a thing it was I had in my hand! You may suppose I was thunderstruck at such a question from the head of a large firm. That firm exists no longer, however, it was too fossilized to live in this enlightened age.

Another similar incident happened but two years ago. A steamboat engineer of over twenty-five years' experience asked me the same question, and wanted to know if it was not a new invention. He ought to be excused, however, for he can't write his name.

"Improvement."

HE HAS BEEN THERE HIMSELF!

Editors Mechanical Engineer :

I want to say that your article in The Mechanical Engineer (No. 8), just received, braced me up and did me $5 worth of good, and I am sorry the $5 is not inclosed.

I refer to "Notice" and "System," page 90. Please accept my congratulations on getting the best of these "system" duffers, and other galoots (excuse French)! I have been having some of this system business myself, and only wish I had half the sand in my gizzard that you must have had to beat 'em!

The close of the article on system makes me think of the time when the main gas-pipe got "busted" in a certain big shop in Stamford, and the man that had charge of that pipe didn't get round that way for half a day. No one dared go after him, or touch the pipe, either!

34 Beach St., Boston. W. L. C.

["A fellow feeling makes us wondrous kind!"—Eds.]

FROM A PATTERN-MAKER AND DRAUGHTSMAN

Editors Mechanical Engineer:

Allow me to congratulate you on the independent stand you take in publishing articles on various subjects. Too many mechanical papers in this country are, apparently, in the interest of some ring or other, —advertising or patent,—who use them for their own benefit.

Being a draughtsman, I am much pleased with your illustrations, which are generally excellent; and being a pattern-maker by trade, I thoroughly appreciate the series on that subject. It is correct in all its teachings, and evidently by a master workman. The mechanical drawing series are really—without flattery—the most instructive I have ever read. "The Professor in the Machine Shop" seems to be the most practical man (for a Professor) I ever heard of! The series on "Dies and Die Sinking" is also very instructive; and being a matter I knew nothing of before, is doubly valuable. The Mechanical Engineer is certainly *the* paper.

Galt, Ont. Accuracy.

Extracts from Chordals Letters.

New and enlarged edition, with new illustrations. John Wiley & Son, New York.

These letters relate chiefly to machine shop life and all that concerns and interests machinists. The style is graphic and terse, full of force and point; and suggestions as to work, and how to do it, abound. The matter was originally contributed to the *American Machinist*, but is deemed worthy of preservation in book form.

Cameron's Plasterers' Manual.

Revised edition containing accurate descriptions of tools and materials used in plastering; appearance and action of the various limes and cements; instructions for making mortar and doing all kinds of plastering; cistern building, etc., etc. New York; William J. Comstock, 6 Astor Place.

The connection between engineering interests and instructions for plastering is not apparent at first sight, but it will be found that there are many things engineers should know. This little manual contains a great deal with reference to cements and mortars that will be useful to them in laying foundations, etc.

"An essential difference between the highly trained scientific observer and the improperly trained amateur, is this: The first understands that we know nothing of a great many causes save what is taught us by their effects, and that we can never be quite sure that a given effect is produced by a cause which has already produced a somewhat similar effect; while the untrained observer is apt to mistake effects for causes, and to assume that when certain facts have been acquired by observation, enough has been done to enable the nature of the cause which has produced these effects to be ascertained, constantly forgetting that the addition of one more fact might suffice to show that the assumed cause could either have no existence at all, or that it did not operate in the particular case stated."—*Long Sentence Writer.*

The Worcester Boiler Works recently sent to the Port Gibson Cotton Mills, Port Gibson, Miss., one Victor Heater, and three 100 H. P. Boilers, in connection with other Western orders. They report trade as holding on well for the season.

General business through the Eastern States is still quiet, but with some, things are taking an upward turn.

Messrs. Boynton & Plummer, manufacturers of horizontal self-feeding drills, Worcester, have just moved from their old quarters, to a building put up for them on Lagrange street, facing the South Worcester depot.

They are putting in facilities for turning out machines in a quicker and more systematic manner than they have been able to heretofore, and at present are making machines for stock, in order to supply all demands at once.

A writer in the *Mechanical World* says this: For patterns which have to be repeatedly molded in damp sand it is advantageous to mix with the glue some good thin drying oil in the proportion of about one of oil to four or five of water. The oil should be added to the glue and well stirred in while it is hot. Glue so made is scarcely affected by moisture and makes a good sound joint, although it is not quite so strong as glue mixed in the ordinary way. Good glue should be clear, transparent, and of a light brown color, and the best way to make it up is to break it into small pieces and soak it for twelve hours or so in as much water as will cover it, and melt it in an ordinary glue-pot, letting it simmer gently for one or two hours. As I have assumed that the glue was required for pattern-making, I should state that it is always advisable—no matter what kind of glue is made use of—in order to thoroughly protect the patterns from moisture, to coat them with good oil paint.

A new English Steamer the *Fulda*, 5,124 tons burden, recently made on her trial trip $20\frac{1}{4}$ miles per hour. On another occasion she made $20\frac{3}{4}$ miles for six hours against the tide! all of which is a good story for the mariners.

Scannell & Wholly, boiler makers, Lowell, Mass., will probably erect a new shop about 60 × 100 feet in size this spring. Among recent jobs turned out by them are a large penstock for the West Warren Cotton Company, fire escapes for the Hamilton mills, sheet metal work for the City of Lowell, and boilers for various parts.

The Hewes & Philips Iron Works, of Newark, N. J., are building for the Dixon Manufacturing Co., of Scranton, Pa., a planer which is to weigh when finished, 180,000 lbs. The table is 27 feet long, and 10 feet wide. Four tools can be used at once, two being on the cross-head, and one on each stanchion. It has an independant feed, by power or hand.

In England shafting of small size, say $1\frac{1}{2}$ inches to 4 inches, is turned exact to size with great rapidity, to wit: 18 feet per hour for the first size, and $6\frac{1}{2}$ feet per hour for the latter. How fast is it turned in this country?

THE
Mechanical Engineer.
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

A NEW DEPARTURE IN THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

From a conversation in this office a short time since, with a leading official of *The American Society of Mechanical Engineers*, we have reason to believe that a policy in marked contrast to that which has obtained in the past will be pursued in its future direction. In lieu of abstract propositions and mathematical diversions of a mechanical nature, papers of a more strictly utilitarian character will be requested from members. These latter will be selected for their special bearing upon the work of to-day, and with a single eye to the general enlightenment of the average mechanical engineer. This latter term is by no means one of reproach, or one that implies a want of ability. It must be borne in mind that there are many men in responsible positions who fill them with honor and credit to themselves. These men have had no collegiate education, or any education, save that which they have acquired through personal application after hours, and by directly engaging in making engines and machines in general. To such (and to others who have had finished educations, for that matter) the sight of a black-board covered with unfamiliar characters, embodying radical propositions, is aggravating to a degree not to be here expressed, and they signify their dislike by inattention to them. Intricate problems, which have taken the demonstrator himself weeks to prepare, have no place in an informal meeting of working mechanical engineers, and are so wholly unpopular—may we not say out of place—that we are glad to learn that the committee upon selection of papers will hereafter discourage their production. In lieu of them we are given to understand that popular papers, upon details in the profession at large, will have precedence; papers which will call out the practical experience of members present and elicit discussion.

This, as briefly as it can be put, is a synopsis of the views of the gentleman mentioned previously; and that the members of the society will coincide with it, seems to us most probable. It is perhaps natural for gentlemen of high attainments to wish the discussion of theories and advanced ideas, but these are the minority; the workers, those who carry on the business of the day, want to know the current practice, in all sections of the country, on matters of adjustment or on detail, rather than abstract discussions of moot points. After these latter are given, the time is inauspicious for assimilation of them. No man, of whatever mental calibre, should jump to a conclusion in mechanical engineering; as for calm deliberation in a throng, and without authorities or books of reference at hand, the thing is impossible.

With this new departure we are sure that the Society will gain greatly in popularity and usefulness, and it is to be hoped that all members who learn of this change for the first time here, will present papers embodying their actual experiences in some particular detail of engineering work. These will, in all cases, have precedence over theses on "The Uncertainties of Instability," for instance.

A CORRECTION.

In our last issue we stated that the present Chief Engineer of the Philadelphia Water Department was, to the best of our information, not a professional man. Since that writing we have better information, and our advices say that "Col. Ludlow, the incumbent, has a long and excellent record of service in the United States Engineering Corps, and his ability has been shown in several important works in the vicinity of Philadelphia."

We make the correction with pleasure, and will thank correspondents who advise us of any misstatement of facts which may appear in our paper.

BUILDING IMPRACTICAL MACHINES.

Not long since, while we were in an Eastern machine shop upon a tour of inspection, a young man came up to the proprietor and objected to some correspondence that had passed between him and the firm. This had reference to an invention of his they were endeavoring to work out practically. The complaint was that an unfavorable opinion had been expressed as to the final result of the experiments going on, and this the young man said was no part of the contract—he did not pay for opinions but for work.

In a general way the proprietor, who is himself a first-class mechanic, assented to this view as a legitimate one, "But." said the proprietor to the plaintiff, "you must hear our side. I don't know what our people wrote you, but if it was anything out of the regular course of business the writer will apologize in person, but as to the principle of expressing opinions in regard to experimental machines you must look at another aspect. In the course of a year—and for many years past—we have had all sorts of inventions brought to us to work out to perfection, and a great many of them did us no credit at all, either in design or performance. A great many more never came to anything in one way or another, and were abandoned as impracticable after a great deal of time and money had been spent upon them. These latter have increased in number, and have been sources of loss and delay from many points; so much so that we have recently made it a rule to advise inventors and experimenters when, in our opinion, they or we cannot profitably go any further. It seems to us that this is best from every consideration of the subject, for we must be credited with some business sagacity and mechanical experience in the many years we have been established. We have men in here from all parts of the country, who have worked all over the world; furthermore, we are entirely disinterested and free from care or anxiety on the subject of the machine's final success. These things constitute us capable judges, and it ought to be satisfactory to an inventor when he gets the benefit of all this. I don't suppose it is though," said the proprietor. "No man, who is an inventor, ever got an idea in his head to abandon it because some one expressed an unfavorable opinion of it; it only made him stick a little closer to it."

The point made was that as a business regulation the firm felt justified in advising their experimenting friends when they had arrived where it was inexpedient for them, at least, to proceed further, and this rule they intended to observe in the future. It would seem to be a very good one.

CONCERNING CLOSE FITS.

A gentleman who is evidently an admirer of fine workmanship writes to a foreign paper as follows, concerning the workmanship on the Cooper lathe:

> "The fitting of one piece to the other is the *bête noir* of all mechanics who are striving after good, accurate work, cheaply produced, and is so thoroughly got over by the Cooper lathe that I have seen Mr. Cooper unpack goods sent from America in which the several parts were sent loose, yet they were so accurately made that any one—out of many hundreds—would fit any companion part equally well."

We can assure this writer that the statement he makes is true of many other American lathes and machines, and is a matter of course. What is not so common is the workmanship on the chasers of the Pratt and Whitney screw-cutting machines. The cutters (chasers) project from the collet inwardly, like the jaws of a chuck, and are simply flat pieces of steel threaded on the ends in an obvious manner. When any one of these chasers is worn out, or broken, it can be replaced by the company by mail. This does not sound formidable, but machinists will see the point we make, and that is, that on each one of these chasers the thread runs out at some fixed point from the bottom of it. This width so left may be any fraction of an inch, from a sixty-fourth of an inch to a full thread, and that is where the fine work comes in, for the new chaser must be an exact counterpart of the old one. "Fit" has no meaning in this connection, for it is not a question of fits, it must be a *fac simile*. This is done regularly and commercially at the cost of a few cents for each cutter supplied. Commercial work, like this every-day business of the shop, is simply a wonderful achievement, entitled to special mention.

As previously remarked, "fit" is a word which has no special meaning, unless the kind of work and its function is known. A good mechanical fit on the chasers spoken of might be secured, and yet the end would not be attained, the new "teeth" on the new chaser must stand *exactly* where the old ones did or else the thread would be spoiled.

THE HOLDFAST OF A SCREW THREAD.

Some devices that we have seen for joining details of machines together are marvels of ingenuity, complexity, and—may we add—uselessness, for they aimed at substituting some more positive hold-fast than the screw-bolt, and ended by employing the screw-bolt as security for the new device! This is a conclusion, ridiculous in its termination, which might have been avoided by the use of the screw-bolt, pure and simple.

Many years ago we were putting a small screw-propeller on its shaft, and we had it made fast with two composition set-screws, $1\frac{1}{2}$ inches in diameter; one at each end, transversely through the hub. Where the end of the bolt would have entered the shaft we used a steel plug one inch long, slightly coned on the end, taking into counter-sinks on the shaft, the composition set-screws being forced down on top of them.

This was an experimental screw, and had to be removed frequently to allow others to be put on, and facility of removal was a necessity. The idea of using set-screws to hold a propeller on its shaft was ridiculed by some, who said that the wheel would work off in the first mile, but as a matter of fact it never came loose even, with all the backing, and filling, and wringing, and twisting that 100 pounds of steam in a 12″ cylinder could give it. The reason was that the screws fitted—metal and metal. Under such conditions there is no more reliable hold-fast than the screw-bolt, always providing the pitch of the thread is suited to the work required of it.

We hear often, and have often heard, of the unreliability of screw-bolts for permanency of structure, but those who advance such views must have curious work in mind. Slack threads in screws, that is, misfits in plain language, are bad, as any other similar job is, whether in screws or elsewhere, but honest work in them renders the screw-bolt or the set-screw, one of the simplest and surest of hold-fasts.

The locomotive is evidence in point, for it depends upon the integrity of bolts and screws for its very existence. Of course many of these bolts are guarded by split pins, so that if they work loose, even, the fastening is not endangered, but there are no split pins in set-screws which stand up to their work wholly and solely through the honesty of their fitting.

There are no split pins or jam-nuts on the bolts which go through the boiler; the braces, for instances, and which stay there immovably and forever, through all the tremendous rack and strain they have to endure.

When screw-bolts are properly fitted they will hold in any place or position they can be put into.

DIES AND DIE-SINKING.

With one more article this instructive series will close, and we think our readers will sustain us in saying that it has been valuable. No similar matter has ever been published. It is unique, and the author is entitled to great credit. He is a workman employed in a large shop and this is the first essay he has ever made in detailing his experience; his writing has been carried on under great difficulties, after hours, and after a hard day's work, circumstances that do not conduce to fine writing. Nevertheless, he has always been on time with his copy and kept strictly to his agreement. This comment is but simple justice to a deserving man and a good workman. For reasons that are obvious his name is not made public. Some employers have an aversion to men with literary ability, when they should, by all means, encourage it.

NOTICE.

In answer to numerous inquiries as to the identity of the author of "The Professor in the Machine Shop," and asking his address, we are authorized to say that he will be pleased to answer all letters sent to this office for him. For reasons given in Number 4, current volume of the series, he prefers to remain unknown.

GIVE US HARD FACTS.

The very foundation of mechanical engineering is fact, not inference. When we know we can proceed. When we are in doubt we wait for further information. Hard facts are supplied directly from personal experience and actual knowledge, and the men who can furnish it are in the engine-rooms and machine-shops to-day, digging them out. Let us have them from all sources.

You, skillful man at the lathe, can tell your co-workers a great many things they do not know; in return they will contribute of their information, not of their belief.

You, skillful draughtsman, can tell us a great many things derived from your personal experience, seen only by your eye, and all will be greatly benefited, if you will take the opportunity to give this information as soon as possible.

You, careful and conscientious engineer, in your engine-room, and at the sensitive throttle of the surging locomotive, can contribute a great many hard facts, by which mechanical engineers will benefit. The correspondence of our friends forms a most interesting chapter of the works of the world, and we hope all will give it the benefit of their experience. We want all the hard facts there are extant!

THIS IS BUSINESS.

It is the business of a newspaper to furnish news of all kinds, according to its specialty; it is also a directory of trade in its line, and if by reason of being on the spot, or having special information, the publisher can direct his friends where they are likely to get good value for their money, it is his province to do so. We deem no apology needed for the business notices which appear in our columns from time to time, for they are in the interest of our readers. It is hardly necessary to add that they are wholly gratuitous in every sense of the word. They are not prompted, or influenced in any way, save by the quality of the goods themselves. So far as advertising patronage is concerned, we have never considered the connection between the two and never shall. We solicit advertising as part of our business, but we do not agree to mention any line favorably unless it is in the interest of our connection; if an advertiser gets the benefit of it he is entitled to it, and so are our readers.

We notice many movements and enterprises favorably whose promoters never have, and in all probability never will, advertise with us.

Philadelphia friends who write us that they cannot find THE MECHANICAL ENGINEER on news stands in their city can always find it on sale at John Wannamaker's, Chestnut street.

THE PROFESSOR IN THE MACHINE SHOP.—No. XXXI.

The sketches in the last article of Blank's engine moved Lamb's admiration, and also excited him somewhat. for he made a discovery which was a very open secret, and that is he identified me as the writer of this series of articles, for of course he reads THE MECHANICAL ENGINEER. I say "of course," but I hasten to qualify the expression, lest some imagine that he is urged to read it, or, in a manner, expected to. There is no compulsion in this shop of any kind, least of all in matters outside of it. When Lamb saw the narration of the events described in a previous article, he would have been blind not to have identified the writer. Not through the names, for they are of course fictitious, including his own, which is not Lamb, but through the incidents and through the drawings. "Why," said he, "soon as I saw that drawing of the cylinder and the chest we put on it I knew all about it."

"About what?"

"About the job we did."

"It don't require any special smartness to do that, Lamb; most any one knows all about things he has investigated, but this brings me right to a point: how is it you don't know anything about it before it is explained to you? What makes you make such a boggle and fuss over every drawing you get hold of, particularly when they are so plain as ours are, with no dotted lines or cross-sections, but just black lines on white paper, coated with shellac varnish to keep them clean? I can't understand it, except upon the ground that you have had but little experience as yet. Whenever you see a part marked ————5″———— why can't you understand that it means just what it says, and not something that it does not say? You asked me the other day, when you were turning up the body of that connecting-rod, where it was marked ————2″———— if it meant that was to be turned two inches across there. What else could it mean?"

"I thought it meant, maybe, it was forged that size, and it was for the blacksmith to go by."

"Now your imagination ran away with your common sense. You have nothing to suppose in a drawing properly made. It is all on the drawing, if the man that made it knew what he was about; and if you had read what was plainly printed on the top:

MOULTON & HESS,
Bungtown, March 1st, 1883,
Repairs to J. Blank's Engine,
Connecting Rod,
☞Marked Finished Sizes,☜

you would not have had to suppose anything—just read, that's all. When you get a drawing to work from, before you do the first thing, read every line that is written on it. Next thing you do, measure your job and see that every part of it has stock enough to comply with the drawing, otherwise you will spoil your own and somebody else's work. Suppose you had gone to work and squared up the ends of that connecting rod, true to length, and then assumed that the heads were the right length, and gone to turning up the body! When you got to the fillets on the heads you found there wasn't stock enough to clean up, then you would have been in a mess. Always read a drawing all over first, then measure the work to be done from it, then go ahead and work by the figures marked on it. Never put your rule to it. Keep your dirty hands off of it. Put the drawing on end in the window, or up against the wall on the vise-bench, and not on your lathe or planer to use as a tool rack. If you find any spots with no sizes marked, it gives you a good chance to be sarcastic to the draughtsman, and catch him in a slip. Now we come back to where we started—what makes you so puzzled when you get a drawing to work from?"

Lamb shifted uneasily from one foot to the other and looked out of the window.

"It seems all straight lines to me. It don't look anything like the job itself, and it puzzles me to know which line is which, or what line on the drawing is represented by the work itself. I expect that is why I have to study it all out so long first; I don't want to make any mistakes."

"Well, now, I see just what the trouble is; you look at the drawing as a whole, not where you want to work on it. Surely it is easy enough to know which the end is, and having found that, begin right there and let all other parts alone until you come to them; that plan lets you out of difficulties of all kinds. When you are measuring the head, or stub-end, let the body go until you come to it, and don't worry, and fear you won't see it when you get to it."

Lamb went away, but I could see by his serious expression that he was not without misgivings as to his natural capacity to understand a drawing.

In this he is not alone, for some of the best workmen I have ever seen labor under the same trouble, and in some cases it is a perpetual stumbling-block. It does not imply any want of intelligence or a natural obtuseness, but it lies in an incapacity to distinguish forms. The The greatest painters have had the same weakness. They were splendid colorists, but poor draughtsmen, and their work suffered in consequence. They flatter and caress the eye with brilliant hues, but they disappoint the precisian who insists upon correctness and fidelity to natural form. A painter who colors merely and cannot draw, is like a person who argues illogically, and give you sophistry for sense.

I try back again to the scent I had a paragraph or so above, because I think it is a point to insist upon in rendering drawings into work, and that is that some mechanics try to see too much at once. As a good workman said to me in earlier days, when we were both at the lathe, he across the alley from me: "Moulton, I swear I never get a new drawing to work from but that I shake all over, for it takes me so long to puzzle it out that I am ashamed, for I know all the boys are watching me and I dare'sent ask any of them what this or that means. If I get a valve-chamber to bore out I see all the lines at once, and it looks like a wheel; or if it is a rod, or shaft, it looks like a rail fence, and I don't know where to begin first. I told this friend what I have written previously, to see nothing at all on the drawing, not to take it in as a whole, but look right at one spot, and start from that, and he would come out all right. In the case of the valve-chamber, for instance, if it had a hole for a stem in it, (on the seat) as many do, take that first and everything will follow in due sequence. Our friend tried this plan and found it a great help to him.

If I take this opportunity and animadvert upon some faults of draughtsmen, I hope our friends in this line will not think it rude and uncivil in me, for I see by *our* paper that a very great many of them read it. In the course of a lifetime, working all over the United States, on every kind of work drawings are made for, I have examples of all kinds of mechanical drawings given me to work from, and by far too many were not suited for machinists. Most mechanical drawings are made with hair lines and not jet-black ink. The consequence is that, with very little shop use they become illegible. The column rules in this paper represent the average line in mechanical shop-drawings when they should never be finer than this line, ——————————— and it is none too heavy. Shops are not as light as they should be—not so light as the drawing-room, anyway—and mechanics' eyes, young and old, cannot discern where hair lines begin and leave off. They can see lines a full sixty-fourth wide easy enough. A drawing to be used by mechanics does not want to be made like an exhibition piece, and so long as it is clean, legible, and distinctly marked, it fills all its requirements.

I do not say that I am "Sir Oracle" in this matter and that there are no other views than mine, but I do think that most men who have been through the rough and tumble of the shop—the average shop—will concede the truth of my views.

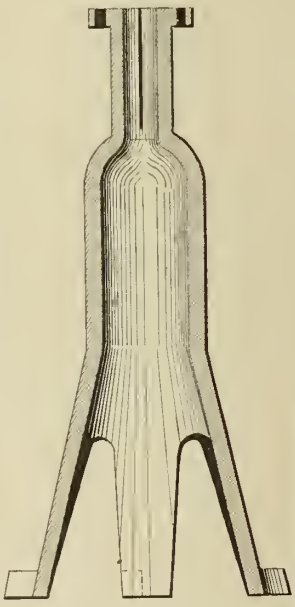
PATTERN MAKING, No. 12.

BY A PATTERN MAKER.

I believe I should be missing a point if I made no allusion in this series to so important a subject as the cone. It is a favorite with designers, because of its greater stability for the amount of material in it than other available forms possess. To my mind it has a beauty peculiarly its own; derived from its stable appearance perhaps. A cylinder standing upon its base looks as though it might topple, but a cone never!

It presents itself as a study to the pattern-maker in various ways, either simple or ornamented, and often combined with other forms. The following example, Fig. 90, belongs to the latter class; it is a pan-driver for a quartz mill, an article probably not very widely known "back East." Nevertheless there is an amount of work in it from which ideas can be drawn for other subjects. The small part towards the top in our section, is that part of the driver which is bored to fit the pan-spindle; it is also slotted to pass over two feathers, by which it is made to revolve, at the same time admitting of vertical adjustment. From the neck downwards the driver is enlarged to escape the cone which rises in the centre of the pan. At the extremity of each of the four legs (some drivers have but three) a toe is cast to engage in lugs on the muller, and so cause it to revolve.

Fig 90

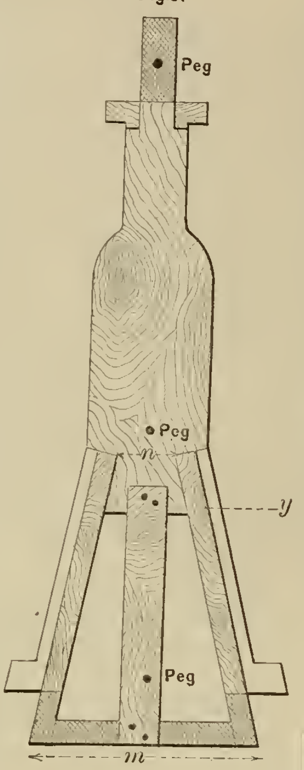


Our first step is to draw the pattern-driver to its natural size, as in fig. 91; we now proceed to prepare the halves of the pattern from *x* to *y*. For this purpose we need a design, roughly pencilled, to show the widths and thicknesses of the pieces to be glued together; in fig. 92 the small semicircle is a little larger than half the print; the next larger than the neck of the driver; the largest semicircle being a little larger than the swell, or largest part of the driver, not counting the cone.

By surrounding the small semicircle with a rectangle, we have the thickness of the first piece, *a*; the outline of this piece must be the same as the driver from *x* to *y*, but say a quarter of an inch larger on each side to allow for turning. The piece, *b*, will extend from *y* to the flange; its thickness and also its width at the neck and swell of the driver being obtained in a similar manner to *a*, which is apparent from the figure. The third piece, *c*, will extend from *y* as far as to cover the swell of the driver.

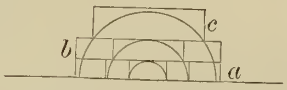
The object of the above operation is to save time in turning, as well as to economize lumber. It is not well to carry this economy to too great an extent, but always to allow plenty for turning, as the courses in glueing may become slightly misplaced. Furthermore the outline of the driver may be considered parallel as far as *y*. It will take but little time to check down for the staves. Having the three pieces, *a*, *b* and *c*, it is necessary to duplicate them, to produce the two halves of the pattern.

Fig. 91

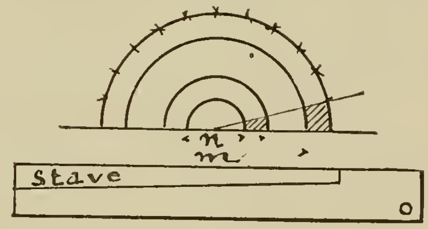


If we now glue the pieces together we shall have time, while the glue sets, to lay off another design, as fig. 93, to obtain the size and bevel of the staves which form the body of the cone.

Fig. 92

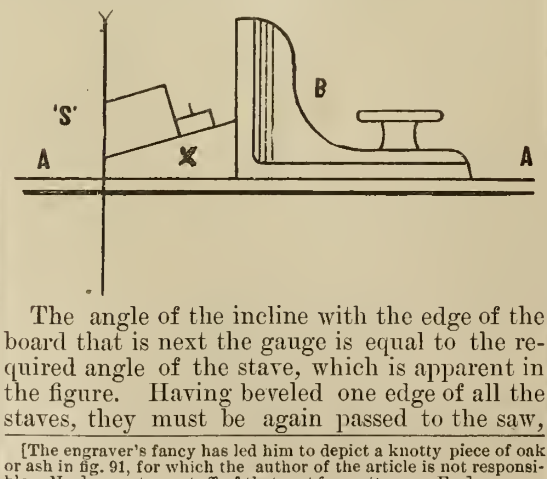


Lay down the semicircles, *n* and *m*; whose diameters are equal to the parts marked with the same letters on fig. 91. Let also two other semicircles be described, at a distance from the former equal to the thickness of the lumber that is to be used for the staves.



Divide for the staves as shown: we have now the size of the stave at each end, and in fig. 91 its length. Allow ½in. or thereabouts on the length, for cutting off in the lathe.

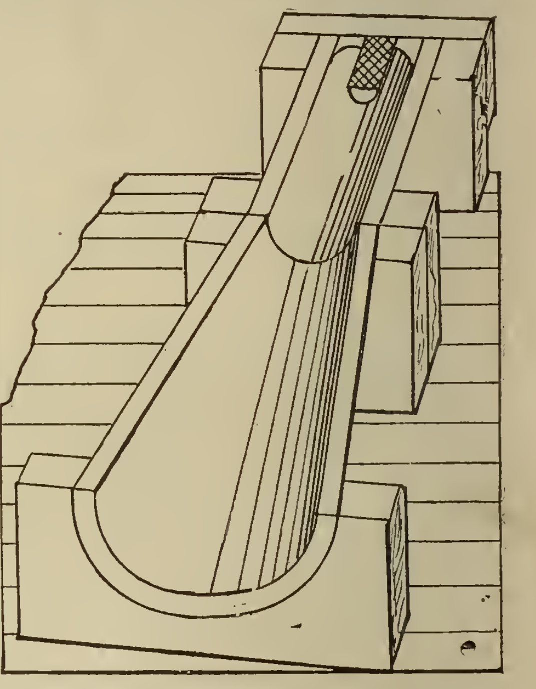
Cut off from a board a sufficient number of pieces for the staves; let half the taper of a stave be sawed from the edge of each. A jog or recess must be cut in a piece of board, fig. 94, its shape and size to be the same as that of the stave. By placing a board in the recess and passing the whole to the circular saw, a stave will be sawn off. Turn the board over endwise, proceed as before, and so continue, reversing the board endways each time a stave is sawed. The staves are now sawed to the proper taper, it remains to bevel the edges of them. This will be understood from fig. 95, in which *A A* is the circular saw table, *B* the gauge, *S* the saw, *X* a piece of board, parallel edgewise, but inclined upon its upper surface so as to cast the stave over to the angle required.



The angle of the incline with the edge of the board that is next the gauge is equal to the required angle of the stave, which is apparent in the figure. Having beveled one edge of all the staves, they must be again passed to the saw, but reversed endwise. The strip of wood shown upon the incline, against which the staves are kept in the act of sawing, must be taken off and replaced to suit the taper of the reversed stave.

The staves, with care, may be so sized and beveled with the circular saw, as not to require any planing.

By this time we find the glue has dried, therefore we set about preparing the stem of the driver for the lathe. Setting one-half upon the other, we observe if there is any wind, or crookedness, in the joint; some planing may be necessary, after which the pegs are to be inserted, and center-plates screwed to each end, because the weight of the pattern is too great to trust to the soft wood of which it is composed. Two dogs are driven into each end of the pattern to hold the halves together, a duty which should not be thrown upon the screws which fasten the center-plates. The work is now to be placed in the lathe and trued, and the part to receive the staves is taken down to size. This is all the turning we can do at present.



The pattern is taken to the work-table and parted, into each half a center bar is fitted, as shown in the figure (91). A head, *m*, in halves, is sawed out and fitted over the center bar, being fixed by screws. The staves are now to be glued and nailed on, and we are ready for the lathe again. This time we turn the whole driver to size, from end to end, nail on a flange and turn it. The next step is to make the legs. Two of them, it will be observed, are at the parting of the pattern and are consequently in two parts, we must shape these legs by hand, having arcs the size of the large and small end of the cone marked upon the pieces to guide us. The work can also be tried on in its place.

The carved portion between the legs is conveniently made by fitting and filling in two short pieces, which meet half between each leg. These pieces are to be glued to the legs, but not to each other. The legs may be screwed from the inside, or fixed by pins, so that the molder is at liberty to cast them loose.

The half core-box necessary for this pattern is shown in fig. 96. It seems unnecessary to describe its construction in detail, as the process is very similar to that of building the pattern, the staves being arranged around the inside of the heads instead of the outside. The narrower the staves are cut the less planing will be required to make the box truly round; ⅝″ wide, at the small part of the cone is sufficient to get a 2″ nail in each stave, which, with the glue, will hold quite strong enough. The heads are made the same in height so that the box may lie level. It should also be strengthened by boards nailed along the ends of the heads. These, and the board, which would close the large end of the core-box, are omitted in the figure.

A plain cylindrical core is used for the neck of the driver, it is fitted into the recess, in the body core, left by the print shown in the box.

Oval cones may be constructed by the same method, with the exception, that the staves

[The engraver's fancy has led him to depict a knotty piece of oak or ash in fig. 91, for which the author of the article is not responsible. He does not use stuff of that sort for patterns.—Ed.]

must be beveled by hand as the angle changes, and the cone must be trued with a plane, for, with ordinary facilities, it cannot be turned.

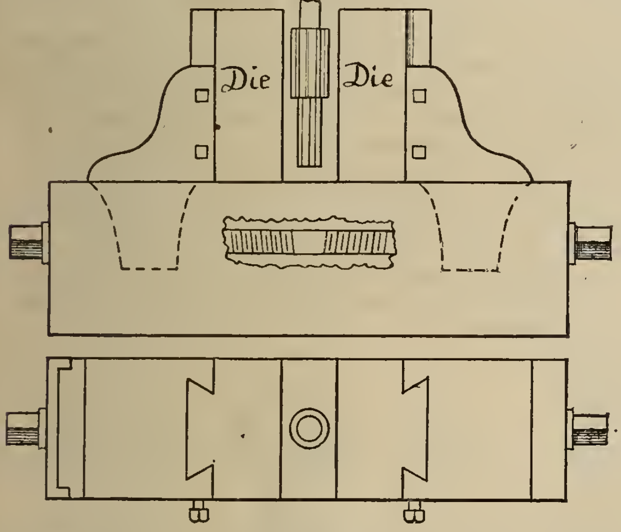
Verni Noir.

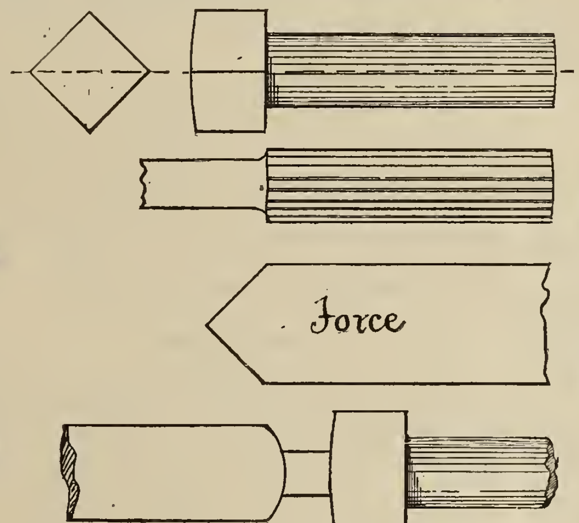
DIES AND DIE-SINKING—No. X.

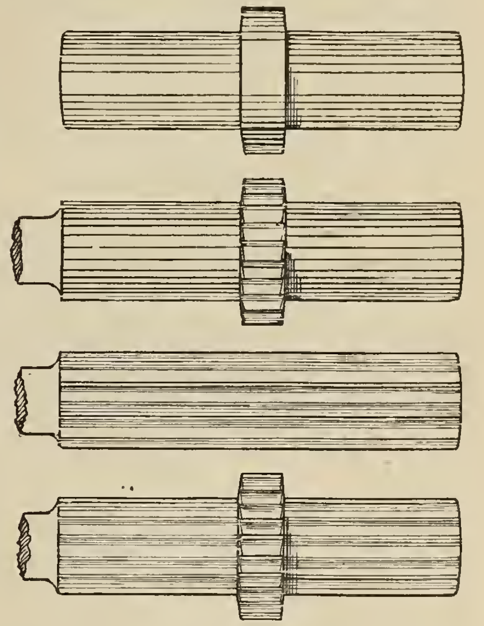
BY A DIE-SINKER.

In this article we begin work with the die-sinking attachment, and I think the best way to illustrate it is with the two die-blocks in, as they have to be in use. This shows the right and left handed screw squared at each end for a handle, so that it can be used from either end when necessary. The cross section shows the movable jaws in place, while the top view shows the jaws dove-tailed and set-screws in them to hold the die-blocks in position. It will be seen that as we turn the screw from left to right, or from right to left, the jaws will move towards, or recede from each other.

We will now put the die-blocks in it, in proper position, and fasten them securely, then we put the attachment in the die-sinking machine, and are ready to work. The first thing to be done is to close the die-blocks together, and put a $\frac{5}{16}$ drill in the machine and then drill a hole (where we cut the grooves described in the last article) right through to the place we chipped out. This hole will allow the narrow shank of the reamer to revolve; the cutting part will of course work in the place we chipped, but before we ream it out, we put a $\frac{5}{8}$ drill in the machine and counter-bore the $\frac{5}{16}$ hole, right down until there is but $\frac{1}{4}$ inch left between the point of the $\frac{5}{8}$ drill, and what will be the body of the die when reamed. This $\frac{5}{8}$th hole gives clearance for the bar of steel, when working in the drop-hammer, the $\frac{5}{16}$th hole being the gate. This can be seen better by referring to the sketch of the die-block. After the hole is counter-bored, we open the attachment wide enough to admit the reamer, adjust the reamer to the proper place, and fasten the table of the machine so that it can neither move up nor down accidentally. Put the machine on the slowest speed and feed the die-blocks very carefully up to the reamer.







As I said before, this is a slow process, and extreme care is necessary lest you break the reamer at the small part of the shank. Plenty of oil should be used, and the reamer will gradually work its way in; this will take three or four hours. The feed must not be put on by fits or starts, but keep the hand always pressing lightly on the feed handle, and it will adjust itself. It will be a good thing to open the attachment every little while and clean the chips out; at the same time try the dies with a depth gauge, to see if they are sinking equally; if they are not, take out the one that is shallowest, and take a cut right along it with a round nose chisel, and make it as deep as the other one. Put it in the machine again, and feed up until the die-blocks come close together, face to face. Then, of course, the reamer will have cut a place for itself in the die-block the exact size we want it to be. This will be smooth, bright, and perfect half circles.

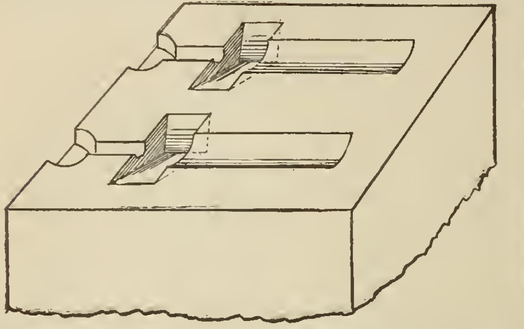
We are now done with the machine, so we take the die-blocks out, and, placing the outline template on them, lay out the square part that has to be on the middle of the bar. As in all dies that are made in halves, we reverse the template for the bottom and top dies. Chip out this part in the usual manner, using the force, or drift, shown to assist us.

We are almost ready now for hardening, but in hardening dies that are long and narrow the face becomes very round lengthways, about $\frac{1}{32}$ in nine inches. This amount on each of the blocks would be a very serious matter. So we anticipate it by filing each of them $\frac{1}{32}$ hollow, and scrape out the impression the same way, as this would make them shallow if we omitted to do so. A remarkable feature is that it (the forging) can be made of $\frac{1}{2}$ inch round iron. When it is taken into consideration that the die at its widest part, which is the square projection near the middle, is $\frac{3}{4}$ wide, this seems curious; but it is because the hot iron cannot lengthen where it receives the blow as it would in open-ended dies, or on an anvil, and, as it has to go somewhere, it finds its way into the square part. Formerly it was the practice to take iron $\frac{3}{4} \times \frac{3}{8}$, and rough it out under the trip-hammer, leaving the large part in the middle on it. It was then reheated and struck in the die I have just described. How this was changed was in the nature of a discovery. One day there was a great hurry for needle-bar forgings, and from some cause there were no blanks roughed out; so it was concluded to try and forge them directly off the bar iron. At first the iron they had been using before was tried, but it was too large for this method. Another smaller size was tried with the same result. So they kept on reducing the size of iron, until they found the right one. This led to the abandonment of the trip-hammer, for this and numerous other forgings. Until this time it had been the practice in nearly all the forgings to get iron or steel large enough for the largest part of the forgings, and reduce it in the trip-hammer. This, of course, involved another operation for finishing them in the drop-hammer; but afterwards it became the practice to get the iron as small as possible to make the forgings. This led to some surprising results.

This feature of iron flowing in dies when it gets the blow is now fully taken advantage of. It is this that makes an article so forged so much superior to an ordinary one, by the grain becoming thoroughly mixed up, and the iron or steel so much more solid.

I will give two more examples of what can be done with milling cutters by the aid of this die-sinking attachment. The first is an ordinary square-headed bolt, the other is a stud. The first requires some finishing with the chisel, the last is completed in the machine. I do not advocate making bolts in this way, knowing that there are so many machines for this special purpose. Nevertheless, it makes a superior article to anything produced by machines. The dies are simply made, and stand well in forging. As much as fifty thousand bolts can be taken from one set of dies, and a good operator can make five or six thousand a day. It will be seen by this that a factory having a constant demand for large numbers for their own use, and possessing the facilities for producing the dies, may as well make them this way, and it serves to keep the hammers going, when they otherwise might be idle. At any rate, the bolt will serve our purpose, by showing the capabilities of the die-sinking machine, combined with proper milling cutters. They will also give us a starting point to work from, on more difficult dies, in which this principle is a prominent feature. When we mount a ladder we take the bottom step first; and, keeping this in view, I will here illustrate the forgings, the bolt and the stud (see engravings). These will be put into the die-blocks in halves, the dotted line showing the centre line and the position they will take in the dies. We will take the bolt first. For this we make two impressions in the die-block. The head of the bolt is placed at an angle in each half of the die-blocks, and if the body of the bolt is sunk exactly half circles, there is no danger of its sticking. We will have to make a drift (or force) for the bolt (see sketch), and this will serve for either top or bottom die. It is easily made, being of a wedge shape; so I will not describe it, neither will I describe the templates, for I think the reader will know how they should be made. Now, we must make a milling cutter or reamer, for the body of the bolt (which is $\frac{3}{8}$ diameter), on the principle that we made the one for milling the needle-bar dies. We make the cutting part of the reamer the whole length of the bolt, including the head; the shank is reduced to $\frac{1}{4}$ inch for a short distance (see sketch). Having cut grooves in the die-blocks, where we wish to drill them, we put them in the die-sinking attachment, and drill a $\frac{1}{4}$ inch hole down to where the point of the bolt will be in both impressions. It will be here noticed that we use the die-sinking machine as a drill press, by feeding the table up to the drill. Then put the milling cutter (or reamer) in the machine, and mill out the body in the same way we did for the needle-bar. This will not take long in a die like this, but we pay particular attention to see that the top and bottom impressions are equal halves of the circle. This being done, we take out the dies and chip the part for the head, which you will observe is a favorable shape, and is easily done: but we use the drift for exactness. To give the reader a clear idea of this, I here show the die-block, also the bolt on the end of a rod of iron—the reader will notice the head of the bolt is considerably larger than the iron it is made from. To make these bolts, it requires two blows—one for breaking down or blocking, the other for finishing; but it is trimmed before it gets the second blow in hot trimming dies. After it is made, the light burr or fin will be removed in cold trimmers; but the reader already knows how these should be made.

We will now turn our attention to the stud, which we will make in a similar manner. There is no necessity to make templates for this, but we make a milling cutter the exact size of the stud, which is $\frac{1}{2}$ in diameter on the body, and $\frac{3}{4}$ on the collar. On one like this we try to keep the shank as strong as possible, so we only reduce it to $\frac{3}{8}$. We put it into the attachment, and drill a $\frac{3}{8}$ hole the proper depth, and work the die as before, with the milling cutter. This will take a long time, owing to the large diameter of the collar on the stud, and it could be helped by chipping it out roughly before milling it. It is a heavy strain for the shank to stand in milling, and there is considerable danger of breaking the cutter off at the small part. This could be remedied by making the cutter in two pieces, as shown in the sketches—that is, having two cutters made exactly like the stud; but one is only cut on the body, the other is only cut on the collar. Of course, this makes more work at first; but it is a good way, and there is less chance of breakage. If you should meet with an accident, it is evident you do not lose everything, as you do in the first case. I have tried them this way, and know it is a good plan for some shapes. The reader will observe there is a little taper on the sides of the collar, which is for draft to prevent the forging from sticking in the die. I presume the reader will now understand this principle of die-sinking; so in other articles I will show more difficult forgings, containing some modifications and combinations of this and other principles, showing some curious results—that is to say, curious to the uninitiated—the expert will know all about them; and if such read these articles, I hope it will not be in a captious spirit. It is a deal easier to criticise than to write. If there are any such that know of better methods, I will be glad to learn from them, and this paper is the proper medium.



HOW LAMPBLACK IS MADE.

Lampblack is now made from natural gas from subterranean wells, and the process is thus described in the New York *Herald:*

"From the gas well a four-inch pipe extends to the factory. At the main entrance it branches off in two directions, and from these eight long pipes, running the entire length of the building, draw their supply. Along each of these pipes are small jets, thin and very close together. They number fully twenty thousand. Over each "bench" on which the long pipe rests are continuous plates of sheet iron, and it is against these the tiny flames from the jets burn. The windows and doors are always kept tightly closed with close-fitting shutters, so as to prevent the admission of too much air. The temperature of the interior must be sufficiently regulated to avoid perfect combustion, and thus save the carbon. Little by little the lamblack forms on the sheet iron until a small mass not larger than a cherry, perhaps, hangs over each jet. At regular intervals of twenty minutes a small iron "carriage," or a sort of scraper, is run along each of the rows of iron, and the matter thus collected is emptied into a receptacle in another apartment. Frequently water is run over the top of the iron to keep it cool. The heat of the place is intense, and cannot be endured long.

"When this finely-divided carbon is removed from the sheet iron it is ready for packing. This is the most difficult part of the work. Being such an extremely light substance, it would require but a very small quantity to fill a barrel if it were thrown in loosely. Ingenious machinery has been invented, however, to obviate this difficulty in a measure. As it is dropped in by the panful heavy rollers and stampers run by a steam engine press it down as tight as possible, but notwithstanding all this labor, only fifty pounds of lampblack can be put in an ordinary sized barrel. It is stated that all the lampblack manufactured there goes direct to Germany."

ARTIFICIAL DRAUGHT.

Some experiments have been tried in England recently with fan blowers and steam blowers, and a summary of the result is given in *Engineering*, from which paper we republish a portion:

"One thing appears certain, viz., that as the air pressure was advanced the increase in the consumption of fuel proceeded at a much higher rate than did that of the power given out at the engines.

"This is borne out by the observations made of the temperatures produced in the uptakes. On the forced draught trial of the *Satellite*, a pyrometer fixed to the uptake registered a temperature from 1,000° to 1,200° Fahr., while on the steam blast trial of the *Heroine* a pyrometer, similarly placed, recorded from 775° to 850°. Also, on the trials of the *Conqueror*, pyrometers were attached to the funnel just above the junction of the uptakes. On the first occasion, under the ordinary draught, the temperature varied from 275° to 280° when the steam blast was off. When the blast was on it varied from 490° to 600°. On the trial immediately following, when the fan draught was used, the temperature registered ranged from 850° to 1,000°.

"The results obtained are sufficient to show that, with engines of suitable size, the steaming power of the low boilers can, by employing forced draught, be increased by about 30 per cent. beyond the maximum power hitherto obtainable with the steam blast, and that the increase of effect is even considerably greater than this in the case of the high boilers.

"Neither in the generation of the steam nor in its employment in the engines is economy to be expected by this method of working the boilers; but neither is it necessary for the few and comparatively short periods that they will probably require to be forced in this manner. The adoption of the fan draught system has this advantage—it tends to facilitate economical working rather than otherwise under ordinary conditions, because it enables relatively smaller cylinders to be used.

"With regard to the endurance of the boilers, there can be no doubt that the frequent use of the forced draught would produce a great diminution in the life of those parts subjected to the intense heat. An examination of the boilers of the *Satellite* and *Conqueror* after the trials showed that they had not suffered to an unusual extent by the exposure to the intense heat for the short time the trials lasted."

CURIOUS OILS.

POPPY OILS.—Oil is yielded by the seeds of three kinds of poppy—the opium-poppy, the spiny-poppy, and the yellow-horn poppy. The unpressed seed is largely exported from India, almost exclusively from Bengal. About ⅔ of the total come to England, and ⅓ goes to France. The French oil is of two kinds—a white, cold-drawn oil, and a coarser oil obtained by a second expression and from inferior seed. The finer oil is fit for alimentary purposes, and is largely used to adulterate olive oil; it is also employed as a lamp oil, and by artists for grinding light pigments, though possessing less strength and tenacity than linseed oil, it keeps its color better. The coarser kind is chiefly made into hard soaps in S. France. The pure oil has a golden-yellow tint, and agreeable flavor. Its specific gravity is 0·924 at 15°; it solidifies at—18°, and remains long in this state at—2°; is slow to become rancid, and saponifies readily; dissolves in 25 parts cold and 6 parts boiling alcohol; and dries in the air more rapidly than linseed oil.

[This last must be erroneous. Poppy oil is universally known as one of the slowest dryers. —EDS.]

SUNFLOWER OIL.—The sunflower has long been grown for its oil-seeds in Russia and India, and the cultivation has more recently been taken up in Germany and Italy. The plant grows readily in most soils, but prefers light, rich, calcareous land, unshaded by trees. The purified oil is considered equal to olive and almond oil for table use. The chief industrial applications of the oil are for woolen-dressing, lighting, and candle and soap making; for the last-mentioned purpose it is superior to most oils. It is pale yellow in color, thicker than hempseed oil, of 0·926 specific gravity at 15°, dries slowly, becomes turbid at ordinary temperatures, and solidifies at—16°.

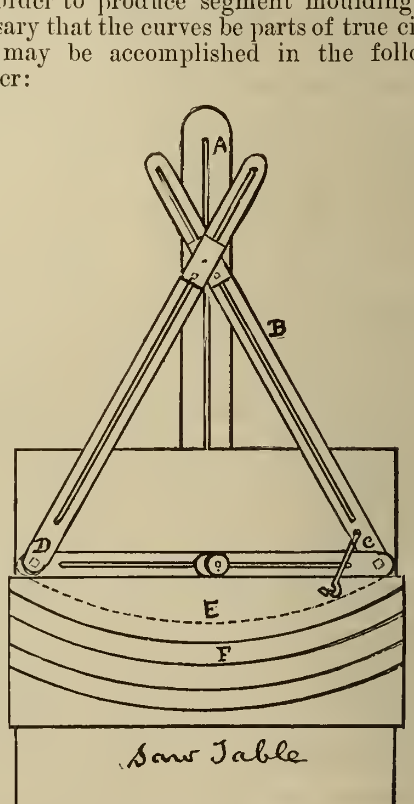
TOBACCO OIL.—The seeds of the tobacco plant contain about 30 per cent. of a fatty oil, which is extracted by powdering them, kneading them into a stiff paste with hot water, and pressing hot. The oil is clear, limpid, golden-yellow in color, inodorous, and mild flavored; its density is 0·923 at 15°; it remains liquid at —15°, dissolves in 168 parts of alcohol at 0·811 specific gravity, and saponifies readily. One authority excludes it from the drying oils; another considers its drying quality to be unusually developed, and recommends it for paints and varnishes.

There is an automatic clock at the English Stock Exchange, which has performed well for six months, invented by a M. Dardeme. The winding apparatus consists of a small windmill, fixed in any place where a tolerably constant current of air can be relied upon. By means of a reversed train of multiplying wheels this windmill is continually driving a Hughens's endless chain remontoire, a device well known to clock makers. A pawl acting on a wheel prevents the motor from turning the wrong way, and, by a simple arrangement, whenever the weight is wound up right to the top, the motion is checked by a friction brake automatically applied to the anemometer by the raised weight lifting a lever. When the weight is thus raised to the top the clock has a sufficient store of energy to go for eight days or more, so that it will be seen that it is by no means dependent on a regular current of air. The Belgian Government has for the past two years adopted this system of clocks on the State railways, and we are informed that they are now being tested by certain English railway companies with a view to their adoption.—*London Engineer.*

A HANDY DEVICE.

A useful device for sawing segments for pattern-making is shown herewith. It was devised by J. A. Crook, and is intended to saw out molding strips and stick them as they are curved. There would seem to be some disadvantages in this, in the way the grain of the wood runs; for pattern work, however, it is useful where a large number of segments have to be made.

In order to produce segment moulding it is necessary that the curves be parts of true circles. This may be accomplished in the following manner:



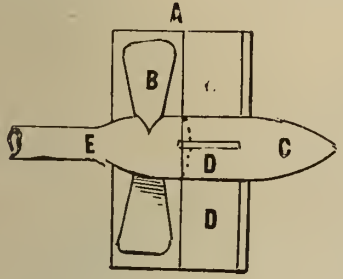
Cross-cut the lumber one or two inches longer than the sixth, ninth, or twelfth part of the circle of the outside curve required. Secure to the jig or band saw table, an arm, *A*, fig. 1 slotted to receive a bolt adjusted from the saw, the length of the radius of the outside curve. On this as a center place a light triangular frame, *B*. Set the distance, *C* to *D*, shorter than the length of the segments, and the distance between the saw and the points, *C* and *D*, should equal the width of the molding. An ordinary 6-inch hook and staple placed near *C* will secure the lumber from slipping while sawing. After cutting the first piece, *E*, bring the curve, *F*, against the frame and saw a piece of the form of *F*, this repeat for full width of the boards, leaving a piece of more or less width, *G*. This piece used as a guide bolted or clamped on the saw table, concave side toward the saw, and distant to resaw the segments the proper width, and thus leave a section of *E* as indicated by the dotted line.

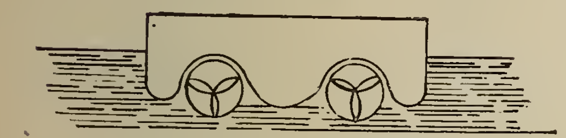
We take this from the *Builder and Woodworker*.

GUIDE BLADES FOR PROPELLERS.

Mr. Thorneycroft's deflector consists of a tube with a projection behind, in which tube the screw is placed, as shown in the annexed sketch. Here A is the tube fixed in the dead-wood, or in the rear of the stern-front; B is the screw; E, screw shaft; D D, deflectable blades fixed in the tube; C, a fixed solid block, same diameter as the screw boss. It will be noticed that the increase of thrust obtained was very great, but the advantage was to a large extent neutralized by the friction of the water passing through the ring, A.

The velocity of the water driven astern is augmented, and this is flatly opposed to the principle which Rankine has laid down, and on which it is worth while to insist here *that, other things being equal, that is the best propeller which drives the largest quantity of water astern at the lowest velocity*. The second sketch shows the cross section of a Congo river steamer. This remarkable craft draws but 12in. of water, and yet steams at 12 miles an hour, propelled by two tiny screws. The remarkable fact is that she gets on as well with one screw as with them both—at least, so Mr. Thorneycroft gave his hearers to understand. Possibly he meant not that her speed was so high, but that her coefficient was as good.—*London Engineer*.





Concerning these guide plates, Mr. Arthur Riggs, a well known English engineer, writes as follows. He claims to be the inventor of the plan:

"The diagram is evidently not a working drawing, but it shows with sufficient accuracy the way in which several of my patent screw propellers were constructed. I do not think the conical projection, C, of any use; and I found the cylindrical tube pernicious. Indeed, a moment's consideration will show that no cylindrical tube can have a forward resultant from the divergent streams of water impinging upon it, but these must get reflected into the main stream, and to some extent damage its efficiency, an efficiency directly dependent upon the absence of any element of motion in the reverse current at right angles to the vessel's course. The proper form of casing for a screw is not cylindrical, and it is easily discoverable for any given vessel. But I found the enlarged boss in the guide blades a very considerable gain, and used it in several of the few propellers made under my patent. Its effect is the same as the large boss in Mr. Griffith's propeller, and its proportions vary from one-third of the diameter upwards, according to the velocity, pitch, and diameter of the propeller. Indeed, this theory of mine, though somewhat scouted by the old school, possesses several advantages. It is geometrically enunciated, and made in the form which is used in Germany, when things become too complicated for mathematics. It will lead to no wrong inferences, or land one in the absurdities of "negative slip," and if applied to Mr. Thorneycroft's experiments, it shows that his increased pitch is unmixed gain, and he can advantageously go further in the same direction provided he proportions the deflectors to suit.

It has always appeared to me that the guide blade system is the only one by which the diameters of screw propellers can be reduced, and their velocity of rotation accelerated; and if we regard the modern steam engine developing itself in the same direction, we cannot fail to be struck with the singularly harmonious laws of matter and motion by which both propeller and engine will ultimately run in quiet unison at a high speed, as they now do so uneasily at a low speed. The largest set of guides or deflectors I ever made was attached to the ss. Corsyra. The diameter of this propeller was 12ft., and its results were extremely instructive. All vibration was destroyed, and the vessel ran a perfectly straight course, and overtook every other while meeting head winds; but during calm weather the blades did no good, and possibly harm. As an experiment, however, this trial was completely successful and most encouraging.

The turbine and screw propeller have much in common, and if one takes an old-fashioned water wheel to represent the screws now generally in use, the guide-blade propeller compares exactly with the turbine, and is subject to very much the same laws of hydrodynamics. Just as a turbine, unscientifically designed, will waste 90 per cent. of the water power flowing through it, so will a guide-blade propeller improperly designed, give a worse result than the common screw, though all the time it has a potentiality for better things.

SOME HINTS AS TO LUBRICATION.

An "Observer" in the *Lumber World* makes some good points on this subject, which it will be well to heed, they apply to machines generally:

"There are so many kinds of bearings in various conditions performing as many different duties, that it would take more space than can here be spared to treat of them, but a few words as to the ways and means of lubrication may not be amiss.

"There are upright and horizontal bearings; bearings neither upright nor horizontal; bearings long and short, heavy and light, of high speed and slow speed, accessible and inaccessible, and I might say unseen, in the matter of lubrication.

"It may be that sometimes an oil is found to do well on a light-running spindle bearing that would prove a failure if applied to a heavy, high speed bearing, but I want to see that kind or brand of oil that performs its duties perfectly on a high-speed, heavy spindle or shaft, that will not do equally as well on a light-running spindle. The fact is that it will do vastly better and at less expense and trouble.

"The principal quality required in lubricants is grease, simon-pure and unadulterated—a grease that, while limpid enough to run into every part of the bearing, will have body to hold itself there until worn out. There must be an absence of all acids, resins or gums, as, no matter how limpid an oil is, if it contains a small percentage of grease, it will wear or last only as long as that percentage lasts. If it has been 'doctored' with any gummy or resinous ingredients, it will soon show itself in the increase of power required to revolve the shaft, and will also heat and stick like glue.

"A great deal has been claimed and said regarding the lubricating qualities of the various oils lately presented to the public, but they are in many cases anti-lubricators. A gallon of sperm oil, or perhaps two gallons of the best pure lard oil, will go as far as twenty gallons of many other so-called lubricants. The oils in the following ratio for value as lubricants: minerals, one; lard, three to four; and sperm, six to seven; with a difference also in favor of the last two named—they do not 'stick' everything fast, and one drop of them will do where ten to twenty of the poor substitutes are required. If any one doubts this statement, all I have to say to them is, 'try it.' I have been lubricated and stuck by cheap oil and oil men, and know whereof I speak. These facts only go to prove the truth of the old adage that the best is the cheapest.

"There are almost as many ways and means by which to get oil into bearings as there are kinds of oil, and some of them are mean ways too—notably, the self-feeding oil chambers or cells attached to, or part of the boxes or bearings. I prefer the term 'cell' to 'chamber,' because it is more significant; they are in a majority of instances 'sells' in more than one sense. They were designed by their inventors to relieve the operator from any care whatever for some time after filling them up. I don't know of any other device on machinery where the design of the originator has been so fully carried out as on self-oiling chambers. The operators generally do a great deal more with them than the inventor could do or would even think of doing. They can fill one and use it until the bearing is *worn* out, and sometimes it doesn't take long either.

"The great trouble is that oil chambers are filled up and forgotten until they become dry and melt the bearings, but no matter how carefully and often they are attended to they will not feed poor oils. Capillary attraction doesn't attract thick gummy substance worth a cent. Sometimes, however, it is almost impossible to use anything else but self-feeding oilers, on account of the location of the bearings. Where this is the case I would say, use good oil, keep it clear of sediment, grit, etc., keep chambers as nearly full as possible, and trouble will be reduced to a minimum in that direction.

"Oil reservoirs of this kind sometimes have a cap or cover made of iron or other metal. This cover gets loose, the hinge pins come out, and it drops, either into the shavings, or into the cutters, which is much worse and causes great damage. A better plan is to make the reservoirs higher and fit wooden caps or plugs to go on the inside of the hole; they do no damage if they jar out, and can be easily replaced if lost, while any ordinary wood turner can get them up so as to look a great deal neater than even a metal cap. They are also much cheaper to fit up.

"No oil holes should be allowed to go without some kind of a plug or cover. They must be protected from anything that tends to produce abration or cutting of the bearings. To assist in keeping journals or bearings well oiled and cleaned, a good plan is to insert pieces of felt or wicking between the joints before screwing together; they will hold oil and wipe off foreign substances at every revolution. When liners or packing of wood are used between the box and the cap, the wood can be cut back from $\frac{1}{2}$ to $\frac{1}{4}$ of an inch and the felt placed therein and against the spindle of the shaft.

"For similar reason, it is the best plan to oil any bearing from the top. Oils are commodities that are greatly wasted. There is perhaps ten times as much poured out as is ever used. If a few drops were placed on at a time, and more often there would be less oil wasted and machines would look less like having been tumbled around in a soap vat. I must not be understood to advise using oil sparingly, but urge that it be used judiciously."

LOCOMOTIVE ECCENTRICS.

A writer in *The National Car Builder* says: What piece of machinery is there about a locomotive that gives less trouble than the eccentrics? In a ten-years' experience on the foot-board, from a 4-wheel outside connected shifting engine at 10 miles per hour, blackboard rates, to a passenger engine with a card time of 45 miles per hour on a road of 200 engines, I never have run across a hot eccentric, much less a broken one. Scientific effusions are met with occasionally about the dangers incident to eccentrics, of "surface friction," and the "great surface in contact." They are said to be perfect receptacles of dust and dirt. But these objections come from men who never use them in a practical sense. Locomotive engineers hardly know what an eccentric is, because the late fashion of keying them in place. or in using a die with teeth held by a set-screw, is so safe and sure, so far as slipping is concerned, and as they never heat or break, as a rule, engineers lose track of them on account of their universal good behavior. There are hot pins, hot driving-axles, hot engine and truck axles, but a hot eccentric is like a dead mule—something which no man has seen. I once saw a hot and broken eccentric strap, and only once. The master mechanic was a graduate of Cornell or some other technical school, had been educated to make perfect fits and could figure to the thousandth of an inch the size of cylinder necessary to just slip any pair of driving wheels—knowing the weight on them. While at his school he had seen it demonstrated that a surface calculated to stand a given frictional pressure, must be a perfect "ground-surface" and in "actual contact." There was an engine in for overhauling, and he had it fitted up on the college theory of "dead surface of contact." On her trial trip, among red hot pins and other manifestations of heat which the "gang" with their water buckets could not control, I distinctly remember disconnecting her two go-ahead eccentric straps and rods, the straps being broken, although the college M. M. had ordered them to be made a perfect fit, *i. e.*, when the wheels were on the floor and the eccentric straps and rods were bolted to place, the fit was so perfect that the rods and straps would stay in any position, the friction of the fit resisting the attraction of gravitation and the leverage of the eccentric rods to descend.

This is the only case of an eccentric giving trouble that I ever saw or heard of. Given a cast-iron eccentric and a cast-iron pair of straps, with an ordinary working lathe fit—*i. e.*, so that the straps can be revolved easily by hand when disconnected from the link, and they will give no trouble in three years of ordinary running if kept properly oiled, whether the speed is 10 or 50 miles an hour. Let scientific investigators and writers aid as much as possible the practical workers; but their time is worse than wasted when they kick up a row with the quiet and peaceful eccentric, the practical users of which have no trouble or cause of complaint. It is the rule in locomotive repair shops to find cylinders, frames, rods and eccentrics, that have been in use 25 years, and it is not easy to see the necessity of doctoring or removing them, as they are the last things in an engine to heat, or wear out, or get broken in a wreck.

[The eccentric fastenings employed in this country are generally set-screws. These are reliable in themselves, if they were only easily accessible, and in such a position that a person could get "a fair show at them," as the saying is, but when in addition to the tightly fitting threads, and small heads, the detail in question is off in one corner, behind another casting, and so situated in general, as scarcely to be seen, even, it is no small matter to set them down solidly on the axle. Aside from this we may go further, and say that in cases of abrading the seats of the set-screws, the wheels may slip and jam hard on the burrs so made on the axle, which necessitates a great deal of pinching and jamming and prying through frames before the wheels (eccentrics) can be got into place again.

All this is certainly unnecessary. An eccentric has one place on the axle, with reference to the crank-pin and valves, beyond which it cannot be moved without detriment to the performance of the machine, and this place once found, the wheel should be immovably fixed in it.

By whatever methods this is obtained the result will be good; the cheapest and simplest is unquestionably the best.—EDS. MECHANICAL ENGINEER.]

◆

THE LARGEST STATIONARY ENGINE IN THE WORLD.

Messrs. Hick, Hargreaves, & Co., Bolton, England, are now engaged on the most powerful cotton mill engines ever made. They are intended to work the machinery at one of the mills at Bombay, and are of the horizontal type, of 4,000 horse power, with high and low pressure cylinders, and a pressure of 100 pounds per square inch, the piston speed being 720 feet per minute. The cylinders are 50 inch and 84 inch diameter respectively, the stroke being 8 feet. The fly-wheel is of the enormous weight of 140 tons, 30 feet in diameter, and about 15 feet wide on the face, which has sixty grooves for ropes. The shaft, which is of forged steel, is hollow, its dimensions being 25 inches in diameter and 25 feet in length. The low pressure cylinder weighs 32 tons, some of the other castings weighing upwards of 25 tons each. All the latest improvements have been introduced into these engines, including Messrs. Hicks, Hargreaves & Co.'s new patent Corliss valve gear, which is applied to both the high and low pressure cylinders.—*London Engineer.*

◆

The Winans Packing Manufacturing Company, of this city, are producing an excellent article for engineers' uses, as we can testify from a visit to their works and inspection of their methods. Their goods are simply the old-fashioned square gasket in form, made of best selected fibre, free from shives, grit, or anything calculated to score rods. With this is thoroughly incorporated a superior quality of plumbago, the whole forming a durable packing for stuffing boxes, that will wear well and give piston-rods and valve-stems a silver-bright appearance.

Being square, the packing conforms well to its place with very little compression, making a steam-tight joint with the least possible friction. These goods seem to us to be very desirable, and we think our friends will thank us for calling their attention to the advertisement on back page, inside and out.

◆

Technical information of more or less value is sometimes found in the daily press, as witness these paragraphs:

> What is a tinker's dam? Why should a tinker want a dam, and of what use is a dam to a tinker, in or out of his profession?—*Graphic.*
>
> As our esteemed contemporary is in pursuit of information, we will reply that a tinker's dam is a dam of dough or other suitable material, constructed by a tinker to confine his molten solder to the business at hand; and that, inasmuch as when a tinker's dam has once served its purpose it possesses little or no commercial value, the phrase has come to be a frequently used, and almost universally understood synonym for worthlessness.—*N. Y. Sun.*

◆

We observe that some manufacturers in their catalogues give long instructions and directions how their goods are to be ordered, and what customers, in prospective, must do to get them. In some catalogues these instructions cover a page, and are mandatory in tone, so that the customer is put rather in the aspect of one who is granted a favor by receiving the goods at all. A careful study of the catalogues is requested, so that goods may be called by the names the manufacturers append.

The conditions thus imposed would seem to the average buyer to be in the nature of circumlocution and red tape, and he would perhaps turn to some other concern who gave no instructions as to what he must do.

◆

OVERHANG IN MACHINES.

It is impossible, no doubt, always to do just what we wish in designing machinery, and it is of importance to know how best to secure stiffness when overhang, or its equivalent, must be introduced. The best method of doing this, and one little practiced, because little understood, lies in the application of the principle of initial strains. In other words, that portion of the machine where elastic motion is to be avoided, is first exposed to an initial strain greater than any that will be put on it by the machine. To make this statement as clear as possible, let us suppose that a shaft bearing has to be carried on a flat wrought iron plate 1 in. thick, 12 in. wide, and overhanging 2 ft. Such a plate will be certain to vibrate if a shaft carrying heavy pulleys revolves rapidly in the bearing, and it will do this because the metal has no initial strain on it worth mentioning, and its powers of resistance are not called into action until some motion has taken place. If now we carry down from the end of this plate and secure to the floor a small rod of iron fitted with a nut and screw, we can put a bending stress on the plate which will be much in excess of anything that the working of the shaft can produce, and we shall have at once a sufficiently stiff base for our plummer block. Of course we have here supposed an almost impossible case, but its analogue is not far to seek. It is well known that in certain types of horizontal engine, with wrought iron frames, the side plates will "whip" in and out at each revolution, owing to the fact that the crank-shaft is itself not quite stiff. The frames whip because they have no initial strain on them, and easily yield to a slight impulse. If now these frames were originally made with a camber outwards, and they were then drawn straight by transverse rods screwed home tight, whip would be impossible, because the plates could not bend inwards, for they had been set outwards, and pulled hard against the bolts holding them together; and they could not go outwards because the bolts resist motion in that direction. Here, then, stiffness could be got with a minimum of metal. But the great advantage of this system of initial stress for obtaining stiffness lies in the fact that very light tension rods can be made to take the place of heavy bars.

Let us suppose that we have a structure mounted on four legs, like a table. We can secure stiffness by putting stout plates between the legs, and these plates must be heavy, for they have to be thick enough to act as struts, and must not bend. But just the same result could be got if, to begin with, we spread the legs of our table a little, and then brought them back to the perpendicular by the use of small tie-rods. Under almost every conceivable circumstance these tie rods must remain in tension; and this being so, all the stiffness that could be obtained in any way is obtained.

To take an extreme case, can anything look worse than an overhanging wheel mounted on a shaft about a foot away from a bearing? Here the line of stress falls a long way outside the lines of resistance, and is very far, indeed, from being surrounded by them. Certain makers of traction engines used to be notorious offenders in this way. We fancy their sins have found them out, for "air bearings" are not so plentiful as they were at one time. A favorite modern expedient for securing stiffness is the use of plenty of material, and this has called into existence certain massive types of horizontal engine now growing in favor. These engines have tremendous bed-plates and not much else to recommend them. We fear it must be admitted that Mr. Corliss, an American engineer, first taught us how a horizontal engine bed-plate should be made. The use of mountains of cast iron, not only in steam-engines, but in other machinery, will, no doubt, secure stiffness,—and mere massiveness has a beauty and fitness of its own—but the highest type of engineering skill is shown by the man who can so dispose his materials that he gets the best results with the smallest quantity of them. The modern locomotive of the best type, and some marine engines supply admirable examples of what we mean.—*London Engineer.*

◆

A German patent has just been taken out for the manufacture of bottles, etc., from cast-iron, containing twelve per cent. of silicon, a compound which is said to resist action of the strongest acids.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. JOHN BECKER, 28 Oliver Street, Boston, Mass.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

PULLEY COVERING.—Norris' Patent Lip Rebate cures slipping belts. Leather (double), rubber (four-ply, three canvas.) Send pulleys to be covered immediately, or drop postal to TABER, Manufacturer, 5 Barclay Street, New York.

BOILER SCALE.—Parties having fine specimens for Sale of Loan for Exhibition, address.
JAS. F. HOTCHKISS, 84 John St., N. Y.

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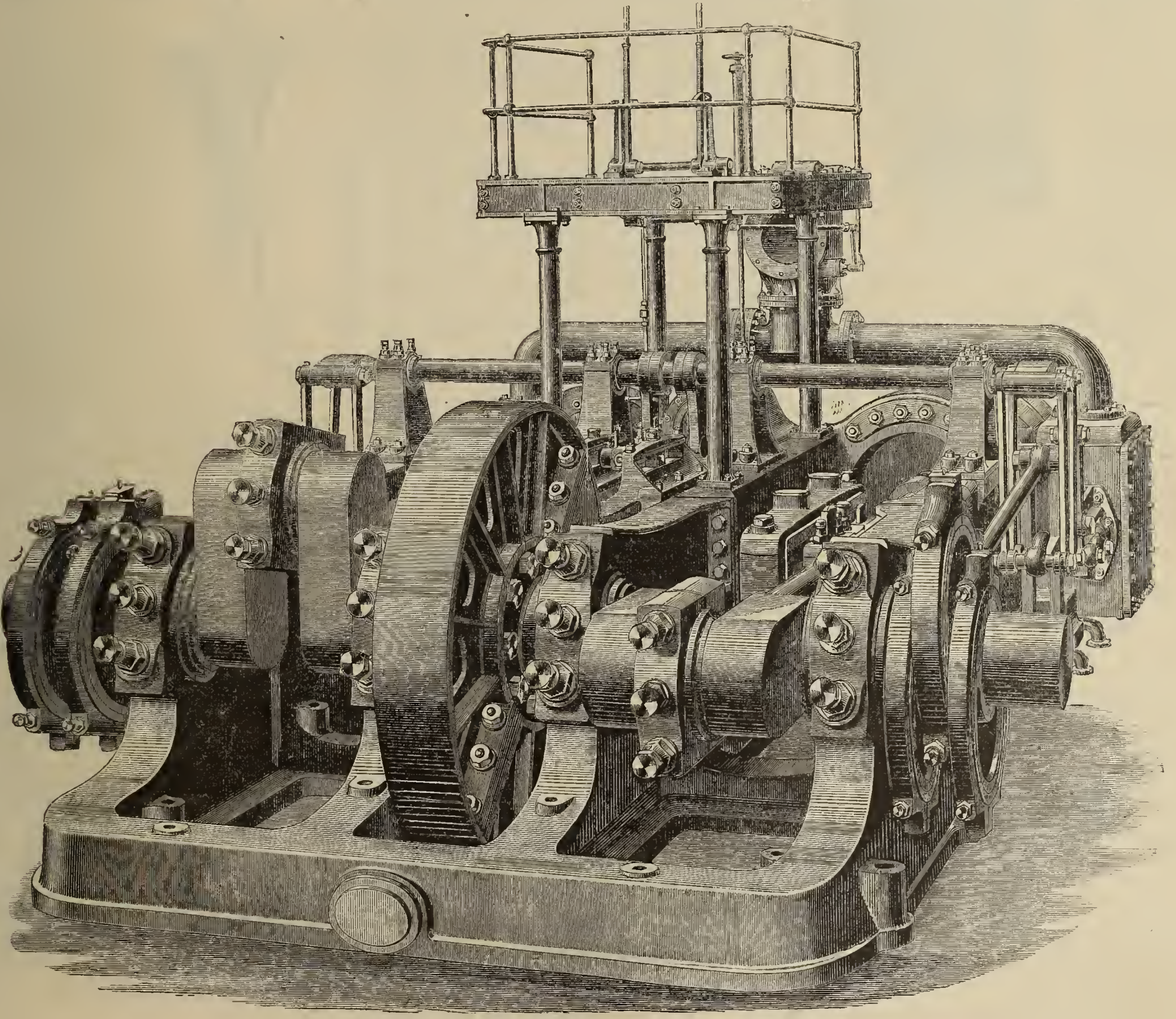
STEEL RAIL-MILL ENGINE AT THE SCRANTON STEEL WORKS, SCRANTON, PA.

Our engravings this week represent the engine driving the rail trains at the Scranton Iron Works and, as will be seen, they are massive in construction. The principal dimensions are cylinder 48-in. diameter by 54-in. stroke. They are overhung and have balanced slide-valves and link-motion which is shifted by a steam cylinder. The crank-shaft is 18-in. diameter in the bearings, 20-ft. long and weighs 13 tons. It is in two parts bolted together in the center, the flanges of the couplings being used for carrying the balance disc. The total weight is about 150 tons.

These engines are of English design and construction, built by Davey Brothers. We take this illustration from *Engineering*.



Steel Rail-Mill Engine at the Scranton Steel Works, Scranton, Pa.

One of the tallest chimneys in the world is the well-known "Townsend Chimney," Port Dundas, Glasgow. The total height from foundation to top of coping is 468 ft., and from ground line to summit 454 ft.; the outside diameter at foundation being 50 ft., at ground surface 32 ft., and at top of coping 12 ft. 8 in. Number of bricks used in the erection is as follows: Common bricks in chimney, 1,142,532; composition and fire bricks for inside cone, 157,468; common flue bricks, 100,000; total, 1,400,000; weight, 7,000 tons.

Jay Gould's new steam yacht is a vessel of 700 tons, 225 feet long, 26 feet beam, and 14 feet deep. She draws 11 feet of water and carries 2,000 H. P. She is fitted up sumptuously, and cost $250,000.

NOTICE.

T. G. Oliver is our accredited traveling agent in Canada, and is authorized to collect for us on account of subscriptions. Mr. Oliver is an elderly man of large stature, and full white beard. No other person, using the same name, will be recognized by us.

QUITE HANDY!

This is one of the paragraphs that will be copied far and wide by papers which quote without reading:

> "A handy method of finding the speed of a locomotive when the size of the drivers and the number of revolutions are known has been given by Professor Frederick Steiner, of the High Polytechnical School, Prague. He takes 2-11 of the locomotive wheel diameter in inches, and the result is a number which represents in seconds the period during which the revolutions of the wheel equal in number the speed of the train in miles per hour; 2-11 = 0·179, so that with a locomotive having wheels 55 in. in diameter, if it is observed that in 2-11×55 = 10 seconds, it makes twenty-four revolutions, the speed of the train is twenty-four miles an hour."

Its "handyness" may be readily seen at a glance, for when we know the revolutions and size of driver we have the number of feet traveled by them in any given time, which, divided by 5,280, the number of feet in a mile, tells the distance run for any period.

The fly-wheel for the Chicago pumping-engine weighs about 65 tons, and has a rim two feet deep by nine inches wide on face. It is 32 feet in diameter, and is built in segments and bolted together.

ROUND PEGS IN SQUARE HOLES.

It often happens in the economy of the shop that some one is put into a position he is incapable of filling satisfactorily, and everything halts by reason of it. We call to mind a person in charge of engine works some years ago who had been brought up in a tool-shop where the fitting is of an entirely different character to that of steam engines. This man had many friends who knew of his disabilities, as regards acquaintance with the work, and they went to him and said that if he wanted any information they would give it. He waved them all aside and replied that he would show them how steam engines should be built! He did not keep his word.

He had all the fits made iron and iron. The glands of the piston rod stuffing boxes fitted the rods so tightly that they would scarcely slide down when the piston stood on the floor; the shafts were all collar-bound in the boxes, and everything else was of the same character. The consequences were soon seen when steam was put on one engine in the shop, and afterwards the man was willing to acknowledge that there were some things he had not learned

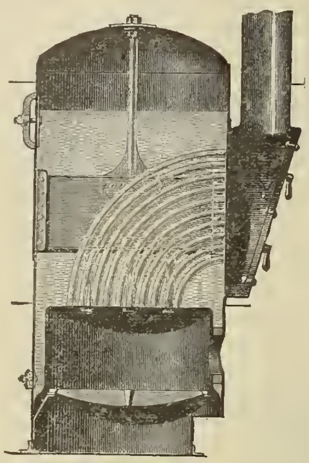
Doubtless many instances like these can be found in the experience of all, and they are familiar examples of round pegs in square holes. They don't fit; the round pegs keep good square pegs out of their places and they should be put where they belong.

The *Meteor's* so-called engines have been put in the scrap-heap!

"In the Round House" commences in No. 11.

HOW NOT TO DO IT.

Illustrations are sometimes valuable as showing errors in construction—how not to do it, in short; and this engraving of an English vertical boiler is a case in point. The faults in it are manifest at a glance. Smoke and flame take the shortest and easiest road to the stack, and the lower and shortest row of tubes (where there is also the least water) will be the hottest. The bent flue is also objectionable on account of its tendency to leak; it is longer hot than cold, and will therefore always incline to push through the tube-sheet, despite the immense horizontal girder introduced in the shell as a brace. A boiler with the flues on one side and the water on the other seems to be a very good thing to avoid.



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We note that a correspondent of the *Mining Herald and Colliery Guardian* writes that the patent fuel so much used in England and Wales is made by mixing five per cent. of pitch with clean, small coal. This is packed in moulds, compressed, dried, cooled, and sold within twenty-four hours. Bricks for export are made about 10×6×8 inches, rounded at the edges to prevent the corners chipping off, as, being porous, they will absorb water like a sponge when the outside skin is taken off. For domestic use the bricks are made two inches thick, and 4×5 inches square, and perforated with holes to assist combustion. The bricks are grooved so they can be easily broken into four pieces.

* * *

It is stated that a gun for splitting logs is being made at a foundry in Marysville, Cal. It is to be charged with a half pound of powder, and then screwed into the end of a log and fired by means of a fuse. Log-guns of similar pattern are in use in Australia.

* * *

Back numbers complete can be had of Volume 4, 1882, and to date, by early application.

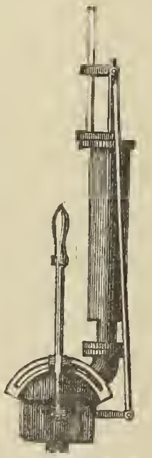
* * *

A STEAM DEMON!

Musical notes are the result of vibrations. A given number of them, in a given time, constitutes the pitch of the note. The length of a tube governs the pitch also, and as it is increased or decreased so the sound given out varies.

Acting upon this principle, an English inventor makes a steam-whistle of varying notes or tones, all derived from one tube, as shown in the engraving. The tube, or cylinder, which answers to the ordinary bell in the usual steam-whistle, has a piston in it, which is worked up and down by the handle attached to the bell-crank, thus lengthening or shortening the tube and varying the sound in the same degree. With this apparatus a long drawn steam-howl, or yell, could be given, demoniacal shrieks could be produced, or gruff barks and shrill squeaks alternately. In the hands of a frisky and not sensitive engineer the most untuneful sounds would salute the air. Its possibilities are appalling.

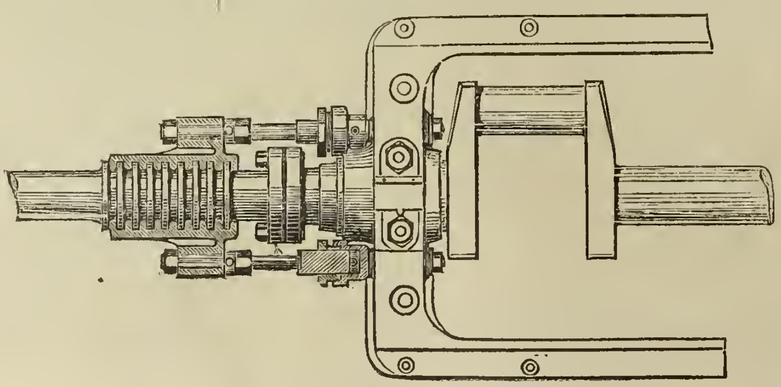
This is not a mere invention, but an article of trade regularly sold in England.



APPARATUS FOR ASCERTAINING THE THRUST OF A SCREW PROPELLER.

"Two ram cylinders were securely bolted to the bed-plate of the engine, one on each side of the aftermost main bearing, and the rams were secured to the thrust block, which is generally bolted down to a bearer in the boat, but which in this instance was left quite loose, and allowed to move freely in a forward and aft direction. It was prevented from revolving by means of two stays, secured at their upper ends to the deck. It will be seen that, with this arrangement, immediately there is a thrust on the shaft the thrust block would move bodily forward, pressing the rams into the cylinders. Copper pipes were led from these cylinders to pumps and to pressure gauges fixed in the after cabin, where they could be conveniently observed. As the rams were exactly six square inches in area, and as the exact pressure per square inch could be read off on the gauges, it was a very simple matter to arrive at the total amount of the thrust. There were three pressure gauges for the sake of comparison, and three pumps, two of them being ordinary vertical reciprocating hand-pumps, and the other a ram worked by means of a screw. The vertical hand-pumps answered the purpose very well for pumping the ram cylinders full of oil in the first instance, but owing to their intermittent action they were unsuitable for use while any records were being taken. The pump having its ram worked by a screw was found by its steady and uniform motion to answer well, giving the utmost pressure required without difficulty. On first testing the apparatus the pressure gauges vibrated very considerably, too much so for a correct reading to be obtained, which it is believed was due to the unequal strains on the shaft during each revolution. To obviate this, a large air vessel was placed on the pipe uniting the rams with the pressure gauges. The greatest thrust on the shaft obtained was 4,080 lbs. at 15·735 knots.

The coupling between the thrust shaft and the crank shaft was of the usual type, steel bolts being secured in the one coupling, passing loosely through holes bored out in the other. Consequently, when the thrust came on the shaft and it moved forward, the amount of pressure registered on the rams would be equal to the thrust on the shaft, minus the friction due to these bolts sliding through the holes and the friction of the rams themselves. Then, by working the pump and forcing the stern shaft in a sternward direction, the pressure obtained on the rams would be equal to the thrust, plus the friction on the bolts and the rams. The mean between these was taken as representing the thrust, and to be as accurate as possible several pairs of these observations were made at each speed, and the mean of them taken as a fair estimate of the actual thrust."



No mention is made of the size of the wheel, or other dimensions, in the *Engineer*, from which this account is taken.

* * *

A Marine Engineers' Benefit Association recently organized in Erie, Pa., has the following-named officers: President, John Engliss; Vice-President, Jas. Mahony; Treasurer, A. Rencald; Corresponding Secretary, Silas H. Hunter; Financial Secretary, W. T. Swain; Conductor, W. Samberton; Conductor, W. Wilson; Chaplain, Jas. Hunter.

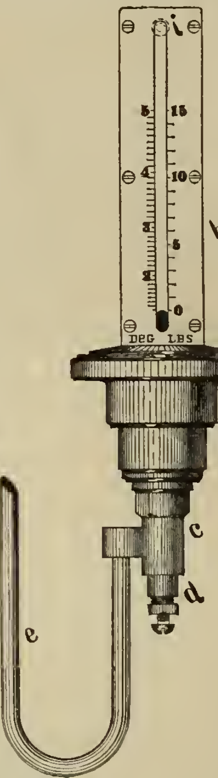
* * *

Bird's-eye maple is used for firewood in Michigan, and sold for $160 a thousand in Liverpool.

SHAW'S MERCURY PROCESS GAUGE. RECORDING PRESSURES AND TEMPERATURE.

A most useful steam gauge, combining functions peculiar to itself, is here illustrated. It not only regulates pressures accurately, but it also gives the temperature due to them, a feature that will be found of great value to all processes requiring steam heat; as sugar-boilers, fruit-canners, glue-makers, and many others in the trade.

The illustration represents the gauge about one-quarter the real size. The right-hand index represents pounds, and is marked up to 15 lbs. The left-hand figures, or index, represents degrees of temperature of Fahrenheit scale, starting at O, or 212 degrees. The first figure, "2," represents 220 degrees, "3" means 230 degrees, "4" means 240 degrees, "5" means 250 degrees. These are all correct temperatures, taken accurately from the steam pressures, giving a correct record of temperatures without heating the gauge. To prevent direct contact of steam with the gauge, it is connected to the process-kettle, or boiler, by a $\frac{1}{4}$ inch bent tube, *e*, that permits a layer of water in the tube between the gauge and the steam. A round-headed screw, *d*, at base of gauge, permits the setting of the mercury column at the zero mark on the gauge, when there is no pressure upon the gauge. The top of the mercury column is open to the air at *i*, by removing a small screw at the back; this screw is only put in to retain the mercury during shipment, *and must be removed when the gauge is attached for use.* All air must be permitted to escape from the kettle, or boiler, and the presence of steam in the boiler, before noting the temperatures, assured.



The manufacturer, T. Shaw, has been for the past fifteen years the manufacturer of the U. S. Standard Mercury Gauge, the principles of which are embodied in the above-described Process Gauge. Address him at 915 Ridge Avenue, Philadelphia, Pa., for price list.

* * *

One of the older railways of this country will send to the Railway Exposition at Chicago a section of "T" rail which has been in continuous use from 1838 to the present year. It is intended to accompany it with statistics showing the total tonnage which has passed over it during its forty-five years of service, and also a history of its experiences during that period.

The same railway will claim to enter the "oldest railroad man in the United States"—that is, the man who has seen the longest term of continuous railway service. His railway life began several years previous to that of the rail mentioned above. What stories he can tell about railroading in the early days!

* * *

Here is another mess to put on a belt, going the rounds:

> "An oil for belting is recommended which consists of nine parts of linseed oil and four parts of litharge ground in water; these boiled to a plastic consistency and then liquefied by an addition of turpentine, furnish an oil which possesses, it is said, many admirable qualities."

It must. As we understand it, litharge is put into paint as a drier, and would have the same effect on boiled linseed oil—that is, it would form a hard, drying varnish on a belt!

Put nothing on a belt except good neatsfoot oil, to keep it pliable.

* * *

A series of lectures upon "Organic Scale Formation," by N. W. Williames, will commence in our next issue.

A WEEKLY EDITION OF THE MECHANICAL ENGINEER.

We have made some allusion to this subject before, and may not have been explicit in our statements in regard to its establishment; but lest some think that we purposely evade this question, we will here state an obstacle in the way of a speedy weekly issue. This is the present size and amount of reading matter. Our readers will see that we give in every issue twelve solid pages, and that it would require a large force of assistants to double this up. As it now stands, THE MECHANICAL ENGINEER, by publishing fortnightly, is enabled to give almost as much reading matter as a weekly paper, at a much less price. These considerations should not be overlooked. In some respects it is a disadvantage to appear fortnightly, and, for our own part, we shall be quite willing to announce a weekly edition so soon as we are warranted in so doing.

THE MECHANICAL ENGINEER has had to make its way against many established papers, in the field years before it; and that it has been able to do so, hampered by many disabilities, is owing largely to the appreciative spirit of engineers and machinists, who were glad to see it succeed and willing to aid its aims.

We cannot speak decidedly upon the establishment of the weekly issue, but we hope that the coming season will mark so great an advance that we can announce it with Jan. 1, 1884. At no period since its establishment has the paper been so prosperous.

A CRITICISM.

What is the matter with the average draughtsman, or delineator, that he cannot make anything approaching mechanical correctness in his pictures? Here, for example is a locomotive wherein the boiler-check sits upon the guides, and the feed-pipe thereof is curled gracefully into the body of the connecting rod; the side rods are within two inches of the tires on a six-foot driver, and the cross-head end of the connecting rod is driven from the steam chest stuffing-box. In a steamboat engine the beam is a wonderful structure, and has steam pipes attached to the top, wherefrom steam is blowing off. In another design before us, the cover of a technical paper, a blacksmith is sitting on a spur-wheel, part of which is cut spiraly, as to the teeth, and the rest straight. It is not to be supposed that artists are mechanics, but it is to be expected that they will copy what is before them. When they depict the human face divine they do not represent a man with his nose on the side of his ear, or his whiskers attached to his forehead, yet these incongruities are no worse than the pictures of machines we see in public prints.

BUTT-WELDING FOUR-INCH SHAFTS.

"There may be some readers interested in my account of how I welded a large shaft recently. It was twenty feet long and four inches in diameter. It had been broken in two places. I first had a good clear fire prepared, then upset the ends, punched a $\frac{5}{8}$-inch hole in the ends of each piece, as near the center as possible, and put a plug in these holes so as to keep the pieces in position while heating them. I then placed them in the fire, held together in position by the plug; took a good welding heat and welded them in the fire. Two men, one at each end of the shaft, did the business with sledges. I then took it from the fire and smoothed it on the anvil."—*Blacksmith and Wheelwright.*

This is good for those who like a weld of that kind.

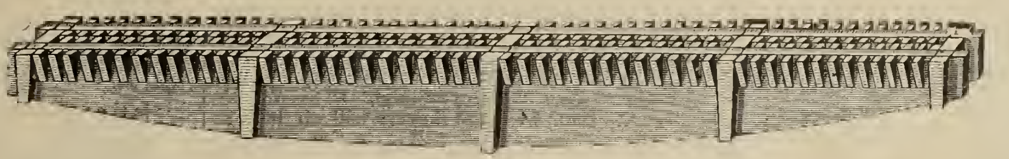
Back numbers complete can be had of Volume 4, 1882, and to date, by early application.

"In the Round House" commences in No. 11.

MAILER'S GRATE BAR.

Mr. John Mailer, of San Francisco, Cal., a practical engineer of experience, has introduced a form of grate-bar which has had an extended use in that city, and is found to answer its purpose exceedingly well. It is very durable, and with any sort of decent firing and attention, will keep a clear bright steam-making fire at all times.

Its general form and design is well shown in the engraving herewith, by which it will be seen that the air space is ample, and that the material is well disposed, uniformly throughout the structure. It neither sags nor warps, and the best evidence that can be given of its utility is the fact that a set of them were in use in the Pacific Woolen Mills for six years, and were in good order then, when the mill was abandoned. It is guaranteed to stand the hardest firing. Parties wishing a good bar can address John Mailer, cor. Diamond and 23d Sts., San Francisco, Cal.

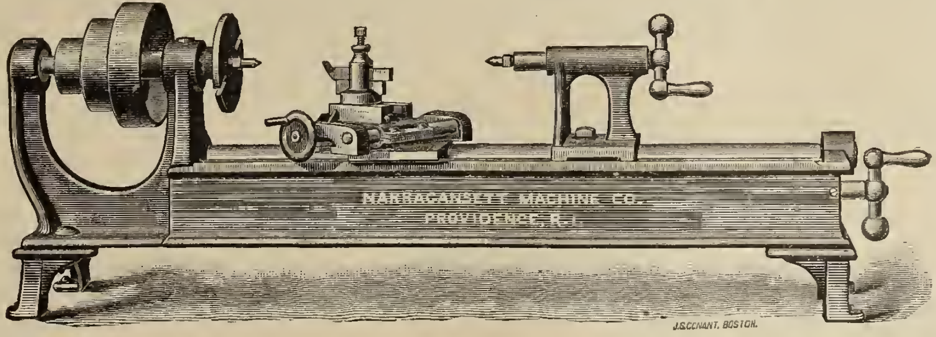


The weathering of brick walls into a friable state is usually attributed to the action of heat, wet and frost; but from recent observations of M. Parize, the real destroyer is a microscopic creature, and the action played by the weather is only secondary. He examined the red dust of crumbling bricks under the microscope and found it to consist largely of minute living organisms. A sample of brick dust taken from the heart of a solid brick also showed the same animalculæ, but in smaller numbers. The magnifying power of the instrument was 300 diameters, Every decaying brick showed the same kind of population, but the harder the brick the fewer were noticed.

THE PROVIDENCE BENCH-LATHE FOR CONTRACTORS, MACHINISTS, AND OTHERS.

One of the most generally useful tools we have seen in a long time is here illustrated. As our readers will discover for themselves, there are many places where small lathes of this class are very convenient, in a tool room for example, where small spindles have to be made, or rings faced up; any job in short that is likely to be required. Also in shops where brass goods are manufactured there is plenty of work for just such tools.

In construction the lathe is peculiar and like no other extant. This feature renders it possible to sell it at a low price; it is a marvel of cheapness, and withal well made. As will be seen the lathe has a slide-rest, adjustable at any angle, and carriage, tail-stock and head-stock, hollow steel mandrel, all fitted in the orthodox manner, with no dodging of execution of detail. In addition the carriage is capable of being fed along the ways by a screw running the entire length of the bed. This screw is shown, as to its handle, on the end of the bed. Above this is a guide-shaft, so called, which also runs the whole length of the bed. On this, and the ways, the carriage rests, and is kept true in its passage from one end of the work to the other. This is one of the peculiar features of the lathe and by it an accurate working lathe is afforded at a small cost. The price of this lathe, we will mention here, is $30, and it is certainly very low for its conveniences. The swing is 8-in. and between centres 18-in. Counter-shafts with all fixtures complete are furnished at an additional charge.



These goods are made by the Narragansett Machine Company, Butler's Exchange, Providence, R. I., who also make foot-lathes upon the same principle.

Wm. T. Comstock, architectural publisher of this city is bringing out a new book to be entitled "*American Cottages,*" which, he informs us, will be ready early in May. The purpose of the volume will be to give designs, of good style, that can be built at a low cost, and to furnish examples of what may be done by a man of taste and culture, even if he has not an unlimited pocket-book.

A FIRE DEPARTMENT COMPULSORY ON SHIP-BOARD.

At the annual meeting of the Board of Supervising Inspectors of Steam Vessels, held in Washington, January, February, 1883, in pursuance of Section 4,405, Revised Statutes of the United States, the following rule was approved by the board, and has also received the approval of the Secretary of the Treasury:

"It shall be the duty of the master of every inspected steamer carrying passengers on the ocean, lakes, gulf[s], or bays, when such steamer is under way, to cause to be prepared a station-bill for his own department, and one, also, for the engineer's department, in which shall be assigned a post or station of duty for every person employed on board such steamer, in case of fire or other disaster; which station-bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week to call all hands to quarters, and exercise them in the discipline and use of the fire pumps, and all other apparatus for the safety of life on board of such vessel, and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log-book, stating the day of the month and hour when so exercised, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce said rule shall be deemed cause for the revocation of the license of such officer. Upon navigable rivers, the captains of all passenger steamers shall be required to maintain a strict discipline and organize the officers and permanent crew so as to act with promptness in extinguishing fire; and the captain shall cause to be prepared at least two station-bills, assigning the officers and permanent crew to definite places; said station-bill shall be conspicuously placed, under glass, near the inspection certificate."

Send for the manual of the American Manufacturing Co., Waynesboro, Pa., on Evaporating Fruit. It contains much information, tables, yields, statistics, etc. Fully illustrated. Sent free on application.

A German technical paper says: "The increasing population and decrease in the number of cattle in civilized countries increases the demand for butter to such an extent that it is simply a question of time when all the tallow will be converted into sham butter. As the makers of this article can always pay a higher price than the soap manufacturers, the latter will soon have to renounce the use of tallow entirely."

Most of them did renounce it long before oleomargarine was heard of. The ordinary soap of trade has about as little tallow in it as possible, the grease being chiefly soap-fat and vegetable oils.—EDS.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

CONCERNING SIGHT-FEED LUBRICATORS.

Editors MECHANICAL ENGINEER:

In looking over my paper of April 14th I read the editorial "Notice," stating that you had bought the entire interest of THE MECHANICAL ENGINEER. I can honestly say that it pleased me the most of anything that I have read in a long time; and that is saying a great deal.

I also prefer to have THE MECHANICAL ENGINEER fortnightly rather than weekly, and for this reason: I think the reading matter more interesting and instructive than it would be if issued weekly. I think it the best engineer's journal I ever saw, and do not see how any engineer can afford to be without it.

I would like to ask a few questions of the readers of this paper who are using sight-feed lubricators for cylinders and valves of their engines. About four months ago the owner of the saw mill in which I am employed had a lubricator placed on the engine on trial. We used it about thirty days. At the time the lubricator was placed upon the engine the cylinder and piston were perfectly clean. After four or five days use I removed the cylinder-head and follower-plate to adjust the piston packing. The cylinder-head and plate were coated with a hard, gummy substance, as were also the cylinder and piston. Between the piston and plate there were ten or twelve balls, in size from $\frac{1}{8}''$ to $\frac{5}{8}''$ in diameter, which, when cold, were harder than beeswax. I cleaned the piston and cylinder, and after running three or four days removed the cylinder-head, and found things in the same state a second time. The only lubricant used at this time was pure tallow, of which I used about $\frac{3}{4}$ pint per day of nine hours; the size of the engine is 12″ bore × 18″ stroke; speed 130 revolutions per minute; boiler pressure 70 pounds per square inch; which is the least pressure we can run the engine full speed on. After using the lubricator eight or ten days thus, I mixed about $\frac{1}{8}$ mineral oil with the tallow—sometimes using more sometimes less—but with no better results. I used the lubricator about thirty days, and then took it off and put on instead a common cylinder oil-cup, in which I used about twice as much lubricant. The cylinder and piston remained clean.

I would like to ask if all graduated lubricators act in this manner? and if so, what is the cause of it? Since I have taken the lubricator off I have heard of another, about fourteen miles from here, which acted in the same manner.

HANCOCK, N. Y. W. C. P.

[This is a curious state of things, certainly. We confess our inability to see any connection between the sight-feed cup and balling up of the piston. This last is common enough, and often happens with ordinary tallow cups. Tallow is blown into the piston by the steam, and after a time gets conglomerated with more or less dirt, and is rolled into balls by the reciprocating motion. The dirt raises the melting point of the tallow so much that it remains solid; a sort of concrete, in fact. As before stated, this action was known long before sight-feed cups were invented, and is generally owing to an excess of lubricant.

As a rule too much oil is put into cylinders, and we should say that the amount used in this case ($\frac{3}{4}$ of a pint in nine hours) is too much for so small an engine; half the quantity would answer quite as well. Possibly one reason why the cylinder was not dirty with the common cup, is that less oil remained in the cylinder, the greater part of it going out with the exhaust. With a sight-feed cup the oil is admitted drop by drop, and taken up at once by the working parts. We shall be glad to hear of any similar instances.—EDS.]

RESPECTING INDICATOR PISTONS.

Editors MECHANICAL ENGINEER:

I would like to offer some suggestions as to the cause of the trouble with the cards taken by "Caution" from a compound engine, and published in your issue of April 28. The high pressure card shows an aggravated case of one of the most common and serious troubles with indicators, viz., friction of the piston at high pressures.

There are many things that may cause this; like improper adjustment of the instrument, grit in the cylinder, or too large a piston; but the most serious is improper design of the indicator itself. If the latter is the trouble, your correspondent can only avoid it by getting a new and better instrument. I will venture the guess that the indicator with which these cards were taken has no piston-rod to guide the piston, which leaves it free to be twisted over by the spring when the pressure is greatest, thereby causing great friction. It will be noticed that the trouble does not show itself when low-scale springs are used, or with low pressures on high scales. This is because the pressure is not great enough to throw much strain on the piston; consequently there is not much friction. There is some, however, under these conditions, although it does not show on the diagrams.

I will suggest a test to which "Caution" may put his instrument that will determine the amount of friction in it. Screw it on to an engine-cylinder, and place the engine on the dead center; then admit pressure enough to drive the pencil to the top of the drum, and see if the piston moves freely when the pressure is on. To measure the amount of friction, place a paper on the drum, and, while the pressure is stationary, press the levers down as far as the friction will hold them; move the pencil to the paper, and turn the drum; then press the levers up and mark again. If this, or any other, indicator will not stand this test, it is not in fit condition to use.

I hope "Caution" will try this test and give us the results, as the subject is one of great importance to engineers. GILMAN W. BROWN.

Agent Porter-Allen Engine, Boston, Mass.

ROSES IN AN ENGINE-ROOM.

Editors MECHANICAL ENGINEER:

Excuse the question—but what will make roses grow in an engine-room? I had two last winter, expecting to have them climb around the windows, but they didn't climb worth a cent. After a while they got yellow and kinder give out, as you might say. What's the matter with them? What flowers will do best in an engine-room? A FANCY ENGINEER.

NEW YORK CITY.

[There is nothing to apologize for in the question. Why shouldn't an engineer be fond of flowers? The reason our friend's roses did not thrive is probably because the room was too hot for them. Roses need a cool place—not over 60 degrees in winter—and an engine-room is more apt to be 80 degrees.

Perhaps the reason the roses did not climb is that they were not climbers. All roses do not climb.

As to the flowers that will do best in an engine-room, it depends somewhat upon the situation, whether there is much sun or not. A fine vine is the maurandia, easily grown from seed, and a rampant climber and bloomer. It bears trumpet-shaped, lilac-colored blossoms in profusion, and is altogether a most beautiful object. It has immense vitality, and will stand almost anything. Fuchsias are beautiful plants, easily grown in a shady room; so are begonias of all sorts, and geraniums. An engine-room neatly cared for, with flowers in the windows, and perhaps a canary bird for company, is not a bad place to work in.—EDS.]

NOT SO.

Editors MECHANICAL ENGINEER:

Please decide between a comrade and myself upon this point: He says the after crank-pin of a compound engine transmits the power of both engines—that is, supposing the engines to be compound, and standing fore-and-aft in the ship. Is this so? I don't see it. Though perhaps unable to put it in the words you would, common sense leads me to feel that it is wrong.

I meant to say above that he thinks the after crank pin is more likely to break, because it has double the strain on it that the forward one has.

SECOND ASSISTANT.

STEAMER ———, NEW YORK.

[Your friend is in error. There is no more strain upon one crank-pin than upon another, (if the engines are properly made) of two engines connected as you state. The second law of motion is this:

"*A given force always produces the same effect; whether acting upon bodies in motion or at rest.*"

A certain pressure upon a piston is a given force, and produces a certain effect on its crank-pin; it is not to be added to any other crank-pin that may be working alongside of it.

Of twenty men working on cranks in a straight line, each would transmit only his own rotative effort in a given moment of time; the last man in line would not transmit the force, or have to carry the force, exerted by the other nineteen ahead of him. Suppose there were twenty engines in line, all of the same power, what size would the crank-pin of the last one have to be if your friend's statement was correct?—EDS.]

THE STATIONARY ENGINEERS' BROTHERHOOD, NO. 1, OF BALTIMORE, MD.

April 11th, 1883.

Editors MECHANICAL ENGINEER:

Being a constant reader of your most valuable paper, and a member of MARINE ENGINEERS' ASSOCIATION, No. 32, I would say that we also have a "Brotherhood of Stationary Engineers" here. We organized Feb. 1st with nineteen men, and are getting a good many to come in. We charge $2 initiation fee and $8 per year dues; members pay five cents per week to the sick benefit fund. We are working under a charter of the *National Association of Stationary Engineers*, and take in only the best engineers. I think in a few years the stationary engineers will outnumber the marine engineers. We also have an aid society similar to the marine engineers, and pay sixty cents assessment dues. The death benefit is $500.

The following named persons are the officers of *Brotherhood Stationary Engineers*, No. 1, of Baltimore: *President*—David E. Hall, also member of No. 32 Marine. *Vice-President*—Wm. I. Lee, also member of No. 32 Marine. *Recording Secretary*—Samuel F. Rose, also member of No. 32 Marine. *Financial Secretary*—N. Smith, stationary engineer. *Corresponding Secretary*—J. B. McClure, stationary engineer. *Treasurer*—K. Hamilton Schultz, of No. 32. *Conductor*—Geo. Tittle, stationary engineer. *Doorkeeper*—A. Gunsell, stationary engineer. *Chaplain*—Wm. Benhoff, stationary engineer.

We are getting along finely, and have many photographs of engines and pumps sent to us for our hall. We expect to have a license law passed here this fall by the city council.

J. B. McClure is the Corresponding Secretary of No. 212, Baltimore city. No. 32 marine is getting along splendid. We have an entertainment and hop to-night. I expect to be among the boys.

DAVID E. HALL.

President of Brotherhood No. 1, of Baltimore, Md.

DRAW-FILING RODS AND VALVE STEMS.

Editors MECHANICAL ENGINEER:

Some weeks ago my engine was overhauled and put in good order, and among other things the piston-rod was turned off, as it was so badly grooved I could not keep it tight.

After a few weeks running I notice it is beginning to get scored again. When it came from the shop it was draw-filed, and a friend tells me that is the reason of its being grooved again. He says he never saw a draw-filed rod that did not cut. Will you please say if this is the reason, or has anything to do with it?

NEW YORK. "FORTY STRIPES."

[We should say no. A grooved piston-rod is a *cut* rod, and something has cut it. This "something" may be several things—bad packing, dirt falling on the piston-rod from holes in a floor overhead, glands screwed up out of square, leaving burnt-out packing in the bottom of the box, etc., etc. This last is a frequent cause of scoring. A stuffing box begins to leak and the engineer claps a turn of new packing on top of the old, and keeps doing so until he cannot get any more in. Meanwhile the old packing is burnt in the bottom almost as hard as stone. We have seen some that actually had to chipped out with a chisel.

A draw-filed rod is no more liable to cut than any other, if it has proper care; that is where the trouble begins.—EDS.

AN EARNEST APPEAL.

Editors MECHANICAL ENGINEER:

Our *Stationary Engineers Association*, of Canton, O., has just commenced to boom; we are getting new members almost every week, and ere long we will have all the engineers in Canton with us, worthy of the name of engineers.

There are dozens of towns larger than ours that have no societies yet, and I say to them: Wake up! and get out of the old rut; fall in line with us! We want engineers to be what they should be. Let all join hands and help our cause in its onward march to good fellowship, economy of fuel, fewer boiler explosions, less expensive repairs, more engine duty, and a better understanding of the science of steam engineering.

Mr. Editor, I wish you could come to one of our meetings, I am sure you would be greatly interested in our discussions, but as you cannot conveniently come, I will give you an outline of one of them at some future time.

I think every engineer ought to take THE MECHANICAL ENGINEER to keep himself posted in what is going on in his line of business.

Success to it and to the *National Association of Stationary Engineers.*

R. D. BRADLEY, *Vice-President S. E. A.*

SPEED OF PUMPS IN PIT-SHAFTS.

Editors MECHANICAL ENGINEER:

In answer to J. Davis, who asks in number 8, current volume, how fast pumps should be run in pit-shafts, permit me to tell him that they should not exceed 100 feet per minute for safety and best effect.

POTTSTOWN, PA. PIT SHAFT.

THE HYDROSTATIC TEST FOR BOILERS.

The hydrostatic test should always be applied to new boilers, and to old ones after any considerable repairs have been made. This is the only way by which the staunchness of joints and quality of riveting can be tested while the boiler is in position. Its value for this purpose cannot be overestimated, but the combined experience of all boiler inspection and insurance associations, both in this country and Europe, shows conclusively that, when a boiler properly designed so that a fairly complete internal and external examination can be made, has once satisfactorily withstood the hydrostatic test, is put into service, and does its work without showing distress or weakness—the periodical application of the hydrostatic test is wholly unnecessary, and reveals no defects. It goes without saying that the boiler insurance companies are interested to a greater extent than any one else can be in ascertaining and adhering to the method of inspection which is *the most efficient*. The fact that the above ground is taken universally by them ought to settle the question beyond dispute. Indeed, the application of the test according to the rules laid down by its most eminent advocates, is an absurdity. We are instructed by them to first make a careful internal and external examination to determine the proper working pressure, then apply the test. It is evident that, if the man who makes the inspection is competent to fix the proper pressure, the test is unnecessary; if he is *not* competent to do so, there is an even chance that he will allow too great a pressure, and the boiler may be subsequently injured by the excessive test pressure which he applies.

The hydrostatic test in itself gives us no knowledge of the actual strength of a boiler unless we burst the boiler by means of it. It does not reveal the presence of scale, sediment, corrosion, burned and blistered plates, and the thousand and one things that are every day discovered by professional inspectors, who prefer to use their eyes instead of a pump, although the former involves much more hard and disagreeable labor.

It may safely be asserted that ninety-nine per cent. of all explosions which occur are due to causes which the hydrostatic test would utterly fail to reveal, while the remaining one per cent. is due to some defect which would be more readily discovered in some other manner.

The fixing of a safe pressure for an old boiler is one of much difficulty sometimes, and can only be done by a man who has had a long experience and a chance to watch the actual behavior of all kinds of boilers under varying conditions of use. It is something which from its very nature defies any attempt at calculation or to reduce it to a set rule or formula. It is amusing sometimes to see the confidence with which experts, so-called, in giving testimony before coroner's juries, will "figure out" the bursting pressure of a boiler, which perhaps they never saw, which might be in good condition, or might be corroded in places to the thinness of writing paper. All such attempts are sheer nonsense.—*The Locomotive.*

BRONZE POWDER AND BRONZING.

Bronze powder is finely pulverized metal or powder having a metallic base, applied to the surface of various articles for the purpose of imparting a metallic color or luster.

Gold powder for bronzing is made by grinding leaf gold with honey, dissolving the mixture to obtain the gold by deposition, the honey water being decanted. German gold is a yellow alloy leaf similarly treated.

Mosaic gold is prepared by incorporating and grinding: tin, 16; flower of sulphur, 7; mercury, 8; and sal ammoniac, 8; then subliming the amalgam. A flaky gold colored powder remains in the matrass.

Copper powder is obtained by saturating nitrous acid with copper, and then precipitating the copper by exposing iron bars in the solution.

Bisulphide of tin has a golden luster, flaky texture, and is used for ornamental work, such as paper hangings, and a substitute for gold leaf.

Dutch foil, reduced to a powder by grinding, is also used, and powdered plumbago gives an iron colored shade.

Another kind is made from verdigris, 8; putty powder, 4; borax, 2; niter, 2; bichloride of mercury, $\frac{1}{4}$; grind into a paste with oil and fuse them together.

Another (red): sulph. copper, 100; carb. soda, 60; mix and incorporate by heat; cool, powder, and add copper filings, 15; mix; keep at a white heat for twenty minutes; cool, powder, wash and dry.—*Glass Ware Rep.*

MANAGING A RAILROAD.

Any one can manage a railroad. Nothing is easier. It is only necessary to sit in an office and issue orders, and the trains come in and go out. Passengers get on and get off. They pay cash down on the counter before they get their goods, and the whole affair runs itself. All the superintendent has to do is to sit in his office and look dignified, bland, or forbidding, according to who approaches. If an "ordinary person" appears, he is coldly received; if one of the influential directors turns up, the superintendent *has* to be bland; but if a master mechanic's wife wants a pass to a large town to do some shopping, the superintendent is a bigger man than the Shah of Persia; but that is all part of the business. The actual fun commences when the trains get out of time, when a block takes place through a break down or a washout, or any of the thousand things that are always happening to bother railroads. There is more fun when the hands strike, and it waxes livelier when the master of transportation can't get rolling stock enough back from connecting roads to do his own business with. Perhaps, as a sort of variety in the monotony, some rival line cuts rates when they were already too low for profit, or else some clerk, whose time is worth five dollars a week, tries his maiden pen on a series of "articles" in the daily papers, concerning the stupid mismanagement, and incompetency of the superintendent. This hurts, for there are times when a man would sooner be kicked by an elephant than be stung by a mosquito.

Pity the railroad superintendent, and don't seek a similar situation, or entertain the idea, for his lot is hard! True, he sometimes wears good clothes, and sits in a black walnut office; but that is only when he has nothing else to do. In that way he takes his recreation; a man must rest sometimes! When he is at work he works like a horse. Every one has a hack at him; he is the one center-pin which carries the load; like Atlas, he carries a little world on his shoulders. Give him a rest sometimes. When he is in his office, doing nothing but answering a thousand questions an hour, or writing fifty letters on matters of no importance to him personally—when he is enjoying himself in this way, give him a rest. Don't be eternally nagging a man who is worked to death.

NOTES ON STEAM BOILERS.

It requires no very forcible argument to convince the average manufacturer that more than one facility is necessary for boiler-feeding purposes, yet an idea obtains most anything will answer for a safety valve. If it is hinted that two safety valves are essential the proprietor will reply that this would not augment the safety of the boiler one iota, he is willing to rely upon one safety valve, and, perhaps, a very fallible one at that.

Engineers should give the safety valve requisite attention to prevent corrosion, and make sure it is blowing when the gauge records the limit of pressure at which the valve is set to blow. If the gauge and valve do not agree, investigate at once to ascertain which is wrong. Compare the gauge frequently with one known to be right. Unreliable safety valves should be closely watched, and care should be taken, on banking the fires, that steam may not form during the night; this has sometimes happened with disastrous results.

The rapid changes in temperature and pressure, to which boilers are usually subjected, can, to some extent, be prevented by the engineer; first, by keeping the pressure as uniform as possible, by closing the damper while firing, by pumping the feed as hot as possible, and by introducing the feed in a locality where it may mingle with the water in the boiler before touching the fire sheets; by careful and frequent firing instead of smothering the flame with fresh coal, by allowing the boiler to cool gradually before emptying; by keeping the fire sheets free of scale, and the tubes or flues free from soot. Some engineers practice opening furnace doors to cool down the fires when the pressure reaches the limit desired. This is wasteful of fuel and injurious to the boiler; cold air is drawn in at the furnace doors, cooling the hot sheets and causing loss and danger.

Internally fired boilers are subjected to excessive strains through unequal expansion. This cannot be avoided, to any great extent, although the kind of fuel burned and proper management of the fire is a consideration of no slight importance. It is essential to keep the fires slightly higher at the sides and corners of the fire-box, for if they are not kept bright but allowed to burn down on the sides and corners, cold air rushes in, in contact with the side sheets, causing unequal strains. Any leak, however slight, should receive prompt attention, as a chemical action commences which would soon cause extensive repairs. The feed should be so regulated as to supply water no faster than it is evaporated. The mode, as practiced by some engineers, of pumping water to the third gauge, then shutting off the feed until the water has settled several inches, is pumping dollars and cents out of the exhaust pipe. By careful observation an engineer can soon determine the proper height to carry the water. Some boilers will carry high water and furnish dry steam, others will not.

In packing hand hole plates, I have sometimes found it a good plan to use a soft gasket, in place of hard packings prepared expressly for this purpose. I have found this particularly desirable if the metal around the hole was distorted or corroded; the metal surely will corrode there if the engineer allows leakage in the slightest degree, for any length of time.

I will relate a case which recently came under my notice, of a boiler that had no hand-hole in the back-head, and both feed and blow-off were attached to the front end. This boiler had been in use some ten years, when extensive repairs became necessary. Corrosion had commenced around the hand-hole, and allowed to go on unchecked, until it had destroyed the lower portion of the head. When the proprietor found that the leak had become serious a boiler maker was called in, who pronounced an entire new head necessary. The expense did not stop here, however, but on further investigation it was found that sediment had accumulated at the back end as high as the second row of tubes, and the first and second row of tubes had to be renewed. It cost a little less than nine hundred dollars to do this job, not taking into consideration the stoppage of the works.

The most curious thing of all was that when the proprietor was advised to have a hand-hole cut in the back end he refused to do so, on the ground that the boiler had run ten years before repairs and would probably last his time, which was all he desired!

I can cite yet another instance where the feed entered a boiler at the front end and the blow-off was attached at the back end. The person acting as engineer had allowed sediment to collect and harden in the blow-off pipe, until completely choked; finally, upon investigation, it was discovered that the blow-off pipe was completely burned off, and it was subsequently removed by being pulled through the masonry, after which the boiler was in use until the end of the week before repairs were made! The circulation had swept the sediment to the back end, and the indurated mass prevented the escape of the water.

Most engineers know that it requires but a short time for mud to choke the blow-off pipe unless it is opened frequently. Prior to unbanking the fires is probably the best time to open it, as the mud which has settled in the pipe, and its vicinity, can be blown out before it is disturbed by the ebullition of the water.

We all know that the extra fuel required to maintain steam in foul boilers (through heat lost) is an important consideration, regardless of danger incurred by their use. It does not seem possible that this state of things should exist, even in extreme cases, as there is plenty of information afloat on the subject in nearly every mechanical journal extant.

SMOKE ARCH.

A new T-piece for a 17-inch plunger pump at the von der Heydt coal mine is strengthened by the insertion of two-inch bolts in the cast-iron. These bolts were put in warm (at about "the temperature of a warm hand,") and it is estimated that in shrinking they exert a force of about thirty-five tons, against the pressure of the water tending to split the casting. The bolts are placed above and below the T-branch, and compensate in part for the loss of strength due to this opening.

A tendency is sometimes observed in individuals who dilate upon common phenomena, to explain the facts connected with them by philosophical principles. We do not criticise this, but the manner of the explanation seems to imply a conviction, upon the part of the individual, that these principles are his exclusive discovery, and that no one else is aware of the existence of them.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

THE MASTER OF THE SITUATION.

Before us lies a letter from a young subscriber who wishes us to tell him what book will give him the questions asked of marine engineers when they are examined for certificates, and what works will teach him to be an engineer. These are questions asked of all publishers of technical newspapers at one time or another, but the answers to them are generally so vague and unsatisfactory that the querist is no better off than before he wrote. At the risk of seeming to discourage such correspondents, we must say that there is not much use in asking for books upon the subject, for the information sought never was within the covers of a book, and never will be—for this reason: That an engineer, fertile in resources and expedients, is the product of intelligence, long experience, and constant study of cause and effect as allied to natural laws. How this can be put into a book, in the form of written instructions, we are at a loss to discover.

Experience is the crop reaped from failures of all sorts. A man learns by his mistakes and those of others, if he is wise, and experience can no more be imparted in so many words than a person can tell what he would do in advance of any event. No book ever made an engineer.

There is an impression extant among some that an engineer is a man in an engine-room, afloat or ashore, who has a sinecure of the most extraordinary character. He draws a large salary, holds a prominent position, and is looked up to in his sphere. He has a very easy time of it, and has only to start and stop the machine, after which there is nothing for him to do but read the paper and answer the foolish questions of visitors; the steam comes from the boiler all the time, of itself, without any attention or further thought.

Silly as it sounds, this is the popular idea of an engineer's responsibilities; but those who are "to the manner born," so to speak, know how far short of the truth it is. They know well enough that sitting in a chair is not idly resting, but that a constant watch is kept up, by sight and by sound, of every action and function. The engineer knows the weak points of his machine, and he is listening to see if they get any weaker, and he is thinking what he will do in case the engine gives out altogether. Or, perhaps, there is no weak point! Suddenly, in the strain of a sea-way, or from too heavy a load in a factory, an important part breaks, and his own life first and that of others is in the balance. Instantly he must do the right thing, without any hesitation, and he must do it at imminent peril and at any hazard. What is that right thing? His experience and that of others, his mother wit and his courage, tell him. No book can. Except in so far as general instructions apply, no printed page can tell a man what to do when his engine breaks down. When the boiler "sulks," if we may use such a term, and refuses to make steam, what is to be done? Where are the written rules which can cover head-winds, bad coal, sail set on the ship that kills the draught by throwing currents right into the stack-top, and a hundred contingencies that are liable to occur to engineers at all times, and for which no rules can be made? There are none, and there never will be any. Forty volumes would not cover the subject of an engineer's experience, and the emergencies that arise and which must be met; for no two days are alike. Things go wrong that in the nature of them should continue to go right. Once a valve, or a dash pot, is adjusted to its duty, why should it not keep doing it?

It is easy to ask these questions, and easy to answer them—after the fact, or after we have found out why they do not; but it is oftentimes very difficult to discover the reason for irregularities. There can be no such thing as a "book engineer."

While we exalt experience as the master in engineering. we do not degrade general education to a lower level. Nothing that we have said can be so construed; but we have tried to convey to our younger readers that a knowledge of natural laws, and their application to engineering, is but a small factor in the problem they are working out. Of what use is it to a young man to take an indicator diagram, for instance, discover a faulty condition of things, and not know the best and quickest way to remedy them? Suppose he was in charge of a sugar estate in Cuba, and in the height of the season the lazy negroes made a break-down, on purpose to loaf, as they sometimes will if not carefully watched. If he cannot repair the engine or machine, in short order, the cane cut sours and a portion of the crop is lost. We might multiply instances indefinitely which go to show that the experienced man is master of the situation, and that after him comes the student. But why should we? Many would differ from us, and for the simple reason that they have had no experience, or at least but a minute fragment of the vast quantity required to make a thorough engineer.

But this lack is in the nature of things, and to be expected. Our remarks are deprecatory of too much reliance upon written rules and stereotyped instructions, and want of experience is a matter time alone can cure. With a determination to learn, the opportunity for it, and correct observation, any intelligent young man can become an engineer, and the longer he lives the more he will find to learn.

* * *

Sulphate of magnesia, sweetened with glucose, has been found as an adulteration in glycerine in the French market.

PERCUSSIVE ACTION OF STEAM.

The effects due to the percussive action of steam are very marked, but not so much commented upon as they should be. That these effects are a factor in many cases of defective working of engines there can be no question. Violent valve motions, if we may use such an expression—those that snatch the valve wide open at a moment, as in some steam pumps, and in a much-lauded foreign invention, which makes an indicator card with absolute rectangles, dead level steam lines, and an exhaust as utter as if cut off with a saw—are examples of percussive action. These are in no wise dangerous, or liable to entail evil consequences; but so much cannot be said of all percussive action. A familiar example of the dangers attending it is found in some alleged boiler-bursting experiments made some months ago by an inventor. This person assumed that all explosions arose from a theory he had evolved. with a view to obtaining a patent on a certain method of construction. He did obtain the patent, and, to prove the soundness of his theory, he built a strong boiler of the ordinary kind. Upon this he carried an extraordinary pressure of steam, and, after repeated experiments, actually succeeded in bursting it by percussive action. That is to say, when the pressure was at its greatest, he touched the boiler off precisely as a gun is touched off, and being overloaded, the result was the same as when there is too much powder in a cannon. The reaction from a charge of steam fired from a boiler into the atmosphere is precisely the same as that of a charge of powder in a cannon —if the structure is too weak to stand the strain it gives way.

Another familiar example of percussive action is that of blowing out cylinder heads of locomotives on starting from stations, before the engine has moved an inch on the track. By careless handling of a too sensitive throttle, a violent pressure is thrown on the head, and away it goes. This head is held down by (generally) ten $\frac{7}{8}$-inch bolts, and any one of these should sustain the total boiler pressure of 150 pounds of steam against the cylinder head. This is to say, more specifically, that all the pressure which can be got upon a cylinder head to blow it off is its area multiplied by the boiler pressure. In the case of a locomotive cylinder, of say 17", and 150 pounds boiler pressure, this would be, in round numbers, only 34,000 pounds. It is very poor bolt iron that will not stand 50,000 pounds to the square inch of section; so it will be seen that, with ten bolts $\frac{7}{8}$ of an inch in diameter in a cylinder head, there is more than ten times the margin of strength (omitting any factor of safety) that is required to sustain the load it has to bear. This only under natural conditions. So soon as any percussive action is set up the head is blown out instantly.

We are thus minute in our mention of familiar examples from a conviction that this action we have noted, and whereof instances innumerable could be mentioned from our own experience, plays no small part in numberless so-called mysterious explosions. Action and reaction are equal and the same, and the boiler, suddenly relieved of strain, is actually under dangerous conditions.

We can remember it used to be the practice along the Hudson River that, so soon as a steamer arrived at a dock and ended her trip; her safety valves were thrown wide open and the steam blown off with a mighty roar that could be heard at a long distance. At such times every old engineer can remember that the boilers used to tremble and quiver in every sheet, from the violent strain to which they were subjected; that they did not explode outright is due to the fact that they were strong enough to stand even that tremendous effort.

As we have said, action and reaction are the same, and a column of steam suddenly fired from a steam pipe or a safety valve strikes a blow on the boiler. A column of steam fired into a steam cylinder by a violent valve motion sets up percussive action—it pounds on the piston, in fact, which in its turn pounds on every thing else connected to it.

THIS IS BUSINESS.

All correspondence upon business matters, whether of advantage to the recipient or not, should be promptly and courteously answered on the day it is received. A neglect of this is a confession that the recipient is either ignorant of commercial courtesy or unbusiness-like in his methods. This rule is observed by the largest concerns, whose daily mail, doubtless, amounts to hundreds of letters. A letter that is apparently of no importance may be of the greatest; it is not safe to judge from appearances.

In any event, a simple acknowledgment of all correspondence addressed to a firm, or an individual, is imperative, if the person addressed would rank with those familiar with business usage and courtesy. A letter is a message through the mail, and is as much to be heeded as the direct address of one individual to another face to face.

In making out requisitions for castings ordered from other foundries, or from parties who have quantities of patterns on hand, specify exactly the thing that is wanted, accompanied by a sketch showing dimensions; "30″ spur wheel" means nothing. There are several kinds of 30″ spur wheels as regards face, pitch, hub, etc., etc., and the foundryman cannot divine intuitively, what is wanted.

Make all orders for any kind of goods specific and exact; so that if errors are made, as they will be at times, the party ordering is not in fault. Send no verbal messages by boys, or irresponsible persons, for goods of any kind, or instructions involving certain work. Boys are heedless and forgetful, and more likely to order the wrong thing than the right, when any margin is left for them to do so. These are simple precautions which, if universally observed, would save a great deal of wear and tear of human patience and time, two things that are strained too much by heedlessness.

ENGINEERS' AID SOCIETIES.

Some interesting details are furnished in the the correspondence by Mr. Hall concerning the benefit society of the Baltimore *Brotherhood of Stationary Engineers.* The great value of these societies is apparent to all, for at very small cost, and paid in such installments that it is not felt, a fund is created which is available at once in case of the death of a member. We urge this provision upon the attention of societies at once, for no man knows when his turn may come. Whether a member is otherwise insured or not is outside of the question; he should avail himself of every opportunity to secure his family from want. In this case the proverb, "delays are dangerous," has peculiar significance.

We hope our friends will continue to advise us of their actions in session, of their several associations. We shall be glad to publish in detail any account they may send. A mere synopsis of the discussion will do. It is not necessary to write a long report.

FIGURE CLOSER.

We have reason to know, from correspondence at hand, that our urgent appeals to manufacturers at various times in these columns to figure closer on expenses, have had the effect intended, and we make no apology for our direct, and somewhat peremptory address in this line to the class named, for the simple reason that it is in their interests. Waste is inadmissible and inexcusable. A man has no right to waste anything, whether it costs money or is given to him.

The difficulty with too many persons who attempt close figuring on expenses is that they begin in the wrong direction. The item of salaries is generally the first attacked, but it is an open question whether anything is gained by this. It stands to reason that if salaries are reduced the quantity of work done for them is also reduced; so the matter remains exactly where it was before. Men give certain work for certain sums, and when the amount paid is decreased the work falls off in the same ratio. This inevitably follows, and although, apparently, the same number of pieces, or weight, is turned out, the cost of doing said work is much more. Though it may not appear at the end of one week, or one month, the lessened production and increased cost will always follow on reductions of salaries.

Man is man, whether capitalist or employee, and were places changed in this question, the result would be the same. No matter how honest, or how anxious men may be to keep their places, decreasing the amount paid to them, for a given amount of work, decreases the product, and therefore increases the cost of it.

Figuring closer means, in reality, increasing the product by employing the best facilities for it. One of the oldest manufacturers in this country was talking with us the other day about putting in new steam plant all round, and we advised him to look into the matter of burning screenings and coal-slack, so called. "Oh," said he, "I don't believe there is any money in that; there is always more or less dirt in the stuff, and I don't want to buy dirt; you can't make steam out of dirt." This is self-evident; but no one proposed to make steam out of dirt, and the incident is narrated as an illustration of the indifference with which suggestions looking to saving are often regarded. Anything out of the regular way, that involves a certain intelligent supervision, and possibly experiment, is certain to be coldly received.

But it need not involve experiment. Confine suggestions of saving to well-known and acknowledged sources of loss, and see what the result will be! Go through any city or manufacturing town, or on board of many ships, and see the money thrown away in trying to heat up the neighborhood, out doors, by means of naked steam-pipes and boilers! The number of instances where these occur is astonishing, but it is difficult to convince steam-users of this fact. A large engine-room in this city is just back of the counting room, and the proprietors complain bitterly of the heat in warm weather. Being quite intimate with the parties, we said that we felt very little sympathy for them, for the matter was entirely in their own hands. "How is that?" said one of them. "Why, the heat comes from your naked steam-chests, cylinder-heads, side-pipes, and anything that has steam passing through it. You might stop at least two-thirds of it by an inexpensive application, but you never will." "Is that so?" was all the answer received, and to this day that engine room remains as it has been for twenty-five years past.

An engineer will often be taken on tours of inspection around shops and factories, and sometimes he will be asked to give his opinion on points of management and sources of loss, but in most cases his suggestions fall upon unwilling ears; but little heed is paid to them.

Figuring closer means more profit, and successful firms thrive as much by reason of their careful management as direct orders. It is part of the business of the workshop to know where to spare, and where to spend.

MACHINE "POETRY."

In parts of New Jersey the machine trade is, apparently, quite dull, and, in lieu of anything more profitable, one machine builder, at least, has emulated Silas Wegg and "dropped into poetry." We find in a contemporary an invoice of the same, which is divided into cantos, otherwise songs, as second, third, etc. These are, apparently, all driven from one countershaft, with a cone pulley on it, as the measures and speeds at one time trip it at a high velocity, while at another they limp haltingly, as though the engineer was slacking up before quitting time.

This curious production, which was perhaps done in overtime, is entitled "*Vulcan and Orpheus; or, Anvil versus Fiddle,*" and is an attempt to record in pleasing rhyme the characteristics of modern machine tools, according as they may be light or heavy. If they are too light they are likened to the lyre of Orpheus, or if too heavy the anvil of Vulcan. This is the motive of the poet, and his effort, we are constrained to say, does not sound to our ears as though it was written by Pope or Dryden. It seems to be an uneven piece of work, and one performed with an irregular feed and speed, and a dull tool. It might be improved by a little surface grinding under an emery wheel, but we doubt if even this would make it smooth. For instance this:

> "In running cost no money's lost,
> As in a car or steamship tossed,
> By adding weight beyond the need
> Of actual strength. The only heed
> Is first expense, which trifling is
> Compared with all advantages."

We confess we do not like the last couplet; it seems rather out of time. The termination of the next to last line—"trifling is"—is intended to rhyme with advantages; but the two are not of the same pitch, and therefore will not run together. We think some other form of expression might have been used. For example, this:

The italics are our suggestions, brazed on.

> * * * * "The only heed
> Is first expense, which trifling is,
> or, { *You bet your life!"*
> { *Don't you forget it!*

This has the same defect of wrong pitch that we noted in the original verse, but it has the merit of being sententious and explicit.

Of course the reader will understand that he must overlook the fact that the poet makes a statement, from the exigencies of rhyme, which is incorrect. He does not mean to convey that it costs nothing to transport a ton of dead weight, or that it is the dead weight which tosses the car or steamship. He gives us to understand that, in his idea, the mere first cost of a ton of iron is not much, and that the tossing is more inconvenient than expensive; it is trifling compared to the advantages. These, we regret to say, are not specified; they are left to be inferred.

We confess, however, it is rather one-sided in us to select one halting stanza and feebly satirize it. We should have presented the poem as a whole, and left our readers to judge of its merits, unhampered by any of our interpolations. There are some difficulties in the way of this, which cannot be given at length. As a partial recompense, however, and an earnest of our desire to do the poet full justice, we append another stanza, which the reader will see follows the one first quoted:

> "In Europe this they understand,
> In some degree. In Yankee land
> A cunning skill would bring to nil
> Each extra ounce in foundry bill;
> *Rare talent's pitted versus weight,*
> *A starveling brood to incubate.*"

We have again italicised portions of this gem to indicate our inability to follow the poet's conceptions. We understand the first two couplets to mean that in Europe they know how to make castings to a certain extent, but it is only in America that they know how to "skin" a casting—that is, to make it look thick and heavy by ogees and fillets, when it is really a sham. "The Yankee's cunning skill will bring to nil" (skill—will—nil) "each extra ounce in foundry bill." That is, the Yankee will annihilate matter; he will bring to nil each extra ounce. This is conclusive enough. But what do the last two lines mean? It is unfortunate that we have not time to write to the poet and ask him to explain at greater length, for these italicised lines really worry us. There are defects in the punctuation, too, which place the poet at a disadvantage. There should be a comma after talent; for the statement runs, "Rare talent's pitted (versus weight), a starveling brood to incubate." What can it mean? We have read it sidewise, and called in an expert, but no one can decipher it. It may be allegorical, and the "starveling brood" are the core-boys—for this is a foundry we are introduced to. Core-boys are always hungry, and the allusion is happy—to designate them as "a starveling brood." But how can they hatch anything? We have seen them on their haunches, by the core ovens, munching bread and cheese. To the casual observer it might appear that they were incubating something, but they really are *not*.

What else to think of in connection with the subject we cannot divine.

We will quote once more:

> "Yes, Orpheus' ghost inspires this host
> Of mad designers still. The most
> He can does he to make them make
> Machines whose function 'tis to shake—
> To twist and wriggle under strains,
> As though they suffered mortal pains."

The proof-reader of our contemporary has evidently read this matchless poem with some reluctance, or else with haste, for he has made nonsense of the third line; it "does not read English," in the terse expression of the fraternity. The poet means to say that Orpheus' ghost (which is really a daring flight) makes these mad designers do the best they can, which is surely a creditable thing for a ghost to do. The sentence is somewhat involved, certainly, but the idea is there.

We leave this poem with some reluctance, but are compelled to ask our readers to procure it entire. We have never seen anything like it before, but hope to read some more effusions from the same talented pen. We think, however, if we may express an opinion, that the author's genius is better when confined to one specific subject; that in generalizing, trying to grasp the whole foundry business in one poem, he essays too much. Let him strike his lyre in favor of "Straight-armed Pulleys," "The Grimy Cope," "The Sour Beer Bucket," "The Shiny Slick," "The Wrinkled Sprue," or any of the thousand and one subjects as yet untouched. He has a wide field before him. He has no need to copyright them, for no other poet extant can approach him in his specialty, as a Scotchman might say, he is a "verra cute" poet.

THE PROFESSOR IN THE MACHINE SHOP.—No. XXXII.

Last week I was in New York, and I took the opportunity to go through one of the large machine shops there, where they build a certain kind of work, and I saw a good many things. Most of them, I am free to say, I had no expectation of seeing. The goods must cost a great deal of money, or else the profits on them are tremendous, to enable them to be built in the way they are. Certainly, no other kind of machine could be got out in the same way. As a rule, the workmanship is good and the material first-class. The forgings particularly are unsurpassed, but the methods are, beyond all belief, behind the times. I saw one man drilling holes in a flange. The job was about 40 inches diameter and 10 feet long, and of course could not be got under a drill press; but some kind of a portable drilling machine could have been bolted on that flange and ripped those holes through in no time at all. In lieu of this, a man, half asleep and half awake, was "pawing" the holes through at the rate of about one in an hour! I don't know what his wages were—certainly not less than $1.75 per day—and at that rate the reader can easily calculate what the holes cost apiece. This was only one example. In another part of the works I came across a large face-lathe, which was turning off a big plate like a piston-follower, say nine feet in diameter. At a little distance this plate seemed to stand still. I said to myself, "The man's back gears have jumped out and he don't know it;" but going closer, and watching the tool, I saw that the lathe was moving, but the only way it could have been discovered was by watching the plate as it passed the tool. I didn't dare time it there, but by counting while it made one turn, and then counting the same number at the same rate elsewhere with my watch in hand, I found that it made one turn in about four minutes! There was no cut on the lathe of any account. Now, taking the diameter as 108 inches (which it was, I found on inquiry), the circumference is about 28 feet 3 inches. As cast iron can readily be turned at a speed of 13 to 15 feet per minute, it will be seen that this lathe was loafing "the worst kind;" for it should have made double its speed when the tool was on the largest diameter! The lathe didn't seem to take any interest in the matter.

Wandering about aimlessly, I came upon dark corners and nooks, wherein shawdowy forms of men and boys scuttled rapidly away upon my approach, and in one of these secluded places was a vice-bench, and a man, of all other jobs, fitting up a connecting rod in it. He had an oil-lamp and a templet, and he was trying to see something, but evidently had hard work. Outside, the spring sun was shining strong and clear, and if the man had taken a pail of water and a broom for about five minutes he could have had all he wanted of it, for there was a window over the vice-bench, but so shrouded in dirt and cobwebs and spuds of red-lead, so barricaded with wooden templets of cylinder-flanges and forgotten patterns of one kind or another, that I don't believe any one in the shop ever thought of the window. Its existence had been forgotten. I suppose the man thought he was not hired to wash windows; and so he plodded on, poking away with his templet and fiddling with his little smoky lamp, doing about ten cents worth of work in an hour.

Everywhere I went this same lavish use of oil-lamps and niggard neglect of natural light struck me. A dark shop is a nuisance too great to be endured, when it can be alleviated, as this one might have been; for the blackened walls and the grimy timbers absorbed all that came in. The place stunk. It was rank and redolent of rotten fish oil, and the men smelled of it also. The bolt-cutters boiled with it, and sloppy, nasty streams of it filtered through the leaky beds and over the sides of them, and made the place a libel on machine shops.

Looking overhead in this metropolitan machine shop, one saw the staggering line-shaft weaving its devious way. At one section it appeared to be in doubt as to whether to go up to the second story or come down to the lower floor, and so it compromised matters by describing a graceful catenary, or "curve of sag," to coin an expression fit for the occasion. The pulleys ran like drunken men, to and fro, sidewise, while some of them varied the monotony of this motion by vertical leaps—so it seemed, as one looked over the tops of them against a distant wall. Oh! it was a lovely place, and made me want to ask the boss for a job instantly! Over every part of it dwelt that sort of lazy, "by-and-bye" air, as though there was no particular occasion for hurry or system, order, method or anything. If a man cut a gauge-stick for a size he whittled pensively, and was particular to make nice shavings and get a truly cylindrical end upon the stick. All his motions were slow and deliberate, as one who took no thought for the morrow.

How much all this worked upon me I can hardly describe here. The shameful waste of precious time, the wilful throwing away of opportunities, the chance of doing something—of being something in the world—of taking a place among one's fellows, of having a voice in the sphere they worked in, was, apparently, the last thing that entered these men's minds. The boys were the same. They had already acquired the indifferent, happy-go-lucky bearing that pervaded the place, and I thought that if one of them were mine I would almost as soon see him with a ball and chain on his leg as in that shop. He could not have been more hampered or tied down. What advantage could a boy have in such a place to offset the evil examples constantly before him? Not one that I could see. Those in authority certainly took no interest in him. Apparently, the apprentice was a better sort of shop laborer, and if he could find out anything about the business he would be lucky.

I write strongly upon this shop, for it is a vicious example and ought to be razed to the ground, or conducted upon different principles. As it is now, it is a disgrace to American shops. I went to the foreman and asked him if he could get all the help he wanted.

"Help be ——!" he said. "There ain't any machinists any more. We have to rely upon the old hands, who have been here for a quarter of a century. If it wasn't for them we couldn't get out an engine!"

"Thou fool and blind!" I said inwardly. "It is just such look-for-six-o'clock-men as you who make the lack of good mechanics. If you know anything about the trade, you take good care never to tell the boys any of it; and if you see a boy doing wrong, or wanting in experience, you stand and laugh at him, instead of instructing him in the right way." After that he (the foreman) complained there were no more mechanics!

It is false. There are plenty. The country teems with them; but they look for jobs where they are appreciated, and where they do not have to wade through an acre of stinking, greasy sawdust, grope blindly in a dark shop for their lathe or planer, and break their shins over castings pitched down anywhere, and in all sorts of unexpected places. No wonder good mechanics are scarce in such shops. It is to their credit that they are. I hope they will be scarcer! Pay is no object for a man to spend his life in such a hole, or any portion of it.

"Though thou bray a fool in a mortar, yet will not his foolishness depart from him," and this is as true as when centuries ago the wise man said it. Its application to this sermon lies here: One might preach and exhort until he was blind and speechless, and all his utterances would fall on dead ears, so far as any change is concerned in such places. It can't be done—not with the present race of men in them. Fire and sword might harry and destroy, but until the old walls were pulled down, even the lathes broken of their tricks of loafing, the old leaven would still work. In such shops men work for wages, but not in real shops. No man works for wages, if he knows himself; he works for his own individual interest and profit, and those that are near and dear to him. He don't care a tinker's curse whether some one else turned a shaft off in one hour or two; he only tries to get it done as soon as he can and as well as he can. He don't try to beat the record, or beat anything, least of all the boss. He goes in tooth and nail, "horse, foot and dragoon," to do the best work he knows how. That's what an American machinist does, of the right stamp. I know 'em. I am happy to say I have lived with them—slept with them, for that matter—eaten at their tables and been in their homes, and I like them because I am one of them myself; but I speak for the whole body, not for myself as an individual. I never saw an American machinist, of the git-right-up-and-git sort, who turned his back on a comrade yet. In many long years of grinding iron into bread for my belly, and clothes for my children's backs, I never yet saw a chap who soured on a friend in difficulties, or who, knowing the contrary ways of a lathe, or the tricks and manners of some short-belted planer that always humped itself with any decent cut on it,—would not come forward and post a new comer. This always provided the new comer looked like a white man himself, and didn't come into the shop the first day with "I-am-a-three-dollar-a-day-man" air on him. Woe be unto the one who does!

This is no eulogy; it is simple fact. I deal in them to the best of my ability, and all these reflections and this moralizing comes naturally from the example of a shop carried on in the way I have described previously. I don't think any one who has ever seen anything different could witness the spectacle and not be amazed at it.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. I.

BY JOSEPH P. MULLIN.

In laying before the readers of THE MECHANICAL ENGINEER these letters, arranged during my leisure hours, I have a two-fold object in view.

First: They are an incentive to study and self-improvement, and consequently are indirect benefit to myself and perhaps some of my fellow workmen, who may chance to read them.

Second: The direct—hard cash—benefit which I receive from the enterprising editors and proprictors of this excellent paper.

There is, I believe, a certain cut and dried form of apology, usually offered by writers, upon the introduction of such articles as these, but I beg leave to reject it, as I think that the editors of THE MECHANICAL ENGINEER know full well what will be interesting to their readers. One thing, however, I will promise, viz: Brevity; and while I don't expect to equal the man, who in order to shorten the word *tic-douloureux* spelled it tic$00, still I will not be quite so verbose as the western editor, who, when his office caught fire rushed into the street shouting: "Conflagration! conflagration!! conflagration!!! Approximate hither with your implements of deluge and extinguish the combustion." (He had to find another office). I may also state that I do not purpose writing fiction; every plan illustrated has been tried and proved to be good.

Among the many methods of making standard pulley patterns, and moulding the same, I believe the following is the best :

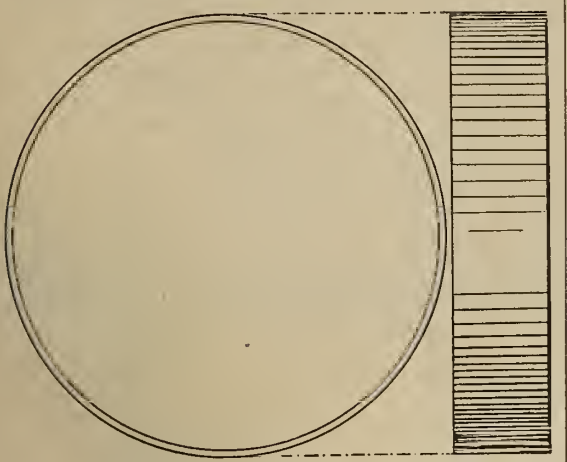


Fig. 1.

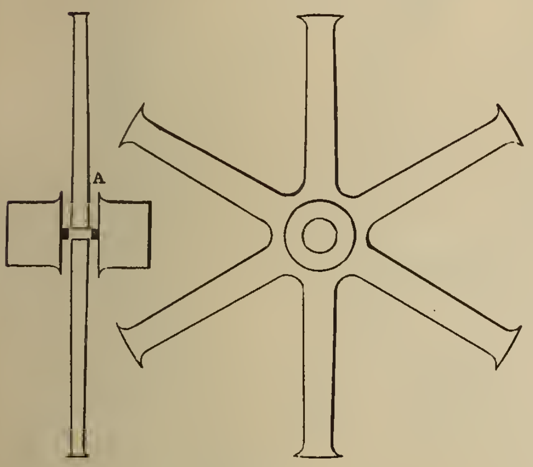


Fig. 2.

Make an iron pattern of rim, the diameter of pulley required, and from 6″ to 8″ face. (See Fig. 1). Now make iron pattern of arms as shown at Fig. 2. The arms should be an easy fit when put in place, say $\frac{1}{16}$th slack. Drill a 1″ hole in center for hub-dowel, as shown at *A*, Fig. 2. Make a set of wooden patterns for all the different sizes of hubs required; hubs should have a 1 inch hard wood dowel-pin in the bottom of each, so that they will fit any size of pulley.

The following dimensions have been found good for general use :

TABLE OF DIMENSIONS FOR STANDARD PULLEYS.

Diameter of Pulley.	Thickness of rim.	Thickness of arm at rim.	Thickness of arm at hub.
6 inches.	$\frac{5}{32}$	$1\frac{5}{16} \times \frac{5}{16}$	$1\frac{1}{4} \times \frac{1}{2}$
8 "	$\frac{5}{32}$	$1 \times \frac{3}{8}$	$1\frac{3}{8} \times \frac{5}{8}$
10 "	$\frac{3}{16}$	$1 \times \frac{3}{8}$	$1\frac{3}{8} \times \frac{5}{8}$
12 "	$\frac{3}{16}$	$1\frac{1}{16} \times \frac{7}{16}$	$1\frac{7}{16} \times \frac{5}{8}$
14 "	$\frac{3}{16}$	$1\frac{1}{16} \times \frac{7}{16}$	$1\frac{7}{16} \times \frac{5}{8}$
15 "	$\frac{3}{16}$	$1\frac{1}{16} \times \frac{7}{16}$	$1\frac{7}{16} \times \frac{5}{8}$
16 "	$\frac{3}{16}$	$1\frac{1}{4} \times \frac{7}{16}$	$1\frac{1}{2} \times \frac{11}{16}$
18 "	$\frac{1}{4}$	$1\frac{3}{8} \times \frac{7}{16}$	$1\frac{5}{8} \times \frac{11}{16}$
20 "	$\frac{1}{4}$	$1\frac{3}{8} \times \frac{1}{2}$	$1\frac{3}{4} \times \frac{11}{16}$
22 "	$\frac{1}{4}$	$1\frac{3}{8} \times \frac{5}{8}$	$2 \times \frac{7}{8}$
24 "	$\frac{1}{4}$	$1\frac{7}{16} \times \frac{11}{16}$	$2\frac{1}{8} \times \frac{15}{16}$
26 "	$\frac{1}{4}$	$1\frac{1}{2} \times \frac{11}{16}$	$2\frac{1}{8} \times \frac{15}{16}$
28 "	$\frac{5}{16}$	$1\frac{5}{8} \times \frac{11}{16}$	$2\frac{1}{4} \times 1$
30 "	$\frac{5}{16}$	$1\frac{3}{4} \times \frac{3}{4}$	$2\frac{3}{8} \times 1$
32 "	$\frac{5}{16}$	$2 \times \frac{7}{8}$	$2\frac{5}{8} \times 1\frac{1}{8}$
34 "	$\frac{3}{8}$	$2\frac{1}{8} \times \frac{7}{8}$	$2\frac{3}{4} \times 1\frac{1}{8}$
36 "	$\frac{3}{8}$	$2\frac{1}{2} \times \frac{15}{16}$	$3 \times 1\frac{1}{4}$
38 "	$\frac{7}{16}$	$2\frac{5}{8} \times \frac{15}{16}$	$3\frac{1}{8} \times 1\frac{1}{4}$
40 "	$\frac{7}{16}$	$2\frac{3}{4} \times 1$	$3\frac{1}{2} \times 1\frac{5}{16}$
42 "	$\frac{1}{2}$	$3\frac{1}{4} \times 1\frac{1}{8}$	$4 \times 1\frac{3}{8}$
48 "	$\frac{1}{2}$	$3\frac{1}{2} \times 1\frac{7}{16}$	$4\frac{1}{2} \times 1\frac{13}{16}$
52 "	$\frac{9}{16}$	$3\frac{5}{8} \times 1\frac{1}{2}$	$4\frac{3}{4} \times 1\frac{7}{8}$
60 "	$\frac{5}{8}$	$3\frac{3}{4} \times 1\frac{9}{16}$	$5\frac{1}{4} \times 2$

NOTE.—In some cases the arms of the large sized pulleys (from 42 to 60 inclusive) may be made lighter. For form of arm see Fig. 3.

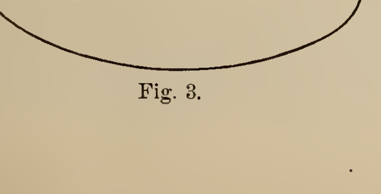


Fig. 3.

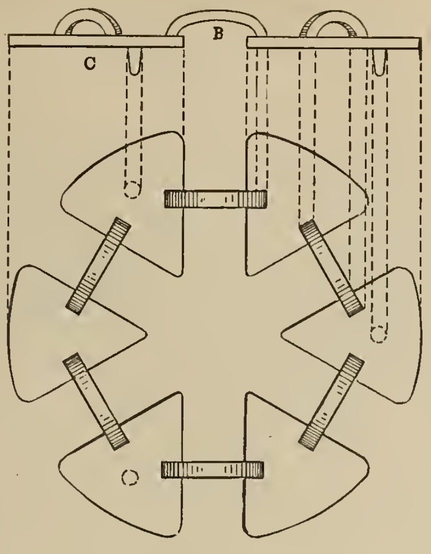


Fig. 4.

MOULDINGS.

Fig. 4 is a core or lifting plate, made to fit between the arms, leaving a margin of about $\frac{5}{8}$″ between the edge of the plate and the pattern. The different sections are connected by a strong bridge, as shown at *B*, Fig. 4. Three or four of the sections should have a large and pointed dowel, or guide-pin, *C*, cast on bottom.

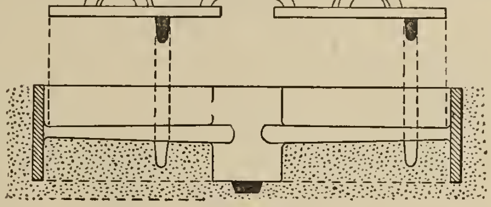


Fig. 5.

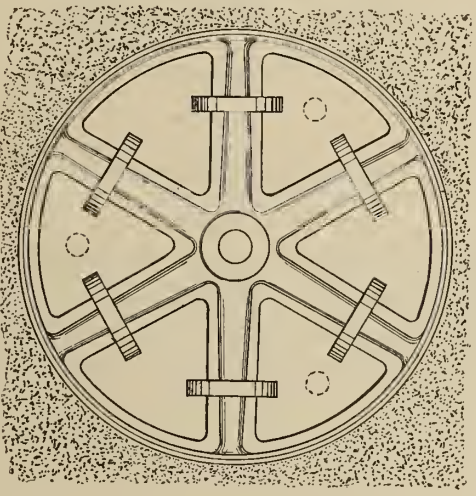


Fig. 6.

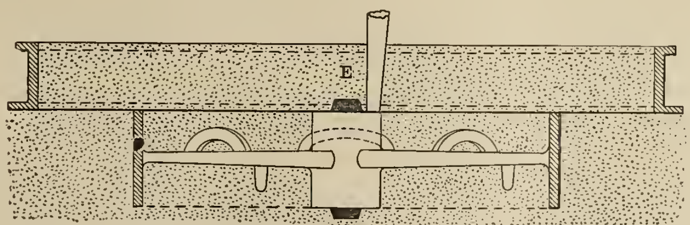


Fig. 7.

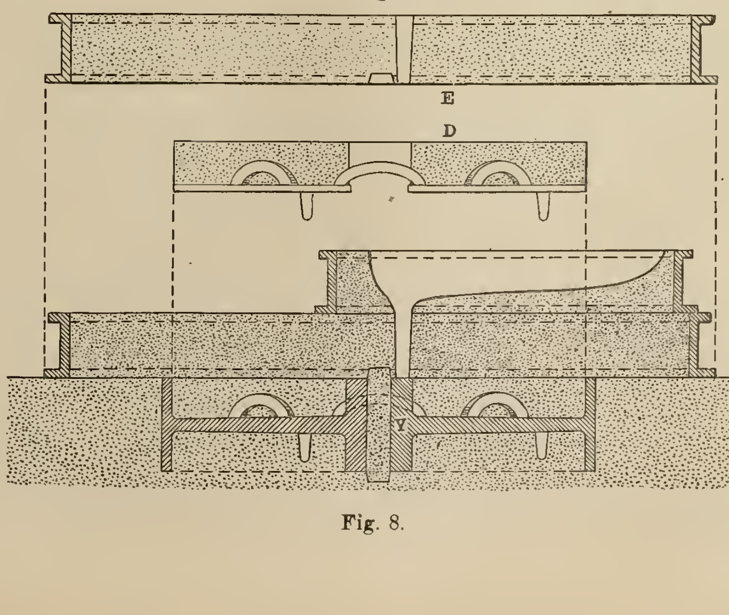


Fig. 8.

Fig. 5 shows the rim moulded on the outside, and the arms and hubs set in position and moulded up to center. The core or lifting-plate, *D*, is now set in place and bedded down solid, as shown at Fig. 6. The parting can now be made, and the center filled in and rammed up level with top of mould. We are now ready to put on cope-flask, *E*, Fig. 7; fill in, ram up, and make gate in same.

We can now lift off cope, *E*, and draw the rim pattern; then lift away the center and draw from the sand the patterns of arms and hub. Finish the mould and set center, *D*, Fig. 8, back into position; close down cope, *E*, make runner, and it is ready to cast as shown at Fig. 8.

[To be Continued.]

STRAINS ON MACHINERY.

Three general propositions may be laid down concerning the framing of machines. The first is that a strain of any kind should, when possible, be made to pass directly through some part of the framing; the second is that the strains should always be transmitted longitudinally through members of the framing; and the third is that if this end cannot be secured, initial stresses should be set up to secure stiffness. If these principles are applied in practice the maximum of stiffness can be secured with the minimum of material. Concerning the first we shall have something to say in a moment. As to the second proposition, its reason will be understood when we reflect that want of stiffness is caused by mobility in the framework which carries the moving portions of the machine; and that the minimum of mobility is always found in metals or wood strained in the direction of their length. Thus, for instance, a pull put on any part of a machine, say a holding-down bolt, can produce little or no effect, because the elongation of iron or wood under tensile strains much below their limit of elasticity is extremely small. When traverse strains are put on them the reverse is the case. Thus, a beam loaded in the middle is certain, unless made extremely heavy, to spring and move under variations in the insistent load, and for this reason plummer blocks should not be carried on beams when great stiffness is desirable.

An apt illustration is supplied by the engines of torpedo boats. The cylinders are mounted on an extremely light steel frame, consisting of six round bars bolted into the bed-plate below, and the cylinder flanges above. At first this looks a flimsy structure; but as a matter of fact it is about the most rigid engine frame which it is possible to make, complying with every one of the conditions of perfection which we have laid down. The strains to be borne are nearly vertical (for the moment we neglect the strains on the guide bars) and they are two in number, operating in right lines drawn through the piston-rods in the two cylinders. To deal with each of these strains there are four pillars, accurately parallel to the line of strain. These pillars lie outside the line of stress, equidistant all round it, so that there is no twisting moment at work. The pillars are alternately in compression and tension as the steam is admitted below or above the pistons, and these are the very strains which the metal is best adapted to resist. Let us suppose that instead of using six columns, four only were employed under the low-pressure cylinder, the high-pressure cylinder overhanging. It will be seen at a glance that the lines of resistance would no longer surround the line of strain; cross-bending forces would be brought into play, and, without using an enormous weight of metal it would be quite impossible to prevent the high-pressure cylinder from lifting up and down at each stroke, bending the bars as it did so backwards and forwards. Or, again, let us suppose that the cylinders, instead of being carried directly on the columns, were supported on a short girder spanning the boat. It is evident that unless a great deal of metal was put into this girder—probably ten times as much as sufficed in the shape of turned steel uprights—the cylinder would jump up and down, bending the girder at each stroke.

A further example of influence of position on stiffness of framing may be found in flour-mill work. In old-fashioned mills the foot-step was supported on what was known as a bridge, hinged at one end, and lifted up or let down at the other end to adjust the stones either by wedges or a screw. We have seen these bridges, although not more than 6 ft. long between centers, made of 12 in. square oak beams. If less in dimensions they would not be sufficiently rigid; it was not a question of strength, but of stiffness. The oak beams were succeeded by cast iron, but that had the same defect as the oak in a lesser degree, and they in turn have disappeared in favor of the vertical pillar foot-steps, through which the strain goes direct to the foundations of the mill, and the maximum degree of vertical stiffness is secured.

We have said that strains should always, when possible, be made to pass through some member of the framing. This cannot always be done directly, but it can nearly always be done by supplying two or more supports for each strain, and dividing the work equally between the two. An excellent illustration is supplied by outside cylinder locomotives. As made at one time, the cylinder was simply secured to a flat frame-plate by about eighteen turned bolts, driven in as tight as they would go, and secured inside by heavy nuts. No one ever yet succeeded in making a good job in this way with cylinders much above 12 in. in diameter. If the bolts held tight the side frame buckled in and out, because the line of stress caused by the action of the steam in the cylinder did not fall in the line of the plate, but a good deal outside it. Then heavy transverse stiffening plates were put in, and the bottom of the smoke-box made very strong. This did not answer; the bolts worked loose. Then engineers, both in this country and the United States, grappled with the problem, and three different methods of securing outside cylinders were adopted, and were all successful. The first consisted in adding a second frame, which butted against the after end of the cylinder and was secured to it. The result was quite satisfactory, for the stress was surrounded by lines of resistance. The second arrangement was invented in the United States, the peculiar form of the bar-frames used there precluding a resort to the outer plates. A very heavy casting, known as a saddle, lies across the frames under the smoke-box, and to this casting the cylinders are secured, not only with turned bolts, but with dovetailed slots, and cotters driven home hard. The two cylinders and the saddle are virtually made one, and the two lines of stress then lie symmetrically outside the two lines of resistance supplied by the frames. The third method was devised by Mr. Wm. Adams. He was much troubled by the working of his outside cylinders under the very heavy pressure—150 lb.—carried, and to prevent this he carried his valve chests through the side frames and united them together by a casting secured with bolts and a long cotter which locked everything up. The result was quite satisfactory. The plate side-frames no longer buckled, because, as in the case of the American engines, the stress fell symmetrically outside the frames which supplied the resistances.—*London Engineer*.

* * *

The *Northwestern Lumberman* says: "A drummer for an oil house recently approached a man, who was about to put in a larger engine, with the story that the expense need not be incurred if the oil the drummer sold was used, for it was so slippery it would add several horse power to an engine."

* * *

Back numbers complete can be had of Volume 4, 1882, and to date, by early application.

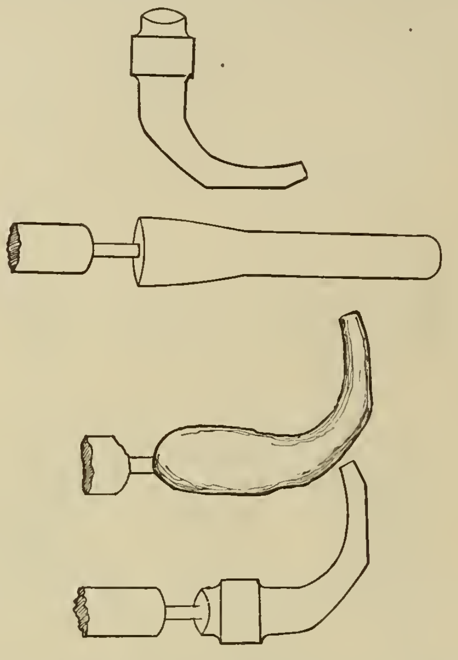
DIES AND DIE-SINKING—No. XI.

BY A DIE-SINKER.

[CONCLUDED.]

So far, in these articles, I have illustrated several different principles upon which to work. To keep them prominently before the reader I here enumerate them: First, dies that are sunk in one die-block only, as the shuttle; second, dies that are sunk one-half in each block, and that can only be cut with hand tools; third, dies that are made with irregularly-shaped die-blocks—that is, the face of the die-block being of the same profile as the model; fourth, dies that are sunk with milling-cutters, and some of these finished entirely in the machine.

There is still another principle I would like to show. Hitherto we have only made dies for forging in one operation (or what amounts to the same thing, as far as these articles are concerned), by repeated blows in the same die; but there are shapes which it would be impractical to make in this way, and other methods must be used. I will endeavor to make these clear, and, by way of introduction, will first give a sketch of the model which we are to make dies for.

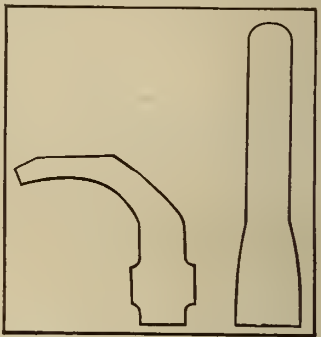


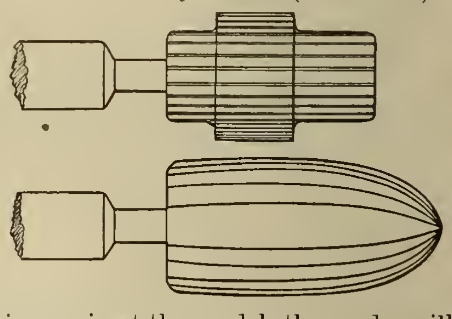
Here it is, in fig. 1: It is a presser-foot for a sewing-machine. This sketch is the forging, with stock left on to finish it. It is irregular in shape, and yet we could not make it on principle No. 3. We have to make it in three distinct operations, which are all performed at one heating of the iron. It is forged on the bar; and to show, in as simple a manner as possible, how it is done, I here give sketches of the shape it will have after every operation. Fig. 2 is the first operation, or what is called "breaking down;" fig. 3 is the second operation; fig. 4 is the forging finished on the bar. These do not include hot trimming, which has to be done twice on this forging.

Here, then, we have three entirely different shapes to make dies, or tools, for. How shall we make them? It is in work like this that the die-sinker requires to have originality and inventiveness, to devise methods for successful work. Some, in reading these articles, may have mistaken them for an essay on drop-forging. They are nothing of the kind; but illustrating the forgings has been an inseparable feature of them, to show what we want the dies for. The forgings illustrated have been selected after careful consideration—not as forgings I would recommend making—but as the best to show the different principles embodied, in the simplest way. I could have shown how to make some very intricate forgings at first, but the reader would not be any wiser, for then he would know how to make one forging only. As the longest word is contained in the alphabet, so the most intricate forging can be made on the principles I have described, and those I am describing, either by modifications, combinations or variations of them; but the reader must not forget that the forgings are only shown to explain how to sink dies, which is the present subject.

Our model requires, as we have seen, three operations, and we will turn our attention to the first, or breaking down die. It is simple in shape, but good judgment is required to make it so that there will just be enough stock to finish in the last operation. It is right to mention here that the fin, or burr, is trimmed off; after this operation the forging is then bent to shape by bending-dies, which are fitted to the press that holds the trimming-dies. It will not be necessary to describe these bending-dies, as I think they have been fully explained. We will confine ourselves to the first and last operations, as possessing the most interest.

The impressions for these two operations will be put in the same die-blocks—one-half in each block. The first step will be to make an outline template. I thought I had fully described these templates in other articles, but as this one differs materially from any others, I here illustrate it, especially as it shows in a clear manner how the dies are made. We cannot work from the center on this very well, but we put the impressions in the position in which they will best suit the purpose. It will be noticed that on the top part of the model, for some distance down, it is perfectly round, with two fillets on it. We take advantage of this, and make milling cutters for this part (on the principle No. 4). We also make a milling cutter for the rounded part of fig. 2, or first operation. These will expedite matters very much (see sketch). By

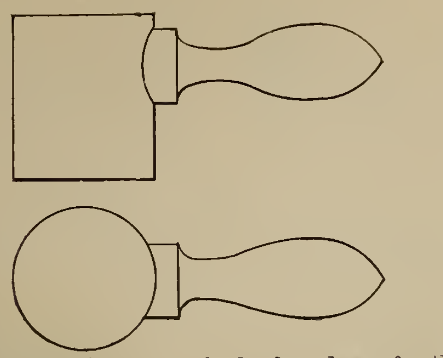




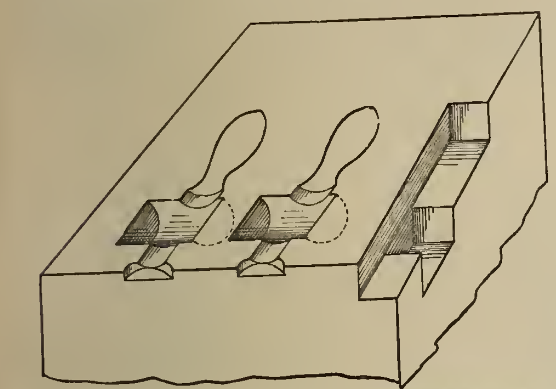
looking again at the model, the reader will see that something else is necessary, and that is to make drifts for the bottom part, or foot proper, of the model. Right and left-hand tools will be necessary, as I have explained before. After this is done we lay the dies out and put them in the die-sinking attachment, and mill out the parts we have made the cutters for (see engraving). When this is done we take them out and fasten them on the compound slide-rest (there should be a suitable vice for this purpose), and mill out the straight part of the breaking-down impression with any suitable cutter. This almost finishes the breaking-down impression, and the reader will understand how it should be done. The finishing impression requires a deal more labor yet, and this must be done by hand. To do so we sink the bottom, or foot, first, for which we made the drift shown. The remaining part, between this and the milled part, has now to be cut away, and, as we have no drift for this, it requires considerable skill to make a nice job.

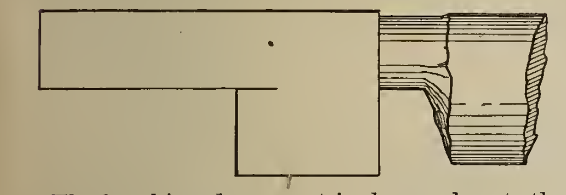
Our next and last model is a lifter for a Howe sewing-machine. It is a very pretty forging, and there is a point about it which I wish to show; that is, the manner in which it is broken down, or blocked. Although these things look easy when described, the reader will find, if he considers the subject carefully before he reads further, that it is not so easy to get a starting point from which to work. As the easiest way to explain it is to show how it is done, I will describe it in my usual way.

By looking at the model we see that two parts of it are round, and could be made with milling cutters. But, as it is evident we could not use cutters in both cases, we decide to make the milling cutter for the smallest part, or handle. We make a drift for the other round part, and one also for the square place shown on the



model. The iron must be broken down for this forging, too; so on the same die-block we make this impression. I think this will be best understood by looking at the die-block shown.





The breaking-down part is shown close to the edge of the die-block, and it can be made in the die-sinking machine with scarcely any handwork. There is no necessity for further describing how to make the finishing impressions, except to say that we mill out the small part, or handle, with milling cutter not shown. The rest, of course, is done by hand in the usual way.

This closes the subject of dies made on this principle, and it also closes the series. I think the reader will be able to devise ways to make almost any forging. Some mechanics are afraid to begin a job they have never done before, for fear that they will not do it as it should be. Others want to do work as it always has been done. They are both wrong. For the latter there is no such thing as progress; to the former I would say, when a mechanic strikes an idea—no matter how novel it may be—he should go right on to the end with it, no matter how much his shopmates may criticise him. I have often seen methods of working, that were at first laughed at, quickly adopted by others; and the writer has not been without sin in that respect, but he has learned better since.

Before concluding these articles, I will say a little about dies for sheet-metal working. The sunk-dies are made on the same principles as drop-forging dies, only there is not so much variety. We take, for instance, a common spoon; a blanking die is first made to cut the blank; then a punch, or force, is made the shape of the top side of the spoon; it is then hardened, and the die is sunk exactly like it, in the way I have described for forgings. The blanking die is made the same way as we made the cold trimming dies. It is the same all through: the dies have all a family resemblance, and the mechanic that can make dies for one purpose can make them for another. But it stands to reason that the mechanic most used to drop-dies is better at that than one accustomed to sheet-metal working, and *vice versa*. They have much to learn from each other. As dies for sheet-metal working deserve a series by themselves, I will now take leave of the readers of The Mechanical Engineer, trusting that some one of more ability will give his experience in this line. If there is no one that will do so, I may at some future time give my experience in that class of work,—that is, if these articles have been satisfactory to the general reader; if not, I will resume my place as a learner in what promises to be the best field for the machinist,—the workshop!

(THE END.)

VISCOSITY OF LUBRICATING OILS.

In practically testing the lubricating power of similar oils, most unexpected anomalies occur. Against petroleums, as compared with animal oils, there has been a prevailing prejudice among practical men which has led to much "compounding" of animal and mineral oils that is not always found to be rational. Many believe that in all cases animal oils can be replaced by properly made petroleums, and the improvements in the methods of making heavy petroleum oils lead to that conclusion.

The most familiar difference between the animal and mineral oils is in their thickness to touch, and their "body" or viscosity, and great mistakes are often made in estimating the value of this quality, especially as applied to cylinder oils. A dealer often tries such an oil by rubbing it between his fingers, under the supposition that its thickness or viscosity are the qualities that determine its value, and it is so generally believed that animal oils are best for cylinders, and that the peculiar thickness they impart to a compounded cylinder oil is necessary, that most engineers either confine themselves to tallow, &c., or else use only mixtures supposed to contain a large per cent. of animal oils. In cylinder oils, where the temperature is often 250° Fah., almost any oil is exceedingly thin, and the body of a compounded oil is then found to be a matter of much less consequence than the power of adhering to the wearing surfaces, and its freedom from acid principles, that are liable to be made active by the action of steam. The petroleums are found to possess these qualities in a most remarkable degree. The tendency of these oils to diffuse over the whole surface of any dish in which they are left for a time, exhibits a peculiar surface affinity that belongs to petroleum distinct from all other oils. This quality, in case of a pure petroleum, is greater according to the viscosity, as it then remains upon the surfaces of the piston and cylinder when the heat and rush of the steam cause a thinner petroleum and animal oils to be blown away in the exhaust. It is from this fact that any engineer can demonstrate, by taking sufficient pains, that petroleums of highest viscosity are recommended for cylinders in point of economy, while the effects of fats, that are produced by their acid principles, are too familiar to require special mention.

But while we admit in comparing two petroleums that viscosity is, for most purposes, the most important, it still depends on the use to which the oil is to be applied and the manner in which that quality is induced. For if it be a comparatively thin oil, thickened by some foreign substance, it may be, and generally is, comparatively worthless for almost any purpose. In the course of some recent experiments to determine the value of several oils under varying conditions of speed, temperature and pressure, it transpires that the value of a lubricating oil varies wonderfully with the temperature of the bearing where it is applied, which of course is governed by the speed of the bearing and the lubricator. An oil that answers excellently on the bearings of heavy mill gear will take fire or stop a quick-running spindle.

While a good spindle oil at ordinary temperature would squeeze out of a heavy bearing and require to be supplied to the box in a steady stream to prevent heating by friction, yet in sufficiently cold weather a spindle oil that thickened sufficiently to have a high viscosity, but did not actually "chill up," would probably answer very well. It is found that, while in the power and amount of oil consumed there may be little choice in several heavy petroleums on a bearing at 60° F., at 200° some become comparatively worthless, and the power required to run the shaft was, in the case of some oils, double that required in others; and, strange to say, some oils supplied in limited quantity at this temperature bore the strain of twice the power without allowing an increase of heat in the bearing, while another similar appearing oil would not retain the heat at 200° when supplied in large excess.

One reason of these differences is that when the temperature reached 200° some of the oils became so thin as not to remain between the bearing surfaces, and were thus useless. It was also found that an exceedingly small amount of oil only is actually consumed by even a large bearing, where no excess is supplied, and there is no way for good oil to run to waste. It is then found that the limit of efficiency is only where the oil becomes so charged with floating particles of metal, worn from the box and bearing, that it will no longer reduce friction sufficiently to keep down the heat of the journal. It is also noted that many thick oils that are excellent lubricants have a certain friction of their own, and thus, when applied to a journal under heavy pressure, will heat up to 125-140°, as readily as an oil deficient in lubricating quality; but at that temperature they lubricate so well as to prevent a further increase of heat, while a thinner oil, of less lubricating value, would keep the same journal entirely cool if applied when the temperature was down.

These facts go to show that no special oil can be expected to answer a diversity of purposes, and that viscosity, like all other qualities of lubricants, is of only relative value.—*Oil, Paint and Drug Reporter.*

GUM-COPAL.

The term "copal" is frequently used in a generic sense, embracing a number of resins of widely different origin. The resin known as Bombay, East Indian, or Zanzibar copal or animi, is a product of East Africa, chiefly the neighborhood of Zanzibar. It is of two kinds, fossil and recent. The exact genus and species of the tree yielding the former must remain a matter of doubt. The present limits of the distribution of living copaliferous trees by no means prescribe the area of the extinct forests which have been the source of the fossil copal. This is dug up by the barbarians of the maritime region. In places, it is found when sinking piles for huts; and at times it is picked up in spots overflowed by the high tides. The natives work it nowhere systematically; they sink numerous test-holes and work those only which alight immediately upon the resin, abandoning many where diligent search would probably be remunerative. The resin usually occurs in red sandy soil; according to the Arabs, the redder the soil the better is the copal. The surface of the copal ground is generally a thin coat of white sand, covering a dark, fertile humus, the vestiges of decayed vegetation varying from a few inches to 1½ feet in depth. In Zanzibar Islands the subsoil is a stiff blue clay. here the copal is found in the vegetable soil' overlaying the clay. At Saadani the pits are about three feet deep in humus and red sandy earth; the product is not esteemed, despite the redness of the soil.

The new, recent, "tree" or "raw" copal, is either picked from the tree or found, imbedded at a shallow depth in the loose soil, where it has not remained long enough to undergo any change. The living trees are of large size, averaging 20 to 25 feet to the first branches, and three to five feet in girth. The trunk is dotted with exudations of the raw resin, and between the bark and the wood, are frequent secretions of the resin in a liquid form. Whenever an injury has been inflicted on the tree, there an accumulation of resin will be found; when the exudation is large, it falls off and becomes covered by the dusty soil. All parts of the tree are impregnated with the resin, even extending to the fruit-pods, which contain numerous little warts of clear, colorless resin, covered by a thin skin.

The true copal is exclusively fossil. It is certainly of vegetable origin. The regular and persistent indentations and elevations of the surface, to which the term "goose-skin" has been applied, have led to the supposition that the resin escaped in a liquid or semi-liquid state, and took impressions from the sand in which it was deposited. This view is doubly erroneous. The impressions are due not to sand, but to the structure of the cellular tissue of the tree; and their occurrence is accounted for by the fact that the secretion of the resin increases with the decay of the tree, and is much hastened by the attacks of ants and other destructive influences; thus it is chiefly formed in masses within the tree itself, and naturally takes impressions from the tissue of the surrounding wood; this occurs with the existing trees. After the destruction of the trees, the lumps of resin have become buried in the sands formerly occupied by the forest. The fossil resin when first dug up has no trace of the goose-skin upon it. It is hidden by the outer layer of the resin, which has undergone some molecular change during its long burial; on removing this outer layer by an alkaline solution and sun-drying, the goose-skin becomes apparent.

The native method of collecting the fossil resin is to "crow" a hole about six inches diameter with a pointed stick, and scrape out the loosened earth by the hand as far as the arm will reach. Each man could easily gather 10 to 12 pounds daily, but the average is about one pound. The digging is carried on only during the rainy monsoon. Cleaning is performed in the following manner: The resin is first washed in a dilute alkaline lye, by which it loses some 20 to 37 per cent. of its bulk; it is then sun-dried for some hours, and subjected to a brushing sufficiently hard to remove the outer coat, but not to injure the goose-skin. The dark "eyes" where the dirt has sunk deep are picked out by an iron tool. The next step is garbling which is done with careful regard to color and size, and requires great experience. As a rule, the clear and semi-transparent pieces are the best; then follow the numerous and almost imperceptible grades of dull-white, lemon-yellow, amber-yellow, rhubarb-yellow, bright red, dull-red, blackish, and grass-green. In size, the pieces vary from that of small pebbles to two to three ounces; they have been known to weigh five and even 35 pounds. Finally the gum is put into boxes for export. The dust of which perhaps 30 pounds daily is brushed off by each workman, is termed "sand," and cast away as of no value; it is probably genuine resin, and of some worth.—*Oil and Paint Review.*

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A HOSPITAL FOR RAILWAY MEN BUILT BY THE RAILWAY EXPOSITION.

Every day throughout this country railway men are being crushed between cars, mangled under wheels, parboiled by exploding steam, crippled for life in collisions. Every day railway men find themselves sick and helpless, with no friends to care for them and no money to buy medicine and nursing. Every day railway men are compelled to face the hopeless fact that their youth and strength are gone, and that they must henceforth drag out their existence a burden upon the cold charity of the busy world. It is a painful fact that very little practical thought has been given by railway officers to the condition of their faithful employes after accident, sickness or old age have rendered them unfit for service. There are always men enough to be had. The vacancy in the ranks which is caused when an arm is cut off, or a leg mangled, or when disease or age strike down their victims, is immediately closed by fresh recruits, and the army goes marching on, forgetful of the unfortunate comrades who have fallen by the way.

The Central Pacific company has for some years maintained a model hospital at Sacramento for this purpose, but the great majority of railway men in the country are still unprovided for, and sudden accident or sickness will leave many of them homeless.

Should there not be at least one great railway hospital and home in this country with an army of more than half a million working railway men? The question seems to bring its own affirmative answer. Everyone will say yes, but the natural question is, where shall the money come from for this noble charity? This question will probably be answered in the next three months.

The managers of the great national exhibition of railway appliances soon to be opened in Chicago did not originate the enterprise for money making purposes. On the contrary, they are giving their valuable time and labor entirely without pay, and they are personally responsible if the exposition should prove a financial failure. Should it however be a financial success they have promised to devote every dollar of the net proceeds to benevolent purposes connected with the railway interest, and the idea of founding such an institution as that referred to seems to be at the bottom of all their plans.

It now remains with railway men and the general public to say whether the dream of these philanthropic men,—a great hospital and home for railway employes, to be located wherever it shall ultimately be deemed best, shall be realized, as one result of the exposition. If the attendance is as great as the extent and importance of the display, now assured, warrant, then the proceeds will be amply sufficient to inaugurate this benificent institution to which railway men from all parts of the country will be welcomed in their times of need. With this prospect in view every railway officer and employe ought to use his best endeavors to swell the multitude which will throng the Railway Exposition during the month of June.—*Railway Age.*

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A CANDID OPINION.

A subscriber in Alabama says:

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What a racket it would be if our subscriber's kind wish became fact!

◆

BE CAREFUL ABOUT ELECTRIC LIGHT APPARATUS.

As we noted some years since, when electricity was being generally introduced for lighting, the chances of accident are many and the peril to life imminent under certain circumstances. That this warning was by no means untimely is shown by the record of death since. On this point Thomas Edison said to a *Herald* reporter:

"Speaking of the number of new electric light companies which are springing into existence, I may safely say that every company that strings its wires on poles is adding additional dangers to the public safety. These wires have been the cause already on several occasions of serious peril.

"I know that scarcely a day passes without some warning being given of the danger of the arc light wires running through the air. Wherever these wires are suspended from telegraph or telephone poles they are liable to cause a fire. For should the current be diverted—and this might occur from the slightest contact—the heat would be sufficient to consume telegraph and telephone instruments and set fire to any ordinary material that might lie near at hand. Some weeks ago a fireman in this city attempted to remove the release key of a fire alarm box. As he touched the key he received a severe shock. There is every reason to believe that in this case the fire telegraph wire had become crossed with an electric light wire, and the current had thus been diverted. Had the ground upon which the fireman stood been damp, or had the soles of his boots been wet, the chances are that the current going through his body would have killed him on the spot.

"Not long ago the accidental contact of an electric light wire with a fire service telegraph wire resulted in the destruction of the electro-magnets in a score of fire boxes in the lower portion of the city, and a complete interruption of the fire alarm signals in that section ensued and lasted until the electro-magnets had been replaced. Again, at a fire in Fourteenth street, some broken telegraph wires in front of a building fell across an electric light wire. A fireman caught hold of these telegraph wires in the effort to disengage the hose. He received a terrific shock. The heated telegraph wires had burned through the insulating cover of the electric wire and contact had been established. Some months ago, as you must remember, as much publicity was given to the occurrence, a workman in the employ of one of the companies climbed a pole for the purpose of mending a wire. A short time afterward his dead body was found clinging to the pole. He had touched the wire and had received a shock which had killed him. And what wonder? Fourteen hundred volts are dangerous, and the arc light companies rarely run any lower than this and run all the way up to 2,000 volts. I do not like to say very much on this subject for fear of alarming the firemen. And it is certainly calculated to alarm a man when he learns that the slightest contact of his person with a wire may be as deadly as a shot from a cannon."

"'What means can be devised to obviate this danger?'"

"Well, the best means I know of and have said is to put all the wires under ground. But the arc light companies say they cannot afford to do this. To put the wires under ground costs in all about fifty cents a foot. To run the wires through the air does not cost more than $500 per mile."

◆

HOW TACKS ARE MADE.

The process of making tacks is as follows: The iron is received from the rolling mills in sheets from three inches to twelve inches wide, and from three feet to nine feet in length, the thickness varying, according to the kind of work into which it is to be made, from one-eighth to one-thirty-second of an inch. These sheets are all cut in about thirty inch pieces, and by immersion in acid cleaned of the hard outside flinty scale. They are then chopped into strips of a width corresponding to the length of the nail or tack required. Supposing the tack to be cut is an eight-ounce carpet tack, the strip of iron, as chopped and ready for the machine, would be about eleven-sixteenths of an inch thick and thirty inches long. This piece is placed firmly in the feeding apparatus, and by this arrangement carried between the knives of the machine.

At each revolution of the balance-wheel the knives cut off a small piece from the end of this plate. The piece cut off is pointed at one end, and square for forming the head at the other. It is then carried between two dies by the action of the knives, and these dies, coming together, form the body of the tack under the head. Enough of the iron projects beyond the face of the dies to form the head, and while held firmly by them, a lever strikes this projecting piece into a round head. This, as we have said before, is all done during one revolution of the balance-wheel, and the knives, as soon as the tack drops from the machine, are ready to cut off another piece.

These machines are run at the rate of about two hundred and fifty revolutions per minute. The shoe-nail machines, for cutting headless shoe-nails, are run at about five hundred revolutions per minute, and cut from three to five nails at each revolution.

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Bessemer steel tubes are now made in this country of good quality, and as small as one-half inch in diameter.

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CAM AND LEVER, PUNCH AND SHEAR.

Our engraving represents a well designed heavy tool for the above purpose, which is wholly self-contained, and carries its own power. It is so massive that but few permanent fastenings to the foundation are needed. It has a peculiar action, caused by the shape of the lifting cam, which allows the lever to pause for half a revolution when the punch is out of the hole, giving time to adjust the sheet again. All parts are so well shown by the engraving that we deem no further reference needed. The machine is of English design and build.

A workman in the employ of an English electrical company had occasion to take part of the apparatus into the country. It was put in a small box, and, on alighting at his destination its appearance and weight excited the suspicion of a policeman. This worthy was not reassured, when he asked what the box contained, to be told—" part of a dynamo."

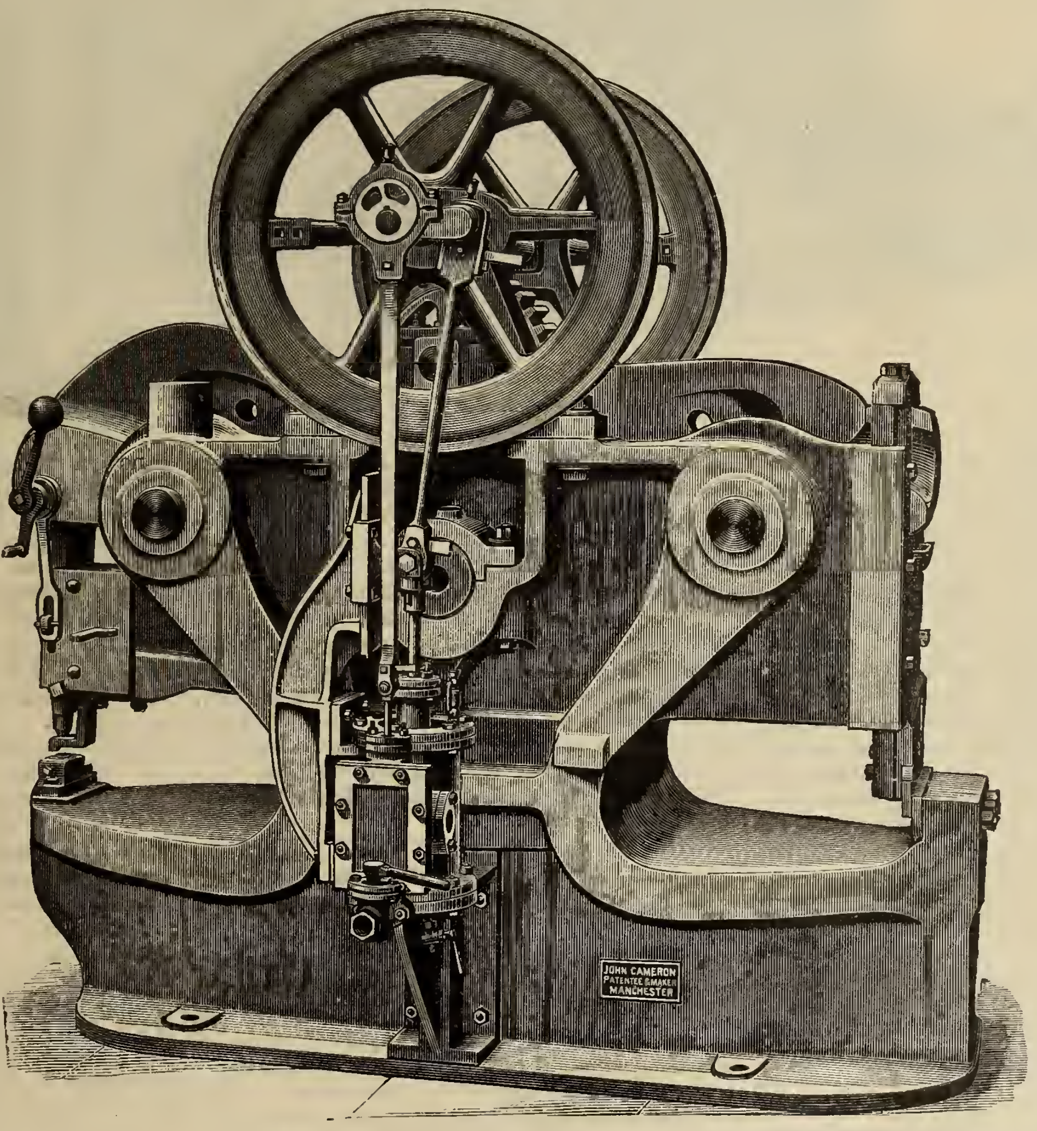
Dynamo and dynamite were one and the same to the officer, so he made the man open his box at once. When the contents were disclosed the policeman was sure he had made a great arrest, and it was with difficulty that the matter was explained.

If a man has a lurking suspicion that his new laid egg is not hard enough for his fastidious palate in the morning, let him spin it, broadside on, in his plate. If it is too soft it will wabble ungracefully; if it is done to a turn it will whirl like a top.

Demonstration: When the egg is partially cooked it is out of balance, for the yolk being denser than the albumen settles on one side. When thoroughly cooked, however, the contents are homogeneous, and better suspended for rotation. This is the whole art and mystery of boiled eggs as far as discovered at present. If we find out anything more we will let our readers know.

If you have anything to say, say it; don't beat around the bush for an hour, telling persons "it is a pleasant day," "likely to rain some time or other," or similar idiocies. Life is too short and too serious to indulge in trivialities in business hours. Our animadversion is caused by a gentleman visiting us recently who, after a ten minutes' conversation similar to the above, asked us to "subscribe" for some "detached illustrations"—that is, pictures taken from worn out plates, formerly published in magazines now defunct!

A writer in the *Coach Painter* says: "Any varnish made with alcohol will become dull in appearance by the evaporation of the spirits, which leaves water in excess in the varnish, as all alcohol contains water. To remedy this defect, procure a thin sheet of gelatine, cut it in strips and put it into the varnish: it will absorb water, leaving the spirits, thus making the varnish as good as new, and it can be used clear and bright to the last drop. The strips of gelatine may be removed when they become quite soft, and after being dried may be used again.



The *Age of Steel* says:

"The largest injector ever made is running in the Cleveland Rolling Mill. The injector has a 5-inch suction pipe, and is feeding twenty boilers located in various parts of the mill, one battery of boilers being 600 feet away from the injector."

We raise this by saying that the steamboat *Pilgrim* has four double-tube Korting injectors, each one capable of supplying 6,000 gallons per hour, and they are believed to be the largest ever made for actual use. Each injector is 44 inches long and has 3″ pipe connections. The injectors in the Cleveland Rolling Mill have a 5″ suction to avoid friction in so long a pipe, but the direct connection to the injector itself is only 2″. We have this from a reliable party.

Lace holes in belts should be punched some distance from the ends, say not less than 1″ or 1¼″ for a three-inch belt. Aside from the greater strength left in the end it affords an easy and quick method of taking up the belt when it gets slack, by cutting half an inch off each end and using the same holes to lace up again.

It is not uncommon for parties to buy boilers very much larger than there is any occasion for, under the impression that it is good practice. Within a certain margin there is economy in having plenty of boiler, for of the two it is better to have too much boiler than too little, but when the furnace doors have to be kept open all day in order to keep the steam down, there does not seem to be any very marked economy. A boiler so treated will soon deteriorate rapidly, to say nothing of the waste in fuel. Where boilers are very much larger than there is need of, a better way, than keeping the doors open, is to reduce the grate area by fire bricks on the sides until the proper amount is reached.

Lead melts at 335 deg. Cent.; bismuth at 268 deg., and tin at 268 deg., but an alloy of the three metals in certain proportions melts in boiling water, and by adding cadmium, which has almost as high a melting point as lead, an alloy is obtained which is fluid at about 60 deg. Cent. These phenomena have not been sufficiently investigated, and they cannot at present be satisfactorily explained. To the enterprising student there is here a most promising field for research.

What is perhaps a cause of failure in many brass castings (which failure is sometimes difficult to trace to its source), is the tin. This metal is not in large proportion, it is true, in some castings, but if it is impure, or other than what it is supposed to be, it is not harmless. Prof. Richards points out in *Science* that changes occur in block tin after it is cast into pigs, which render it very brittle and crystalline. These being examined into showed the presence of 2·62 per cent. of mercury present. A result of bad smelting.

The force of imagination is well shown in a recent incident on the Erie Railroad. A coffin was in the car, and the baggage-man complained that the odor was so terrible that he had been obliged to ride in one of the coaches. He was greatly surprised when shown that the coffin was new and entirely empty!

Natural amber is adulterated to a large extent with colophony, and insects, moss, etc., such as are found in genuine amber, are introduced into the substitute in order to heighten the deception.

Part II. of the lecture on "Organic Scale Formation," will appear in our next issue.

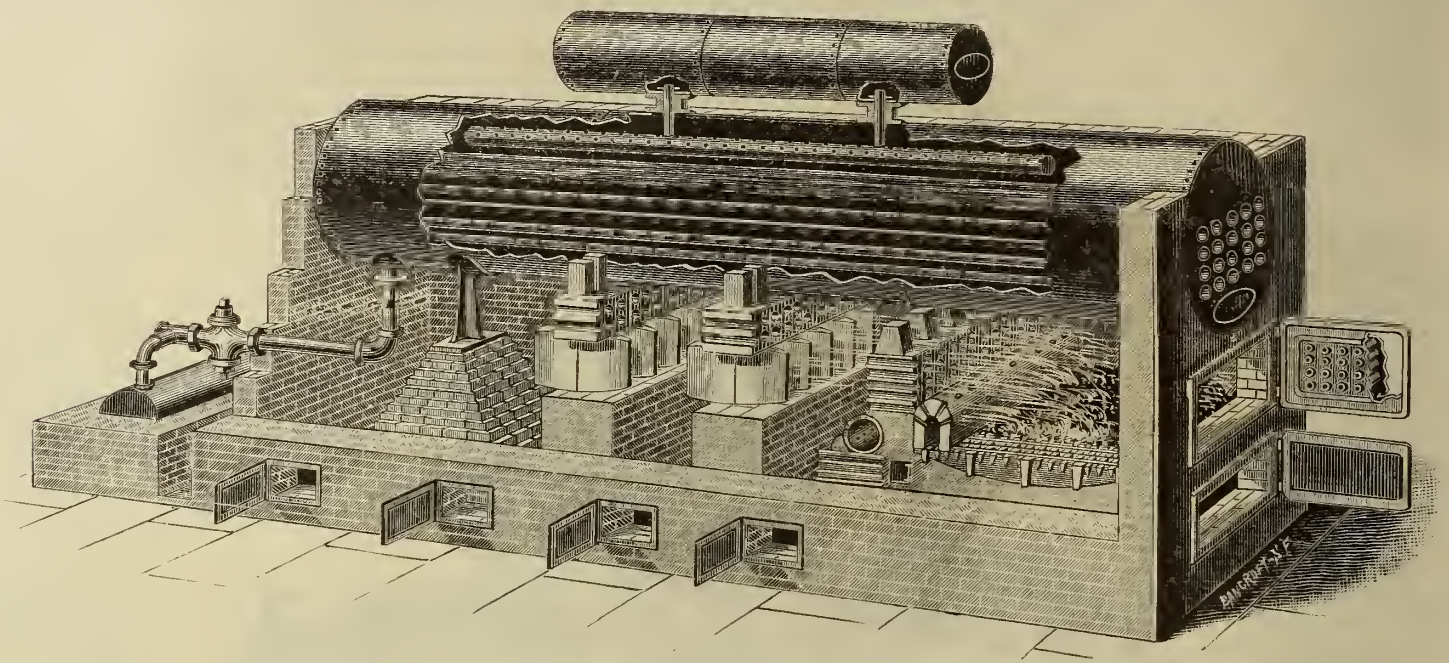
When designers of high speed vessels thoroughly understand that power is the first consideration, and all others secondary, we shall hear less about the shape of the hull and its construction. A square box could be driven at a high speed if it would carry the engines required to produce the power.

What with *Verni Noir's* article upon "Gears and Gear Wheels" in "*Pattern Making by a Pattern Maker*" and J. P. Mullins' elucidation of the method of molding them, this important subject is entirely covered in this issue. It is very complete and should enable any good mechanic to make gears after the most approved practice of the day.

Recently, at Cap Rouge, near Quebec, an ice bridge thirty-five feet thick barred all egress and ingress to the city, and it was determined to blow it up. Holes were bored in it and 300 pounds of powder in barrels were sunk and fired by electricity, with the desired result.

A locomotive with a "double" fire-box is a novelty on an Eastern railroad, the idea being to fire them alternately. The plan is said to work well as a smoke consumer.

MAILER'S FLAMELESS COMBUSTION AND REGENERATIVE FURNACE.



More attention is being paid to the subject of combustion at this time than ever before, and steam users are becoming aware of the great losses incurred hitherto by wasteful and defectively-set boilers. One of the latest devices for the purpose indicated is here shown, and the arrangement is so clearly set forth in the engraving that it is only necessary to call the reader's attention to a few of the details to enable him to comprehend it. These are the hollow firebrick U-shaped bridge wall at the end of the furnace, the regenerative wedge-shaped and perforated tiles over each combustion chamber, and the round pipe, and brick air-inlet behind the bridge wall. The effect of these appliances is, it is claimed, to thoroughly consume the products of combustion. The action induced is as follows: After the fire is well under way, the parts noted above become red hot, and in this condition they ignite the gases which have escaped burning in the furnace, and which, but for these perforated and solid tiles, would pass out of the smoke stack unused. The hollow bridge-wall connects with the atmosphere and delivers a certain volume of highly-heated air directly into the cloud of gases evolved from the fuel at the moment when they are best fitted to combine with it. This change, so to call it, passes into the first combustion chamber through the perforated tiles, and being now thoroughly mingled they ignite and form a flameless sea of intense heat in each chamber passed through. With proper attention and regulation of the firing this furnace should give excellent results.

The engraving also shows some other improvements of the inventor which are of value. These are, attaching a dry pipe inside the steam space and connecting it with a steam-drum overhead, and the location of the mud-drum outside of the setting proper, and in a suitable place for thorough inspection at all times.

This form of furnace is patented by John Mailer, who can be addressed in regard to it, corner Diamond and 23d streets, San Francisco, Cal.

ADVERTISING.

This is our first essay on this subject, and no other "treatise" upon it will be published in these columns for some time to come. Our wonder is sometimes excited by the curious contradictions which arise in connection with it. Advertisers place themselves in periodicals that never, except by chance, reach the hand of the trade desired, and they waste their money by leaving out the very pith and backbone of the matter. The wording of an advertisement, to catch the eye and excite the readers desire to know more, is a special talent, and as many goods are sold in that way, as by the mere announcement of the makers place of business. Change in matter and form is also desirable, and serves to renew attention and awaken demand. In some instances we have pressed this point upon our friends to their benefit.

We have autograph letters from old firms who aver that, covering equal periods, they have had more actual business from THE MECHANICAL ENGINEER than from any other paper in the same trade, and they have spent hundreds of dollars to get what they paid us less than a hundred for. One patron advised a canvasser for another journal (who certainly had no object in repeating it to us) that he had kept accurate account of answers he received from advertising in three papers, one of which was THE MECHANICAL ENGINEER; of the rest, one is 35 years old, and the other one isn't! From the veteran he received over 1,000 answers in one year, from the second about 250; and from THE MECHANICAL ENGINEER 95. When asked how that paid, our advertiser said that the 95 answers from THE MECHANICAL ENGINEER brought more *actual trade* than all the others together.

We do not select a few isolated instances in our favor; the best evidence we can offer of our value to the trade is the regular presence, year in and year out, of leading firms. In its line, and for its price, THE MECHANICAL ENGINEER is one of the best mediums to reach actual buyers. Some reasons for this are, its paid subscription list, its thorough perusal, and its wide circulation.

A SECONDARY POWER.

In the general enthusiasm about storage batteries and the use of electricity as a motor, it is just as well to remember that it is a secondary power, derived from some source independent of itself. That is to say the power given out by electricity must first be imparted to it by another power. In case this is a steam engine it is much more expensive than that agent. There may be instances where this is incorrect, as for example, in small powers the use of steam may be inadmissible, and an engine of 500 horse power will cost less, per horse power, for maintenance and fuel than one of five horse power, but the observation previously made holds good in most cases.

We do not know the writer of the following paragraph, for we find it in an obscure paper that seems to appropriate it upon general principles, neither have we an enthusiastic belief that electricity will ever become important as a motor; certainly not until it is derived from some other source than steam:

> "Mr. Edison, whose prestige as an electrical inventor entitle his opinions to respect, is reported to have lately said that the storage battery looked very well in theory, but could not be made to work in practice. From what has already been accomplished in this field, however, we are firmly convinced that the day is near at hand when the problem of the storage of electricity will be solved in such a manner as to satisfactorily meet every practical requirement. Enough has already been accomplished to show that the theory of electrical storage is correct, and that the difficulties to be overcome in realizing the theory in practice are not insurmountable. It is worthy of remark, also, in this connection, that Mr. Edison, if he is correctly reported, stands practically alone among electricians in his contemptuous opinion of the future of the storage battery."

Mr. Edison is probably a better judge of the possibilities of a storage battery than the commentator just quoted, and argues against its general utility from a practical base.

RESPECTING CAR WHEELS.

At a late meeting of the Master Car Builders' Association, Mr. Davenport remarked that plates may crack from bad proportions of pattern or want of elasticity of metal; it might also be due to increased loads and high speed. The proper distribution of material in wheels is a matter for the makers to decide. The imperfection at the junction of the two plates may be due to a deposit of scum in casting the wheels or to a displacement of the core at that point. In the process of melting iron, it loses its elasticity. He stated that iron after the first melting, tested in a Thurston torsion testing machine, twisted 15½ degrees and broke with a strain of 38,750 lbs. per square inch. After being melted the second time it twisted only nine degrees before it broke, and after the third melting only six degrees.

The objection to using old wheels in making new ones was that it is impossible to know how often the iron in the old wheels has been remelted. The loss of elasticity in remelting wheels may account for the breaking of plates. He recommended that wheels should be made entirely of new iron, and that old wheels should be converted into bar iron and axles. The temptation to reduce the weight of wheels by the reduction of price was too great for the wheel makers to resist. If a wheel weighing 500 lbs. is all right for a 10-ton car, it is much too light for one carrying 20 tons, and if the speed is also doubled, the 500-lb. wheel is very much too light.

What seems rather a peculiar appurtenance in an engine room is a stove; yet in a large photograph hanging before us a stove stands unobtrusively in the background, and with an air of being there seriously, on legitimate business. Our inference is doubtless correct, for the steam surfaces are all so well protected against radiation that the engineer gets chilly and wants a fire in winter! Every engine room ought to require a stove.

> "Courtesy towards others, and respect for their opinions, generally pays."—*Am. Machinist.*

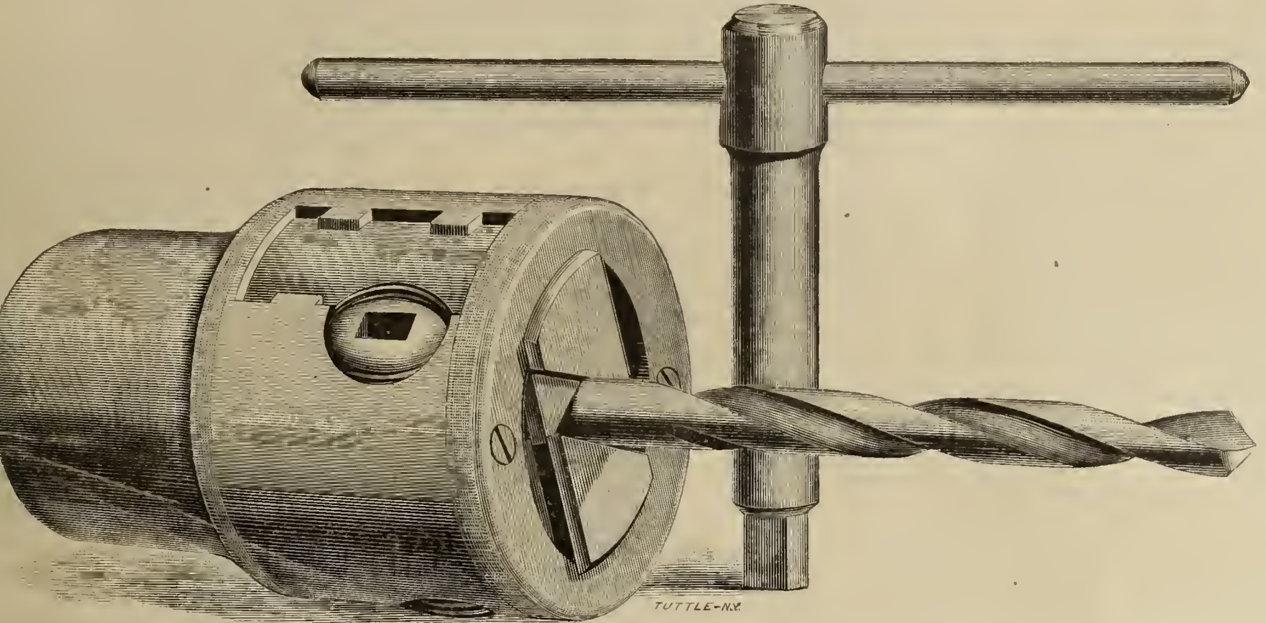
This is solid truth, and an observance of it would take the sting out of the tail of many paragraphs. Whether courtesy pays, is not of so much moment, as the fact that it is an inalienable right, which should not be trespassed upon. The man who is habitually discourteous, rude and boorish in his address, has only himself to blame when people hold aloof from him.

Iridium, the hardest of merchantable metals, can be deposited by the electro plating process. Prof. Dudley, of Cincinnati, has obtained a good deposit, which is susceptible of a high polish.

NEW DRILL CHUCK.

BY THE ONEIDA STEAM ENGINE AND FOUNDRY CO., ONEIDA, N. Y.

The chuck here shown is one recently put upon the market by the manufacturers noted, and is a good, substantial, and efficient tool for its purpose. It has a very wide range of capacity, and is wholly positive in its movements. It has no complicated mechanism in small pieces to get out of order under strain, or jam fast, and these features are of great value in a tool of its class. While its grip is firm on the drill, it does not burr the shank of the same and scar it up, so that it looks as if it had been screwed in the jaws of a new vice; drills thus disfigured become in time so that they cannot be made to run true.



As will be surmised by our readers this chuck consists of a pair of jaws, interlocked as to each other, actuated by a right and left-hand screw cut on the same axis. This is operated by the handle shown, in a manner too well known to require explanation.

The engraving shows the general appearance, and it will be noted that there are no projections to catch in the sleeve of the workman, or liable to be injured in use. It is made wholly of cast steel by the most approved methods, and is good value in any machine shop.

Price lists on application to 95 Walnut street, Oneida, N. Y.

DYNAMITE.

What is dynamite? How is it manufactured? We are prepared to answer these questions, as we manufactured the first nitro-glycerine ever made in the United States, nearly twenty years ago. Dynamite is simply nitro-glycerine, mixed with an adulterant to render it safe to transport. The added ingredient is usually a fine earth of great absorbent capacity. It has been found that the best is the earth housewives use to polish silver with, properly called *infusorial* earth, because it is made up of the fossil remains of minute organisms. Dynamite, then, is a mixture of polishing powder and glycerine after it has been acted upon by nitric acid. There is nothing apparently very frightful in this mixture, but here a strange law of chemical combination comes in. A law by which a vast change is produced in innocent bodies by a slight disturbance of their molecular constitution. We disturb the molecular constitution of glycerine by subjecting it to the action of nitric acid, by which nitrogen becomes a constituent of the body, and its whole chemical nature and relationships are changed. This dull, stupid nitrogen, which exists so abundantly in the air, and which we breathe every moment, day and night, becomes the agent which confers upon glycerine the most terrific powers possessed by any agent, save two, known to man. Does not this fact teach an impressive lesson as to the mystery of the forces of nature, and of man's capability of bringing them into action, and we may say, into subjection?

In the manufacture of nitro-glycerine, we simply mix with pure glycerine a certain proportion of sulphuric and nitric acids, and stir the mixture until the reactions occur, which is in about twenty minutes. The vessels must be placed in freezing mixtures, for if at any time the temperature rises above 32 deg. F. decomposition occurs, and if there is no explosion the whole mass goes off in a vast cloud of nitrous acid vapors, which are troublesome and dangerous.

We never ventured to act upon more than one hundred grains of glycerine at a time, and with this small amount the danger was great and accidents were not a few.

Our method was to arrange upon a shelf, in a refrigerating mixture, twelve beaker glasses, each containing 100 grains of glycerine, and into each of these the mixed acids were slowly allowed to enter, the thermometer being anxiously watched all the time. If the heat from the reactions rose above 32 deg. in any glass, away would go the contents, filling the laboratory so densely with red fumes that no object could be seen six feet distant.

In what has been said we have endeavored to afford a popular view of the chemistry of dynamite. It does not explode at the touch of fire, as does gunpowder, but it must have brought to bear upon it, or in contact with it, another explosive agent, a *fulminate*. A fulminate of mercury is better than a fulminate of silver, for the *rhythm* of its detonation is more in accord with that of the dynamite. Dynamite *detonates*, and does not explode as does gunpowder. Its action is so much quicker than the movements of air, that it strikes against a column of air with the same force as a hammer falling upon a blacksmith's anvil.—*Popular Science News.*

* * *

The value of dead walls in New York is well shown by the enormous prices they bring for advertising purposes. The space on the dead wall corner of Broadway and 23d street, which is visible from a limited distance, comparatively, was recently rented for $1,700 per annum.

* * *

The *Oil, Paint and Drug Reporter* says: "The time when lard oil will no longer be used in lighthouse lamps will soon be here. Already all the lamps except those of the first order are burning kerosene oil, and new lamps for the first order—lamps which have five wicks and will give a light of 424 candle power, and will consume two gallons of kerosene oil, while the present lamps consume one gallon of lard oil—are being constructed. The first of these lamps will be placed in position early in May, and the others of the first order—lamps now burning lard oil—will be displaced as rapidly as the new lamps can be constructed. The oil used in the new lamp is of the best quality, and must not flash under 140° F. By the use of kerosene of this quality a saving of sixty per cent. is made over lard oil, and an increase in illuminating power obtained of fully five per cent."

The L. B. Flanders Machine Co., Philadelphia, Pa., have favored us with their illustrated catalogue of machine tools chiefly for railway use. These tools comprise a large number of special attachments for repair work on locomotives and stationary engines, and are now in use on a large number of railroads all over the country. Our readers in this line of trade who may send for it will find it of value.

Work in the locomotive factories of the country is by no means dull. The Baldwin Works, of Philadelphia, have nearly 3,000 hands, and do not mean to discharge any. The Paterson shops combined have about 3,160; the Rogers Company having over half of them, and the demand for engines, though not overwhelming, is enough to keep the shops busy for the next six months.

* * *

Science is a new weekly journal which, as its title imports, gives a clear synopsis of what is doing in its field. It is not of the popular order, but addresses itself wholly to professional readers. Judging from its published list of subscribers, it has already a large following all over the country. *Science* deals with every department, in its retrospect of contemporaries honorably crediting where it copies. It is ably conducted, and has the advantage of the encouragement of leading men in its lines, who are also interested in its management. There seems to be a field for a publication of this character, if its interest is sustained; and it has our best wishes for its welfare. $5 per annum. Moses King, publisher, Cambridge, Mass.

A DANGER SIGNAL.

A certain way to injure any society or body of men is to intrude personal issues, or to raise personal questions that have no connection with the objects of such bodies. Likes and dislikes have nothing to do with the principal business, which is to unite all of one calling in a strong bond for mutual benefit. Anything outside of this is irrelevant, and nothing is more injurious than attacks upon one section of the country at the expense of another.

If one feels he has a mission to right all the wrongs there are in the world, to act generally as censor of others, and to measure their motives, or capacity, by his own standard of what their conduct should be, such an one has a large amount of work on hand, and he should pause a moment and see if it would not be the wiser part to do the best he knows how himself, and permit others to do the same.

All men are fallible, some in one point, some in another; and knowing this we should respect weaknesses. Ridicule, in particular, is a two-edged sword, and cuts the wielder as often as the adversary. Those who brandish such weapons should be careful and not hurt themselves.

* * *

In handling $14,000,000, incurred in building the New York and Brooklyn bridge, the sum of $100 was all that was lost in paying large and small bills. This is represented as and charged to "friction."

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

SOME FACTS ABOUT FEEDING BOILERS IN FRONT.

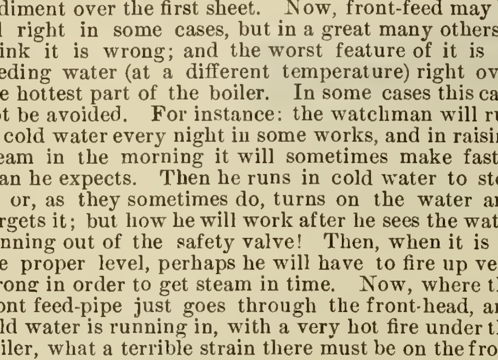
Editors Mechanical Engineer :

There has been a good deal of information lately about feeding boilers brought out by different engineers in your spicy paper, and with your permission I will give some of my views on the subject.

I have fed water to boilers through the front-head, and have had cracked and bagged sheets, for which I blamed the mode of feeding, for this reason: After the feed was changed to enter the top of the boiler, I had no further trouble. I have seen several cases of cracked sheets caused, it was said, by front feeding. There is one case in this town of two boilers that are fed from the front, and the sheets bagged so much that they had to cut them out. They put in new ones, and now these are going down also. They carry sixty pounds of steam, and the firing is easy. In this case I think the circulation is bad, because the front-feed deposited sediment over the first sheet. Now, front-feed may be all right in some cases, but in a great many others I think it is wrong; and the worst feature of it is in feeding water (at a different temperature) right over the hottest part of the boiler. In some cases this cannot be avoided. For instance: the watchman will run in cold water every night in some works, and in raising steam in the morning it will sometimes make faster than he expects. Then he runs in cold water to stop it; or, as they sometimes do, turns on the water and forgets it; but how he will work after he sees the water running out of the safety valve! Then, when it is at the proper level, perhaps he will have to fire up very strong in order to get steam in time. Now, where the front feed-pipe just goes through the front-head, and cold water is running in, with a very hot fire under the boiler, what a terrible strain there must be on the front sheets from unequal contraction, which, in time, is sure to speak for itself!

In some places the temperature of the feed water will vary considerably, even in the day time, and the water will be shut off and turned on probably twenty times a day. I don't think this is very good for a front-feed boiler, or any other. I know of one place where they have fed in front on one boiler for over thirteen years, and have had no repairs; but I think such cases are not very numerous.

Some engineers say that the front-feed washes all the scale to the back end. Well, maybe it does; but I think if they were to change the place of feeding to, say, the top, that they would find the scale in the back end just the same. I feed my boilers in the steam space with what is called the "old Ohio River feed;" it is very simple, as the sketch shows. There are various devices for feeding in the steam-space: some are good, some are not. This plan gives good satisfaction, and I prefer it to any front, back or mud-drum feeds.



I once had to run two boilers four months through the winter without a heater, and with the feed water between 35 and 40 degrees. I fed in the steam space, and had no trouble at all. If I had fed water at that temperature in the front head I certainly would have looked for some, especially if the feed-pipe did not extend to other portions of the boiler away from the front head. With steam-space feeding in this way, and blowing off a little every day, I never have anything to clean out of the boilers except a little loose scale, and I don't think there is any undue contraction caused by so feeding.

In the sketch the pan is 1½″ deep, 10″ wide, 2½′ long, and held up level by hangers. The feed-pipe in boiler is 4″ long; the pan is 2″ below end of pipe, and of course, the water falls into it and overflows in small streams. The check stop-valves I have close to boilers.

I could give several good reasons in favor of steam-space feeding, but I must bring this to a close.

I was very well pleased with that interesting letter from Mr. N. W. Williames, of Philadelphia, and hope he will give us more.

R. D. Bradley,
Canton, O. Vice-Pres. S. E. A.

[Mr. Bradley says, in a postscript, that he is "a plain man and no writer." All we can say is that we hope he will keep on writing in the same way, for it is the plain men who write hard facts that are coming to the front. Give us the plain men! Whoever wants the ornamental ones may have them without opposition on our part.

Mr. Bradley states his case strongly and argues it well. His points are numerous against front-feeding in some localities and with certain waters. It does not follow (and he does not say that it does) that it is always injurious. On the contrary, he cites an instance in favor of it.

The value of these communications cannot be overestimated, for they give us an insight into the practice of the day all over the country, and enable us to draw our own conclusions as to the utility of certain plans. Mr. Williames' letter, of which mention is made, has benefited a great many, and we hope that all will continue to use this page for the good of the craft. Let all write as often as they wish. They cannot come too frequently.—Eds.]

ANSWER TO "CAUTION."

Editors Mechanical Engineer:

The diagrams published in your issue of April 28th are certainly very peculiar, and, most surely, the fault is in the indicator itself. I do not say I do not agree with "Caution" as regards expansion between the cylinder and piston of the indicator, such a thing is possible, but not probable. The piston would have to be a very snug fit before that could occur. With an indicator that has been in use for any length of time it would not be possible to have a snug fit. My first impression on seeing these diagrams was that they were taken with a Tabor indicator. I have used that instrument considerably, and invariably after using it for a few times the steps occur. There are two reasons which would cause them, in not only the Tabor, but all others, except the Thompson. One of these reasons is that water, during the exhaust, collects on top of the indicator piston, and is re-evaporated so soon as live steam enters again, driving the piston down. Before it has time to recover the same thing occurs again. Further, the less the initial pressure the less likely this is to occur.

Another reason, or cause of steps in diagrams, is where the spring is connected to the piston without a guide through the head. The piston is likely to get canted to one side or the other, bind harder, and stick. Some springs are more liable to this than others, depending on the temper. The difference in temper in this case is so slight as not to affect the piston until the spring is under a high tension, hence its reason for good behavior under the low pressure.

May I ask "Caution" to send me two of these cards with full dates. My name and address is with the editor.

Brooklyn, N. Y. A. M. S.

THE MISSION OF MECHANICAL PAPERS.

Editors Mechanical Engineer:

The majority of engineers in this vicinity do their own firing (myself included); but I know of men who have never seen the inside of their boilers, who do not know the uses of the indicator, and whose only aim and object in life is six o'clock and pay day. So long as the boiler does not blow up, and the power keeps in motion the bosses are satisfied. Now, it is here that a good mechanical paper works in just right, for it opens both parties' eyes; and if an engineer has any ambition to excel it will be a great help to him, for he gets the best ideas of the best men in his business.

Being a member of the Society of Stationary Engineers, I should think, would be a great benefit to a man wishing to rise in his calling, for he can get the opinions of others who have had more experience than he has.

I am sorry to say that I am not a member, as there is no Lodge near here that I know of; but I intend to join as soon as I get an opportunity. I think the times are changing, and are going to change more, for manufacturers are buying better engines and are figuring closer on fuel, and this will soon create a better demand for practical men. At any rate, it is a good idea for a man to qualify himself to take his place in the front rank, and then he will command good wages anywhere.

Blower.
Westboro, Mass.

MARINE ENGINEERS ASSOCIATION, NO. 36, OF NEW HAVEN, CONN.

Editors Mechanical Engineer:

As you have generously opened your columns to all engineers, I have thought that a letter from the land of steady habits would not come amiss.

Let me say we have an association here of marine engineers, known as No. 36. We have been in existence nearly a year, and propose to stay with the rest of the boys. Our meetings are well attended, and we are prospering. I hope the time is not far distant when we can call every engineer in the country (worth having) a member of this glorious organization. Ours is a noble work, and one none of us need be ashamed of. Already this association is acknowledged as a power here, and we are respected and known as such. It has been the means of much good in preventing engineers from signing applications of men who after running a stationary engine awhile felt competent to take charge of a marine engine. Some of the steamboat owners curse us, others laud us, and will hire none but engineers whom they know belong to the association.

Now Brother Engineers (who run marine engines) help us to build this glorious order up, and make it known in every city and town on the coast, lakes and rivers, where marine machinery is used. We have now 38 associations scattered from the shores of Maine to Puget Sound, on the Pacific Coast. Any information I can give will be cheerfully afforded.

New Haven, Conn. Frank A. Foster.

A BOILER MAKER GIVES HIS VIEWS.

Editors Mechanical Engineer:

I have been taking your paper for some time, and think it is strictly common sense, containing nothing but what we can all understand; that is the paper that is wanted; it fills the bill.

I want to say that I notice in *Smoke Arch's* "Notes on Steam Boilers," in your last issue, he says a case came to his knowledge of a boiler, that had no hand-hole in the back-head. The boiler was, or had been in use ten years, when extensive repairs became necessary. Can he cite a case of a boiler with a hand-hole in the back end that has lasted ten years without repairs? I have known boilers that did not last two years without needing a new head, for it is about the same as putting a soft patch on the crown sheet or side of a furnace. The gasket on the plate will burn out in a short time, and leak. Then the moisture combined with the heat, soot, and ashes, will corrode the metal quicker than in any part of the boiler; and the worst of it is that the mischief can't be seen till it is done.

If I were building a boiler for myself, I would have a mud-drum on it, and a good large hand-hole, or man-hole if the boiler would permit, in the front end under the tubes, so that it could be cleaned well.

I am very glad to see boilers discussed, for I have been a boiler-maker nearly thirty years, and have given much attention to them. I will conclude by hoping the paper will prosper. I shall do all I can toward getting subscribers for it.

Erie, Pa. John Cook.

[We are glad to hear from Mr. Cook, and hope he will give us his views upon the action of soft coal on a steam boiler as compared with anthracite. Which of these fuels is most destructive ?—Eds.]

WELDING A FINISHED CONNECTING ROD.

Editors Mechanical Engineer:

The method of welding a 4″ shaft, described in your issue May 12th, is nothing new. I did this many years ago, and so have others. I will state how I fixed a new connecting rod that was all ready to put on the engine but was found to be 2″ too short. I cut it off in the middle in a lathe, squared up the ends, and drilled an inch and a quarter hole two inches deep in them. I then made a piece the diameter of the rod (with enough to finish,) and bored an inch and one quarter hole through it. I then fitted a piece 1¼″ diameter, and long enough to go through all and bottom in the holes in the butts of the rod. I then put the rod in the fire and soon had a good welding heat on "it, and setting the whole upright," jumped a weld on it with a heavy sledge. A straight edge applied after the job was cold, showed just one sixteenth crook in the rod, which was easily taken out. This rod has driven a heavy load ever since, and no one would know what had been done to it.

Allow me to thank Mr. Gilman W. Brown for his kind advice (testing an indicator), in your last issue. The instrument I use is a Tabor.

Troy, N. Y. Caution.

NOMINAL HORSE POWER OF AN ENGINE.

Editors Mechanical Engineer :

Please inform me how to get the exact capacity of an engine by measurement.

Bennington, Vt. J. E. C.

[We cannot tell the exact capacity of an engine by measurement. The only fact so ascertained is the nominal power. Multiply the diameter of the piston by the same number, and this product by ·7854. This gives the number of square inches in the piston. Multiply this again by the steam pressure and we have the pounds exerted on the piston. Multiply again by the speed of the piston in feet per minute, and we have the foot pounds in one minute. Now divide the last product by 33,000, a nominal horse-power, and we have the capacity of the engine as far as it can be ascertained in this way. The indicator is the only means of finding the power of an engine with any correctness. —Eds.]

CAULKING LEAKS IN TANKS.

Editors Mechanical Engineer :

As I have learned many things from your valuable paper, I would like to ask for a point or two on caulking leaks; I have not got that branch of the business to my satisfaction yet. I have a tank which has two small leaks in the seams between the rivets. I emptied the liquor out of it and caulked them when cold, but had only used the tanks two or three days before it leaked as bad as ever again. Can you give me any advice how to stop the leaks ?

A Brooklyn Engineer.

[Caulking a tank (made of tank iron) is ticklish work; unless one is careful, for the spring of the sheet is liable to make a bad leak worse. Under the circumstances, that is without knowing more about the details, we can hardly give any opinion on the course our correspondent should pursue.

We would remind him that he has omitted to sign his name to his communication !—Eds]

A NEW LATHE FOR PATTERN MAKERS.

The Fitchburg Tool Company (S. W. Putnam's Sons) are putting on the market a new lathe for pattern-makers, which is one of the handsomest tools of its class we have ever seen. It is not only beautiful in contour but it comprises many improvements, some, that, to us, are novelties. Of the latter is the friction brake, operating on the cone pulley to stop the lathe quickly when at its highest speed; the compound tool-carriage, in which the ordinary T rest occupies the place of the tool post, and lastly the design of the machine itself. It is a gap-lathe, so called, and while these are common enough in machine work, this is the first we have ever seen for pattern-makers use. The feed-table carrying the tool-post is operated by a diagonal worm, so that the handle which works it stands at an acute angle with the bed ; it is therefore entirely out of the way, and does not annoy the workman by sticking the sharp end of the handle into his body when he reaches over. The carriage is gibbed to the bed, and the tool has a compound movement, by which any given angle or bevel can be worked at all times. It is a most complete tool, and indispensable in all shops where large work is done. An illustrated circular will be sent by addressing the company at Fitchburg, Mass.

PROMISE OF GREAT ATTENDANCE AT THE COMING CHICAGO RAILWAY EXPOSITION.

It has become apparent that the National Exposition of Railway Appliances, which opens May 24, in Chicago, will be very largely attended by all classes of people. Not railway men only, but mechanics, farmers, merchants and professional men all over the United States are preparing to embrace this great opportunity of observing how railways and the industrial and commercial activities of our modern life are dependent upon each other. To see what a line of railway involves, what varied industries, what wonderful inventions, what ingenious contrivances, what shrewd adaptations of the oldest principles of mechanics and quick recognition of the newest discoveries, what manifold uses of materials gathered in all parts of the world—the chance of doing this will be eagerly embraced by tens of thousands who have no personal or direct connection with railway enterprises.

The educating influence of this Exposition cannot fail to be very great. And it will be strange if it does not accomplish much toward dissipating existing prejudices, and causing a more accurate understanding of those problems involving capital and labor which are now attracting so much attention. The fact that railways are tributary to all departments of labor, and that upon the industries which they have created, or vastly increased, depend the food upon hundreds of thousands of tables and the fires on innumerable hearths, will be strongly impressed upon all who look upon the magnificent display of exhibits with intelligent observation.

The crowds of workmen engaged in pushing forward the construction of the Annexes, and in preparing for and receiving exhibits, make the exposition building and adjacent grounds suggestive of a bee-hive at swarming time.

ORGANIC SCALE FORMATION IN STEAM BOILERS.

A lecture to the Keystone Council of Stationary Engineers, No. 1, Philadelphia, Pa.

By N. W. Williames, President.

You all know the subject to be discussed this evening, and I hope that I shall be able to explain my ideas upon it clearly. By comparing them with your own experience we may find it mutually beneficial.

Organic scale formation, its prevention and removal, is a matter of great importance in the life of steam boilers, and young engineers should be specially interested in some of the ways that foreign substances find their way into a boiler; accumulating in quantities sufficient, in some cases, to fill up half the water spaces to the very great injury of the heating surfaces. The same amount of steam, for a given duty is required, whether the boiler is dirty or clean, and it is easy to see, therefore, that if it is in the former condition the fuel bill is largely increased. This waste is sometimes attributed to the engine being out of order. The valves and piston are said to leak, when in reality they may be in perfect condition.

In every instance where a boiler is dirty it will require more coal for a given amount of work, so it should be the ambition of every engineer to keep his boiler thoroughly clean, to say nothing of greatly lessening the chances of accident thereby.

The priming of boilers is generally due to dirt, sometimes in the boiler, sometimes in the water itself, and possibly in both together. When a boiler primes there is no time when it is safe from accident. Water going over in the steam pipes endangers the fittings, as well as the engine, and the boiler itself is undoubtedly in a dangerous condition whether it be old or new.

You need not be afraid to fire a clean boiler, either externally or internally, when the heating surfaces are covered and the safety valve is right in all respects. Be careful, on taking charge of a boiler for the first time, to make a thorough inspection. If you find it clean you need not be afraid of burning it.

I will now explain how, under some conditions, dirt may accumulate in boilers. Pure water is composed of two gases—oxygen and hydrogen. These two gases, when compounded by weight in the proportion of 1 to 8, or if by measure (volume) 2 to 1, form water. That is to say, one pound of hydrogen, added to eight pounds of oxygen, forms water; or, if by measure, two quarts of hydrogen be added to one quart of oxygen, the result will be water.

Pure water is one of the most powerful solvents in common use; as a chemical agent its uses are various and important. From its neutral, mild, and salutary character, we are accustomed to regard it as a negative substance possessed of but little energy, while in fact it is one of the most important agents in the daily work of the world. Owing to its solvent powers in combines with many other substances, especially minerals, forming hydrates, of which the hydrates of lime and of potash are examples.

Absolutely pure water boils at 212°, at the pressure of 14·7 pounds. Its boiling point, however, is controlled by its density, and the pressure applied to its surface. It may be boiled at a temperature less than that of the human body, which is 98°. To do this, we must remove all pressure from it, as in a vacuum for example. While water will boil below 98° in a vacuum, it may be heated red hot, say to 1,000°, without boiling, provided pressure enough is applied to the surface. The generation of steam also raises the boiling point. This is caused through its increased density by the concentration of foreign substances in it, and the augmented pressure on its surface. Steam generated from pure water will, under some conditions, be of the same temperature as the water itself, but in case the water in the boiler is dirty, steam from it at a pressure of 14·7 pounds will be 212°. while the water itself may have a much higher temperature.

Water holding animal and vegetable matters in suspension, used in a boiler, is concentrated, and sometimes the foreign matter is precipitated on the heating surfaces. In our subject to-night we shall deal with some organic matters taken up by water through the ammonia and potash in it. Ammonia is derived from the decay of vegetable and animal matter, and there are but few fresh water streams without these substances. When water is heated, the ammonia is driven out, destroying the alkaline property of the water and precipitating the foreign matters held in suspension. Under such conditions these are no longer chemically combined, but are held mechanically. Before the ammonia is volatilized the water will look perfectly clear, but afterward it presents a muddy appearance. This same water may hold 10 or 15 drachms, per gallon, of organic matter, which, when precipitated, forms a rust-colored deposit in the boiler. It may be found along the steam-line and at the water surface, always remote from the point of greatest ebullition.

It is to remove this that we use surface blows in fresh-water boilers; by blowing off the scum which floats on the surface in the quietest parts of the boiler, as the water is evaporated. But I may say here that a large proportion of surface blows are put on in the wrong place—generally where there is the greatest agitation in the boiler, the scum meanwhile floating away to where there is the least disturbance. Also, when properly applied, they are sometimes wrongly used. A surface-blow is useless unless the water is about on a level with the center of the pipe. If the surface-blow is opened when the water is over the opening in the boiler we simply blow out hot water, which, of course, is at the expense of the coal pile. It is easy to see, therefore, that it requires nice judgment and an accurate estimate of the height of the water in a boiler, to know when the surface-blow should be opened. To-day we may be drawing a certain amount of steam and to-morrow twice as much. It is next to impossible, therefore, to know the actual height of the water surface, and this alone makes a surface-blow at times unavailable.

I wish to call your attention again to the surface scum, for I believe it is the cause, indirectly, of cylinders and valves being cut. It may come over with the steam, carrying with it small particles of grit; these act as powerful cutting agents and cause the valves to wear in all conceivable shapes. In every instance where a boiler primes, the valves will wear rapidly. The cylinder can never be kept in a first-class condition; the engine will run heavily and tallow and black lead will be of little use. This cutting quality in surface scum I attribute to diatoms and animalculæ which abound in all river water. I have found in the deposit taken from steam boilers and in surface-scum some very beautiful specimens. These diatoms appear wherever matter is found in a condition fit for their development, and being provided with a silicious shell their form remains unchanged to the remotest periods.

Some of my hearers have seen these specimens; but for others I have arranged my microscope with a double nose-piece with an $\frac{3}{10}$ objective, 32° angle of aperture, and $\frac{1}{8}$ "Tolles" with 175° angle of aperture. The eye-piece is an achromatic *B*, and I have also a Moller's diatomacen No. 2. By the aid of these I propose to show you some inconceivably small shells, not exceeding $\frac{1}{10000}$ of an inch in diameter. Minute as they are, they were once living organisms, instinct with life. It is these animal substances, together with some vegetable forms, that compose the organic scale, and, I believe, to some extent the inorganic in a steam boiler. Sulphates and carbonates of lime, and also of magnesia are assisted by these diatoms, as I have found traces of them in inorganic scale.

Let us take a 25-horse-power boiler and engine, which you will admit is an ordinary size, and make a calculation of how much organic substance would be left in the boiler by running the engine ten hours a day, for three hundred days consecutively. We will allow the engine 50 pounds of water per horse-power per hour, which is a fair average for its size. Let us further suppose the boiler is not blown off during the three hundred working days, and that none of the foreign matter is carried over by the steam. Under such circumstances we shall have a very much larger amount left in the boiler than is generally supposed. We will assume as a basis that the water holds in suspension one drachm of foreign matter per gallon of water evaporated. Under the conditions named above, we should have 1,500 gallons of water evaporated in ten hours, which quantity divided by 16, would give us 93·75 drachms; divide this again by 16 to reduce it to ounces, and we have 5·8593 pounds pumped into the boiler every ten hours. Multiply this by 300 and we should have 1,757·97 pounds solid matter carried into the boiler in one working year. This enormous quantity shows the necessity of careful handling and frequent blowing to insure absolute cleanliness.

With these remarks I will close this lecture, and on next Tuesday evening I shall speak further on the same subject.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

A FRIEND ANSWERED.

We have received the following letter:

Editors MECHANICAL ENGINEER:

Being an admirer of your paper for its bold and fearless stand on questions affecting your constituency, and appreciating to the full your independent spirit in the conduct of the paper, I still feel that sometimes you press rather hard on new inventions, and schemes intended to benefit the world at large. To make my object in writing this letter plainer, I will instance one article in your paper, current volume, No. 5, entitled "Another One." wherein you, in a satirical mood, animadvert upon a new locomotive which, if it is successful will revolutionize the machine; it will effect the greatest changes in it, and in short, advance its capacity in a marked degree. I might mention also a tendency in your paragraphs to belittle the efforts of capitalists who are spending their money, laudably, with the object of improving transportation and ameliorating the condition of mankind at large.

I should be sorry to see your usefulness (for your paper has a great field before it) marred by mistaken efforts in the direction noted, for no man, be he ever so capable, versatile, and brilliant with his pen, can stand against the march of progress. He may bid the ocean retire but the tide will rise all the same, and if he does not get out of its way will overwhelm him.

NEW YORK. SINCERELY YOUR WELL-WISHER.

We are under obligations to our friend, whose name is appended to his communication, and thank him for his efforts to point out our defects. We never wince at honest criticism, for we receive it as a proof of interest, and we publish this letter as an evidence of our sincerity.

Suppose, however, that we feel that our friend has mistaken our aims in criticism, and suppose that the sequel—the experimental trials of certain machines criticised in THE MECHANICAL ENGINEER—prove the soundness of our views, and justify all that we said! How then? Would our friend admit, in such an event, that our judgment was good, and that in advance of the fact, we predicted the failure which subsequently resulted? Suppose him to be a capitalist seeking an investment, and was about to invest money in a scheme which, personally, he knew nothing about. Suppose that this venture was of a mechanical nature, and depended upon the successful working of certain details, would he not like to have an independent opinion upon its possibilities? Would he not like to know from an uninterested, and presumably capable, source what chance he had to get his money back? We answer this question as he would himself if present, and say certainly; and then we point out to him that this is precisely what he will find in THE MECHANICAL ENGINEER'S criticisms of new fangled devices that are founded on mechanical fallacies.

Our friend instances one article which seems to him a judgment in advance of the fact. We will mention another in advance of the fact, and that is concerning the Fontaine locomotive. When this machine was exciting great interest and attention, backed up by the *Scientific American* as one of the greatest inventions of the time, THE MECHANICAL ENGINEER demolished its pretentions, and showed by feet and inches, ounces and pounds, that it was an impossibility for it to succeed. We were the first to expose its fallacies, and our position was abundantly proven by the results. We might go through the past volumes and find many similar instances of minor paragraphs and criticisms upon hopeless inventions, but why should we? It would have an air of vain-gloriousness, and seem to exalt to an important position two qualifications which are common to a vast number of engineers besides ourselves, and which are not our especial birthright. These are experience, and a knowledge of mechanical laws. When these two sit in judgment on a new invention, and the judge is unbiased, the verdict is a true one, and no specious arguments or mechanical sophistries can alter it. The machine fails if the weight of evidence is against it.

We might turn critic ourselves upon our friends communication, regarding some of its assertions, but we have no intention of so doing. We only wish to point out to him that criticism is the duty of the conductor of a technical paper, if he is capable of impartiality. The public look to him for decided utterances, not halting opinion or cautious, non-committal statements as to probabilities. The public want specific, exact, and unprejudiced opinions, as to the merits of alleged improvements, and these we attempt to give to the best of our ability. Canute, with his courtiers assembled upon the sea shore, is not a fitting metaphor for our position, for we have never said to chimerical inventions "Thus far shalt thou come and no further." We have simply argued that in a mechanical sense they could not come at all.

We have no fear that we shall be overwhelmed by the rising tide of public indignation, or that our constituents will disapprove of our efforts in the line mentioned. We say this because we have the advantage of our friend in being behind the scenes. An editor, who is also a proprietor, watches narrowly the effect of a certain line of conduct upon his paper. It is his business venture, and according as he is shrewd and far-seeing in his estimates, so is his reward. Judging by the gain since January 1st in our audience we are on the right track, for the votes are overwhelmingly in our favor.

We do not indulge in prophecies, mechanical or otherwise; we do not hazard predictions, but we do at all times say that a pound avoirdupois is sixteen ounces; that a foot is twelve inches, and when any mechanical device is originated to make the one or the other of these standards greater than they are, that invention is a fallacy and will not succeed.

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It would seem, at times, from the character of some of the schemes foisted upon the public, that the more absurd and impossible they were the quicker they were taken up.

THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

A correspondent in our last issue, Mr. David Hall, of Baltimore, speaks enthusiastically of this body, and says he thinks it will, in time, be a great one. So do we. So far as prophecy goes we think it is very safe to say that the stationary engineers of this country have an opportunity now open to become powerful as a body, for they are organized and have made a beginning. All that is required hereafter is constant proselyting for the cause. Every engineer who is already a member in some city, should write to his connection in other places, setting forth the great value of such associations, and urge him to form such a body in his own town. In this way a great deal can be done at very little expense. Nothing can be effected without work, and we must all do what lies in our power for mutual benefit. So far as our efforts can go we shall be glad to do what we can "without fee or hope of reward" other than to see the Association become great.

It may take some time to cover all the ground; it undoubtedly will; but ceaseless and earnest effort accomplishes all things. In the state of Pennsylvania alone there are 38,000 engineers, a large proportion of them stationary, and other states have their quota. The class is one of the most important in the country. The members of it have millions of dollars worth of property under their control, to say nothing of priceless human lives. Such responsibility as is here involved demands a class of men of the very highest qualifications as regards sobriety—earnest purpose, and high intelligence, and there are hundreds of thousands of just such engineers in the country to-day who should be enrolled in the National Association. They are wanted, and it is their bounden duty to come forward and organize.

One reason for the apathy which exists in some quarters is plain enough, and this is the popular view of such organizations in general, or as they have been in the past. Trade societies are looked upon in many quarters as hostile to manufacturers, as bodies of men working in secret, and in an underhanded way to injure employers, and no man of any self-respect would care to be connected with such concerns. This idea has a firm hold and it will take some time to eradicate it; but it will be, in time, and all classes, employers and employed, will see that it is for their mutual benefit to get every worthy man enrolled.

The latest intelligence of the Association's doings is here appended:

"Number of associations Jan. 1st, 1883, 11; number of members Jan. 1st, 1883, 725; number of associations chartered during quarter ending April 1st, 11; number of members admitted during quarter, 198; number of applications rejected, 30; number of members suspended, 29; number of members expelled, 4; number of members died, 1; total membership April 1st, 923.

The only association reporting property is from Providence, R. I., viz.: Library, worth $600; pictures, $100; other property, $150; funds invested, $500. Total, $1,350. This has largely been donated by the manufacturers of Providence and vicinity.

Applications have been received since April 1st from Cincinnati, Ohio, and Meriden, Conn. One hundred members have subscribed to the aid. Now let all the societies make one more effort, and let us have at least five hundred more names on the Aid roll by June 1st, at which time those who have expressed their wish to support the aid will pay their admittance fee to the persons elected for the purpose."

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THE TYRO IN MECHANICS.

When men who have had experience in any department of the trades make suggestions as to methods of doing work, one listens to them with respect, even though his own views may not coincide. It is difficult, however, to exercise the virtue in question when a tyro or an amateur lays down the law as he understands it. The want of experience is so apparent as soon as the tyro makes suggestions upon moot points that it would seem instinctive in him to suppress himself.

Of all other places the novice is most unnecessary in mechanical papers, for not only are his suggestions crude and incomplete, but they are positively mischievous. In some cases these suggestions are accompanied by sketches which clearly reveal their weaknesses. This occurs in a late number of a contemporary, where a "new" method of making cranks for small engines is shown. This consists of putting the crank-pin in, independently, by running a bolt through both arms, with a steel bush on the bolt to answer for the crank-pin. There are no counter-bores shown in the crank-throws, and the whole thrust of the piston comes on a bolt, say 1¼, or perhaps 1½ inches in diameter!

It is true the editor corrects this amateur (who finds it necessary to give his dimensions in the form of an equation) by saying it is not new, but "like the cross-head in the Lawrence engine." If it is, the Lawrence engine is very badly constructed. We prefer to think, however, that the engine in question is not so made, and that the statement is incorrect.

A HIGH HONOR TO A DISTINGUISHED INVENTOR.

Thomas Shaw, Esq., the well known mechanical engineer, of Philadelphia, has just received the rare award of the *Scott Legacy Medal*, as a recognition of his valuable invention of the Friction Buffer.

This medal was given by the Board of City Trusts upon the unanimous recommendation of the Franklin Institute, and in only one other instance has it been recently bestowed.

The sub-committee of the Franklin Institute, in referring to this invention after making severe tests, report as follows:

Extract from Report of Committee of Experts appointed by the Franklin Institute to test "Shaw's Friction Buffer."

"In the opinion of your sub-committee, Shaw's Friction Buffer fully and satisfactorily accomplishes the purpose for which it was designed, and constitutes a useful and practically valuable improvement. It substitutes the utilization of a correct mechanical principle for a construction which serves as a mere make-shift; is of simple, durable and inexpensive construction, ready application, and is effective and reliable in operation. Your sub-committee consider it in the above particulars to be superior to any device for the purpose within their knowledge; and, believing it to be sufficiently meritorious, recommend the award of a 'Scott Legacy Medal' and premium."

H. R. HEYL, Chairman,
WILLIAM H. WAHL, Secretary.

The Friction Buffer was illustrated in THE MECHANICAL ENGINEER, page 14, current volume, and its great utility as a life-saving device at all railway termini has thus received high indorsement.

We feel like making some extended remarks upon Mr. Thomas Shaw's career as an inventor, but, not being certain that they would be sanctioned, we have concluded to omit them. It is enough to say that the list of his inventions, many of which are in daily use, would occupy a large space in THE MECHANICAL ENGINEER. They have the great merit of being useful to the world, and, what is doubtless a greater satisfaction to the inventor—commercially valuable.

Mr. Shaw is still a young man, and may reasonably look forward to a long career of usefulness. It gives us, personally, great pleasure to announce this award and indorsement of his ability.

SINCERE REGRETS.

It has been hinted in the pages of a contemporary that we were making ourselves active in behalf of the *National Association of Stationary Engineers*, with the hope and in the expectation of becoming the "organ" of the body mentioned. THE MECHANICAL ENGINEER is not an "organ," it is an engineer's paper, and to it properly belongs the discussion of matter interesting to them, only limited by our ability to discover what that is. If our efforts to carry out our plans interfere with others in any way, it is not through premeditation on our part. If we are so unfortunate as to wound the sensibilities of a well-meaning man, we can only go apart and weep. Our efforts, then, in this line, are stimulated by no promises or expectations from any source, but solely from a conviction that the body of men we have named have rights which we can, and do, put forward in our paper for their advantage. If they chose us as their representative rather than another—judging from our columns it would appear that they do—why should we be reviled for it?

To avoid even the appearance of controversy and wrangling (a thing we detest) we do not mention our contemporary by name. Our readers do not care what it thinks of us, or we of it. They pay us for matter relating to their businesses, not for private squabbles or exhibitions of childish jealousies, and we shall make no allusion to the subject hereafter.

We have never boasted of our great honesty and sincerity, and we have made no attempts to hire the officers of the "National Association" as canvassers to increase our circulation among engineers. Our contemporary has. Two of them are now in its employ, and it has made overtures to another prominent one for next fall. This gives us no anxiety whatever. We hope that all our contemporary's schemes and plans will be realized, that it will be chosen the "organ" if that is what it wishes, and that it will become great. We shall continue, on our part, to work in our own way for the benefit of all engineers everywhere, "National Association" or any other.

This is the first and the last utterance we shall make on this subject. We might say a great many sharp things, but we have no desire to do so. Altercation is not to our taste privately, and in public print it is simply an affront to readers and subscribers. We shall read no articles in our contemporary bearing on this subject, so it has the field all to itself.

INERTIA.

Misapplication of terms and erroneous deductions are not infrequent, but it is seldom we find so marked an instance as the following, copied by the *Scientific American* from a French periodical, *La Nature*:

The Principle of Inertia.—The experiments which serve to demonstrate this principle are innumerable, and we have already cited a large number. The one represented gives a means of uncorking a bottle without a corkscrew. If we take a well-corked bottle of wine, beer, or other gaseous liquid, and, after protecting the bottom with a cushion formed of a napkin, give it several strong raps against a wall, the liquid, by virtue of the principle of inertia, will drive out the cork; and sometimes even, especially if the experiment is tried with beer or carbonated water, the cork will come out with such force that a portion of the liquid will spurt out at the same time.

It is asserted that it is not rare to see the waiters in hotels uncork bottles of carbonated waters in this way, by striking them against the floor. These waiters are assuredly not aware that they are performing an operation in physics, and giving a demonstration of the principle of inertia.

Inertia means "dead," "want of action," "sluggish," and when it is applied to mechanical matters its meaning is obvious. It is not a principle but a property of matter. If a bottle partly full of any liquid, gaseous or not, is inverted and the liquid violently driven towards the cork, the air in the space between the liquid and the cork will be compressed, and the cork will be driven out. The liquid acts the same as an elastic piston, filling all space. Inertia has nothing to do with the action. Momentum has, for it is the *movement* of a given body which produces the effect, not its inertia. So far as inertia is concerned the cork would remain in the bottle forever.

The cork is driven out by the live force (*vis viva*) of the mass of water, that is its weight multiplied into its velocity.

BRASS CASTINGS.

If what was put into a crucible came out of it there would be less diversity in results. What with the volatility of some metals, and the varied melting points of others in the same mix, it is wonderful that anything like uniformity can be obtained in ordinary work. Zinc sublimes (burns away) at 773 to 800 degrees, while the heat of the metal with which it should be intimately mixed in making yellow brass—copper—is nearly 2,000 degrees. Zinc, tin and lead enter into compositions of copper to form alloys in varying proportions (always in definite quantity for a given alloy). It will be seen, therefore, from the ease with which the lesser metals are burned away at comparatively low temperatures, that it is a very easy matter to make several different kinds of metal with the same mix.

As a matter of fact, this very thing occurs, and, quite recently, an engineer engaged by a large concern said that they had the greatest difficulty in getting bearing brasses uniform—so much so that they had made up their minds hereafter to babbitt all bearings, as the best way out of a trouble of magnitude. In one lot of castings the bearings would be soft and tough, in another hard, and so on.

We fancy that this is not a peculiar experience, and that an honest showing would discover it in many shops. Zinc is added the last thing as the crucible comes out of the furnace, and any one who has watched a brass-founder at his work, or his melter, must have noticed that the amalgamation, the unity of the mass, so to speak, is a matter of great uncertainty. In a sense it is guess-work, for, if the metal is too hot, as it generally is, for the zinc, a large percentage of it goes up among the rafters in the form of a greenish cloud of vapor, and the longer the stirring goes on the more escapes. Further, the union of two semi-fluid, pasty metals, as effected by an iron rod about ¾ of an inch diameter, is another element of uncertainty, and it is, as before stated, little to wonder at that brass castings are so variable in character. The two metals which enter into the composition of brass have an affinity for each other, but they must be brought into intimate contact before they will combine, and where this is effected mechanically the results will be as we have stated.

Some brass-founders use precautions to prevent volatilization of the more fusible metals, introducing them under a cover of powdered charcoal on top of the copper, but we fancy the number who do this is very small.

TRADE ADULTERATIONS.

Doubtless in that day when men are convinced that honesty is not only the best policy but the best principle, trade adulterations will cease; until that time they will be common. At the present the most gross and ridiculous substances are palmed off upon purchasers in lieu of the genuine article. Cocoa-nut shells for example, are ground up and flavored with different spices and sold for the regular goods. A sample of ginger which we purchased was wetted with water, when it immediately solidified into a cake, and was baked in an oven, the product resulting being a peppery dough. Samples of soda and cream tartar revealed gross adulterations. When these were brought to the notice of the sellers they evinced no interest in the matter. The manufacturers of such goods urge the propriety of their conduct, upon the ground that the purchaser is himself the cause of sophistication, for the reason that he demands goods at a price for which the genuine cannot be afforded.

The fallacy of this is shown by the fact that the adulterated goods are sold at the same price as the true. If the two articles—true and false—were so labeled, in every instance the buyer would take the genuine at the highest price.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXIII.

Last Monday we received an order from a certain mill near-by to overhaul their line-shafting, and I had scarcely laid down the letter before the street door opened, and a young man came in and asked for a job. It was opportune, for I was just thinking whom I should send out on the job, for it so happened that, at the moment, there was not one I could have sent. This young man of whom I have spoken, was a bright, smart-looking chap without any nonsense about him. He had a blue flannel suit on and a Derby hat. In one pocket I saw a square outlined against his breast, and under his arm he had a bundle rolled up, from the end of which a hammer-handle protruded. This looked just like business, and pleased me.

"What are you?" said I, "lathe-hand, or vise-hand?"

"I'm a mechanic," said he.

I made no answer for the moment, but looked at him steadily. "I suppose you are aware of what you are saying," I replied, after a pause of some length.

"Yes, sir; I am," said the young fellow civilly enough. "I looked at you when I came in," said he, "and saw you were one of the old-school men. If I had said to you that I was a machinist you wouldn't have given me a job. You want mechanics in a shop like this, not machinists."

Now the man fell in my estimation at once, for there was a trifling amount of egotism and freshness about this that lowered him, so I replied to this address by saying that we did want machinists who were also mechanics, but we didn't so much care about machinists who were philosophers and students of human nature. So far as their usefulness in the shop was concerned, there was no connection between the two qualities.

The young man was abashed, and said he meant no offence, that he wanted a job sincerely, and came ready to go to work, and he would be glad if we could take him on.

"Can you line up shafting?" said I.

"Yes, sir," said he.

"How would you go to work to do it?"

"That depends upon circumstances," said the young man.

"How so?" said I.

"Why, this way," said he. "There can't be any cut-and-dried rule for lining up shafting for the reason that, take the country over, there are scarcely two lines alike. In some lines the first three sections may be 3″ shafts; the next 2″ for the rest of the way. The 3″ shaft is all right vertically, but one end of it is out, perhaps an inch, from the pull of the belt on it. Then the 2″ is all wrong vertically and all right horizontally, and so on through the whole line. Now what am I going to do with this, and how am I going to find out which section is right and which is wrong by any rule? How am I going to line up a lot of shafting that is full of pulleys of all shapes and sizes, some of which run out and some run in? No rule can do it, and I don't know how I can do it myself until I see the line; but if you will give me a job at it I will guarantee to make a line shaft, two hundred feet long, so it can be easily run round by one man when the belts are off, and I won't be a week over it either."

"Will you need to cut the belts to do it?"

"I won't cut the belts, but I will run them all off, so as to have the shafting free from the strain of them."

"Will you require to take any sections down?"

"I might and I might not; it depends upon circumstances; probably not."

"Well," said I, "we'll give you a job; you seem to have had some experience, and if your work is satisfactory we will keep you on. We do not make any permanent engagements, or hold out any inducements of permanency until we know what a man can do."

"When shall I come on?"

"This afternoon," said I. "Mr. Hess, who hires the help generally, is away to-day, but when he comes back he will give you a job. But," said I, "my friend, a word in your ear! If you want to get along with Mr. Hess don't have too much to say; you will get along faster."

"That's all right," said the young man, and out he went.

In the afternoon Jake came into the office about half-past one, and I told him I had hired another man for him while he was out, as a job came in that had to be done right off, and we had no one to send out on it.

"All right!" said Jake, "where is he?"

"There he is out in the shop near the door."

Jake took a look at him and said: "I like that; he minds his own business. If he was all over the shop now, buzzing this one and that, and asking all kinds of questions of every man, his stay would be short. I believe that chap has come here to work," said he.

"Form your own conclusions," said I.

The young man went to work and did the job of lining up the mill shafting satisfactorily, and I have introduced this incident here merely as showing how a man asked for a job and got it. There is a vast difference in men in this respect, and we have wanted help at various times, but have not hired some who presented themselves for the reason that they did not seem as though they wanted work, but would like to get a soft place at big wages. A great many come with very fine clothes on; far better in appearance than any I have (and I am not a shabby man); they came be-ringed and breast-pinned to such an extent that it made me wonder where they had been working, and how much wages they had been getting. It rather set me against them, for every man who has worked at the trade for a living knows perfectly well about how much of this sort of gaudiness can be sported on a salary of, say six hundred dollars a year. I do not think a man need be slovenly or careless in his appearance, neither need he be a dandy. There is a mean between the two which sensible men strike and preserve; but when it comes to "seal rings," with a "stone" as big as a small hand-hole plate, and fictitious "diamonds" that deceive no one, it rather looks as though the wearer had a thin place somewhere. On the other hand, a man who goes into a shop with his shop clothes on and his kit under his arm, is pretty certain to have the first show, if there is any. A trifle one way or the other has its influence for or against success.

ABSURDITIES OF SOME PATENT SPECIFICATIONS.

It is a fiction of our patent laws that a patent must contain such a description of the thing patented as to enable one, skilled in the art, to produce it. When one turns to the *Official Gazette* of the Patent Office, and looks over the specifications of patents, he comes to the conclusion that one much more needs to be skilled in the slang of patent agents than in the arts. The most extraordinary combination of words and sentences is found, and it would seem that the principal aim of many patent lawyers and patent agents is to conceal ideas by the use of a slang which shall be unintelligible. In a recent number of the *Gazette*, we find a patent in which the words "substantially as set forth" occur three times in one single short sentence, yet the "setting forth," so far as we could see, had not been done in any portion of the patent or its claim. The "herein described" and "hereinbefore mentioned" and similar imitations of legal phrases were introduced without rhyme or reason. We also found such absurdities as "imperforate" instead of impervious, and "backwardly projecting," "bi-furcate," "upwardly projecting" and other similar terms, which were used with a frequency which does not speak well for the clearness of thought of the writers. There is also a growing tendency to introduce hyphens between words that cannot be compounded with any show of reason. The result will be that a patent may be anything but what its name denotes, and we apprehend that a large proportion of those granted within the last two or three years will be utterly valueless until the courts have decided what the jargon employed really means in plain English. If this rubbish did convey a clear meaning to any one there might be some excuse for it, and it would be tolerated, but it conveys ideas neither to examiner, patentee nor public.

We must not, however, be understood as saying that these criticisms apply to all patents. Occasionally one is met with where the clearness and accuracy of the language, both from the literary and mechanical standpoint, leave nothing to be desired. We call to mind some that are models of mechanical description. Such patents are their own defense. They are not spring-traps laid with the hope of catching some unwary infringer by means of legal juggling.—*Chemical Review.*

In round numbers, the weight of one million dollars in standard gold coin is 1¾ tons; standard silver coin, 26¾ tons; subsidiary silver coin, 25 tons; minor coin, five-cent nickel, 100 tons.

The English Commissioner to the National Exposition of Railway Appliances, to open May 24th, in Chicago, recently arrived on the *Alaska*, bringing many interesting contributions.

PATTERN MAKING, No. 13.

BY A PATTERN MAKER.

In entering upon the subject of gear-wheels I am reminded, by experience and otherwise, that there are many situations where, in the absence of regular designers, the pattern maker has not only to make the patterns, but has also to decide upon the size and pitch suitable for a pair of wheels.

It will be well, therefore, if we consider this subject from the root up. Let us suppose the approximate distance between the centers of two shafts, that run parallel to each other, to be 40 inches, and that we require to gear these shafts together by a pair of spur wheels that will transmit a given amount of power at a certain velocity.

Let the wheels be required to transmit 40 H.P., and the velocity to be brought up from 65 at the driving shaft to 185 at the driven.

Now, without knowing what may be the sizes of the intended wheels, we know very well that the radius of the pinion must be to that of the wheel as 65 is to 185, or as 13 is to 37; further, we know that the radii of the wheel and pinion, taken at the pitch circle, must together be equal to 40 inches, or as near as may be. Firstly, therefore, we divide the distance, 40 inches, into two parts, bearing to each other the proportion of 13 to 37. The geometrical method of dividing this line proportionately is as follows:

Let AB be the given line, fig. 97. Draw from A a straight line making any angle with AB. Upon this line, with dividers set to any convenient distance, and commencing at A, lay off a number of parts, equal to the sum of the two numbers which represent the proportion in which the line is to be divided. In this case $13+37=50$. Join pt. 50 to B, through pt. 13 draw a line parallel to $50B$, intersecting the given line in the pt. C: then $AC : CB :: 13 : 37$.

In drawing diagrams and measuring them, one cannot expect to reach the exactness of calculation, therefore the following rules are to be preferred.

RULE I.—Multiply the velocity of the wheel by the distance between the the centers of the shafts, and divide by the sum of the velocities of the wheel and pinion. The result will be the radius of the pinion.

RULE II.—Multiply the velocity of the pinion by the given distance, and divide as before. The result is the radius of the wheel.

$$\frac{65\times 40}{65+185}=\frac{2,600}{250}=10{\cdot}4 \text{ rad. of pinion.}$$

$$\frac{185\times 40}{65+185}=\frac{7,400}{250}=29{\cdot}6 \text{ rad. of wheel.}$$

Those who are not averse to boxing the X about, use the following simple equation:

Let X = rad. of pinion; then $40—X$ = radius of wheel.

$$X : 40—X :: 13 : 37$$

$$37\,X = 520—13X$$

$$50\,X = 520$$

$$X = 10{\cdot}4 \text{ rad. of pinion.}$$

The sizes having been determined, the pitch is the next consideration. We must take such a pitch as will permit a sufficient thickness of tooth to bear the power to be transmitted. In order to avoid troublesome calculations, Tables I and II, copied from Appleton's Encyclopedia of Drawing, are appended.

In our example the radius of the pinion being 10·4 inches, its circumference is 65·34 inches or 5·445 feet, which multiplied by the number of its revolutions, 185, gives a velocity at the pitch circle 1,007·3 ft. per minute, or 16·79 ft. per second.

In Table I we find certain velocities at the pitch circle, viz: 3, 4, 5, 7 and 11 ft. per second. As it is evident that a wheel revolving 16 ft. per second will transmit four times as much power as it would if only revolving at 4 ft. per second, therefore, instead of looking for 40 H.P., let us look for 10 H.P. in the column headed "4 ft. per second," and in line with 10 we find 2¼ in. the required pitch.

Table II gives the pitch proper for a given stress in lbs. at the pitch circle. It does not seem to agree with Table I, and, therefore, some judgment must be exercised.

One H.P. = 33,000 lbs. raised 1 ft. in 1 min.
40 H.P. = 1,320,000 lbs. raised 1 ft. in 1 min.

which being divided by 1,007·3, the velocity at the pitch circle in ft. per min. gives a stress of 1,314 lbs., which, according to Table II, demands a pitch of 2 inches. We will, for the purposes of our example, accept the pitch given in Table I, viz: 2½ inches. Having the pitch the wheels may be drawn on a board according to the following proportions, the pitch being divided into 15 parts:

Pitch line to pt. = 5 parts; pitch line to root = 6 parts; thickness of tooth = 7 parts; width of space = 8 parts; thickness of rim = 8 parts; thickness and depth of web inside of rim = 7 parts; thickness of arms = 7 parts; width of arms at rim = 1½ pitches, tapering toward hub ½ in. for every foot in length; thickness of metal in hub when bored, 1 pitch.

To avoid the inconvenience of frequently dividing pitches into 15 parts, a simple scale, shown in fig. 98, may be constructed. The line, *BC*, is made in the largest pitch one is likely to use, say to 6 inches; line, *BA*, drawn square with *BC* is of any convenient length, say 12 inches. *BC* being 6 in. long is divided into 15 parts; *BA* into 6 parts. Draw lines from *A* to the 5th, 6th, 7th, and 8th part on *BC*.

The divisions on the line, *BA*, are to be marked for inches, as in the figure; through the points of division draw lines parallel to *BC*; other lines may be drawn midway between these for half inches, and, if desired, the operation may be continued to quarters and eighths. In drawing the wheels, we have to take into consideration that, being limited to a certain pitch and to pitch circles of such size as to admit of being divided by the pitch without a remainder, it is more than probable that the radii we have previously found for our wheels will need to be slightly altered. Diameter of pinion being 20·8 inches the circumference equals 65·34 inches, which (divided by 2·5, the pitch) gives 26 as the number of teeth in the pinion. Diameter of wheel being 59·2 inches, the circumference, 186, divided by the pitch, gives 74 for the number of teeth in the wheel.

TO FIND THE TRUE DIAMETERS.

RULE.—Opposite the number of teeth in the wheel find X in Table III,[*] which, multiplied by the pitch, gives the true diameter. 26 being the number of teeth in the pinion, X = 8·2959, which, multiplied by 2½, gives 20·74 in. as the true diameter of the pinion.

Opposite 74, the number of teeth in the wheel, we find X = 23·5695, which multiplied by 2½, gives 58·92 for the true diameter of the wheel.

By adding these diameters together and dividing by 2 we find the true distance between the centers of the wheels or shafts must be 39·83 in. If we try a wheel having 75 teeth, we shall have a result as much over 40 inches as with 74 teeth it was under, therefore it is indifferent which wheel is accepted. But as it is advisable to have a number of teeth in the wheel which is odd, or prime to that of the pinion, to equalize the wear, we should probably decide upon 75 teeth instead of 74.

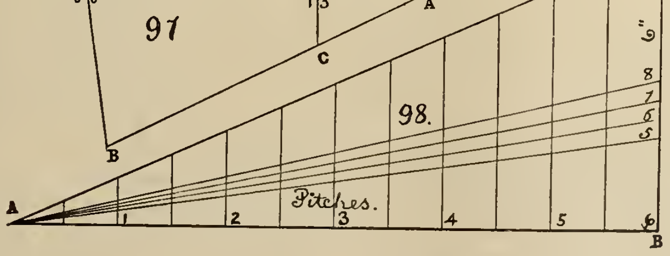
In designing gear wheels it is now universally recognized as of the first importance that the form to be given to the teeth must be laid down on correct principles. Otherwise uniformity of motion and durability of work are, to a great extent, sacrificed.

Wheel-teeth perfectly designed work together by rolling contact, not perfectly perhaps, but still to such an extent as very much to reduce the wear as compared with others not properly shaped. Improperly shaped teeth not only abrade each other to an injurious extent, but do not bear uniformly upon one another in working, hence they are very liable to break. Teeth having a correct form show three points in contact constantly, therefore there are always three teeth to bear the strain, except, perhaps, where there is a very great disparity in size between the wheel and the pinion in gear with it.

Camus, a French engineer of the time of Louis XIV., was, I believe, the first to apply mathematical principles to the curvature of the teeth. The ingenious, clear and conclusive demonstrations render his work of absorbing interest to the student; being demonstrations, and not speculative ideas, the work is of permanent value as an instructor, and cannot be overturned by any others that succeed it. The author demonstrates that, if a circle whose diameter equals the radius of the pinion, be rolled upon the pitch circle of the wheel, both inside and outside, then a point in the rolling or generating circle will describe a correct curve for the face, and also for the flank of a tooth. Many years elapsed before this information *struck in*, but when it did wheel-teeth were shaped in conformity. There was, however, still something wanting, for by this time cast-iron had come into use for gear wheels, and it was found that *any* two wheels, though of the same pitch, would not work together. Only those specially made for each other would work perfectly. This led to a multiplicity of patterns, both expensive and inconvenient, being required, until the lamp of science was again turned in this direction by the late Professor Willis, who made the important discovery that it was not absolutely necessary, to insure the correct working of two wheels, that the radius of the one should be the diameter of the generating circle for the other, but that all that was necessary to insure the correct working of any pair of wheels of the same pitch was to use a generating circle of a diameter equal to the radius of the smallest possible wheel for that pitch. He went yet further and showed us that we need not trouble any longer to cut templates for pitch-circles, concave and convex, that it was unnecessary to make generating circles, with projecting sharp points to roll on the base circles, and by rolling trace the epicycloids required, for the reason that, as but a small portion of such curves were required, a sufficiently near approximation might be made with a pair of compasses, provided we knew the right distance to open them, and the proper place for the center.

This led to the invention of the Odontograph which bears his name, an instrument which the writer has often used, and remembers the first time he used it (in 1864), when a drawing of a bevel wheel was brought him, and the Odontograph. No particular mental effort was required to master it, you read the directions, and you knew right away what was required.

After the Willis Odontograph came other contrivances. said to be improvements, whether they are or not, I do not wish to discuss, for the simple reason that I consider the whole of them worth next to nothing, beside the card I am about to reproduce for the benefit of the reader, said card being originally taken from a copy of the *London Engineer*.



Having drawn the three circles for the pitch, the points and the roots of the teeth, as in Fig. 97, draw a radius, *A B*. At the point of intersection of the radius and pitch circle, draw the tangent, *C D*. It will be at right angles to the radius. Above and below *C D*, draw lines parallel to *C D*, at a distance therefrom equal to 113 multiplied by the pitch; this distance is marked with a triangle in the figure. The centers for striking the tooth curves will lie in these parallel lines. In the table opposite to the number of teeth in the wheel, will be found the numbers *R* and *R'* for that wheel. *R* multiplied by the pitch, will be the radius of the face, or that part of the tooth which extends from the pitch line to the point. *R'* multiplied by the pitch, gives the radius of the flank, or that part of the tooth which extends from the pitch line to the root.

No. of Teeth.	R	R′	No. of Teeth.	R	R′
11	1·60	7·4	30	·78	1·5
12	·612	8·0	34	·80	1·4
13	·63	9·6	36	·81	1·37
14	·64	5·3	39	·81	1·33
15	·66	3·9	42	·83	1·3
16	·67	3·16	48	·83	1·25
17	·68	2·74	49	·85	1·25
18	·69	2·45	56	·85	1·2
19	·70	2·24	72	·89	1·15
20	·71	2·09	79	·90	1·14
21	·72	1·97	100	·92	1·1
22	·73	1·88	140	·94	1·07
23	·74	1·8	210	·96	1·04
24	·75	1·73	420	·98	1·02
25	·76	1·69	Rack	1·	1·
27	·76	1·6			

TABLE 1.

Pitch	Thickness of Teeth	Length of Teeth	Least breadth of Teeth	Velocity of the wheel at the pitch circle.				
				3 ft. per second	4 ft. per second	5 ft. per second	7 ft. per second	11 ft. per second
In.	Inches	Inches	Inches	H. P.	H. P.	H. P.	H. P.	H. P.
6	2·9	4·2	8·4	43·2	57·6	72·	100·2	158·4
5½	2·6	3·85	7·7	36·3	43·4	60·5	84·7	133·1
4	1·9	2·8	5·6	19·	22·5	32·	45·	70·5
3½	1·6	2·45	4·9	14·75	19·5	24·5	34·25	54·
3	1·4	2·1	4·2	11·	14·5	18·	25·	39·5
2½	1·2	1·75	3·5	7·5	10·	12·5	17·5	27·5
2	0·95	1·4	2·8	4·75	6·25	8·	11·	17·25
1¾	0·83	1·225	2·45	3·5	5·	6·25	8·5	13·5
1½	0·71	1·05	2·1	2·75	3·5	4·5	6·25	10·
1¼	0·59	0·875	1·75	2·	2·5	3·125	4·2	6·8
1⅛	0·53	0·7875	1·575	1·5	2·25	2·5	3·5	5·5
1	0·48	0·7	1·4	1·2	1 6	2·	2·8	4·4
⅞	0·41	0·6125	1·225	1·	1·4	1·75	2·5	3·8
¾	0·36	0·525	1·05	0·7	0·9	1·125	1 5	2·5
⅝	0·33	0·4375	0·875	0·5	0·625	0·75	1·	1·7
½	0·24	0·35	0·7	0·3	0·4	0·5	0·7	1·1
⅜	0·18	0·2625	0·525	0·2	0·25	0·3	0·4	0·6
¼	0·12	0·175	0·35	0·075	0·1	0·125	0·175	0·275
1½	2½	3·	2½	3·	3·	3·	3·	3·

TABLE 2.

Stress in lbs. at the Pitch Circle.	Thickness of Teeth.	Actual Pitches to which the Wheels would be made.
LBS.	INCHES.	INCHES.
400	0·50	1⅛ to 1¼
800	0·71	1½ " 1⅝
1,200	0·87	1⅞ " 2
1,600	1·00	2 " 2⅛
2,000	1·12	2¼ " 2⅜
2,400	1·22	2½ " 2⅝
2,800	1·32	2⅝ " 2¾
3,200	1·41	2⅞ " 3
3,600	1·50	3⅛ " 3¼
4,000	1·58	3¼ " 3⅜
4,400	1·66	3⅜ " 3½
4,800	1·73	3½ " 3⅝
5,200	1·80	3⅝ " 3¾
5,600	1·87	3⅞ " 4
6,000	1·94	4 " 4¼

TABLE 3.

N	X	N	X	N	X	N	X
8	2·6131	32	10·2023	56	17·8308	80	25·4713
9	2·9238	33	10·5224	57	18·1505	81	25·7963
10	3·2360	34	10·8396	58	18·4718	82	26·1096
11	3·5495	35	11·1584	59	18·7893	83	26·4304
12	3 8637	36	11·4737	60	19·1073	84	26·7595
13	4·1789	37	11·7913	61	19·4254	85	27·0645
14	4·4941	38	12·1100	62	19·7431	86	27·3989
15	4·8097	39	12·4240	63	20·0653	87	27·7076
16	5·1258	40	12·7454	64	20·3862	88	28·0238
17	5·4421	41	13·0642	65	20·7050	89	28·3471
18	5·7587	42	13·3838	66	21·0212	90	28·6537
19	6·0757	43	13·6975	67	21·3339	91	28·9923
20	6·3924	44	14·0207	68	21·6561	92	29·3134
21	6·7093	45	14·3355	69	21·9742	93	29·6160
22	7·0268	46	14·6589	70	22 2873	94	29·9515
23	7·3449	47	14·9709	71	22·6094	95	30·2680
24	7·6612	48	15·2897	72	22·9255	96	30·5638
25	7·9787	49	15·6085	73	23·2509	97	30·8931
26	8·2959	50	15·9259	74	23·5695	98	31·2012
27	8·6137	51	16·2491	75	23·8802	99	31·5184
28	8·9318	52	16·5617	76	24·1994	100	31·8632
29	9 2494	53	16·7143	77	24·5273	120	38·2015
30	9·5667	54	17·1984	78	24 8463	150	47·7491
31	9·8842	55	17·5134	79	25·1550		

NOTE.—The author inserted an example, which also contained an illustration, or a diagram, fig. 99, containing signs that are not in a printers' font. We regret that we did not notice it until too late to have it made, and have therefore been compelled to omit it here, but will publish it next issue.

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[*] Molesworth.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. II.

By J. P. Mullin.

MOLDING LARGE GEAR WHEELS.

For the transmission of power by machinery, gear wheels are frequently brought into action, and for standard work may be considered next in order to pulleys.

Now, the manner of molding any ordinary gear, where we have a complete pattern, is too well known to require any notice in these articles. But suppose a special order comes in, and we want a gear wheel 10 or 12 feet in diameter, 2½″ pitch and 9″ face. The quickest and best way to make such a wheel is often of more than usual importance, and to make a full pattern is entirely out of the question.

From among the various ways of making such wheels I have selected the following, which I will try to illustrate:

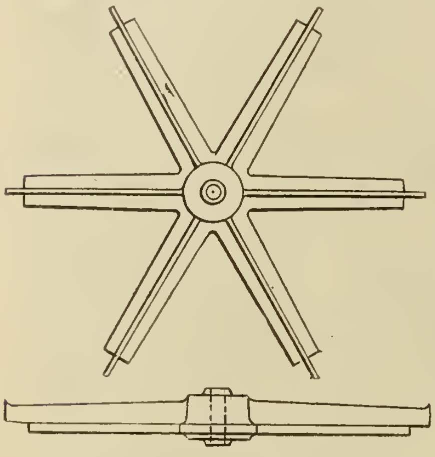
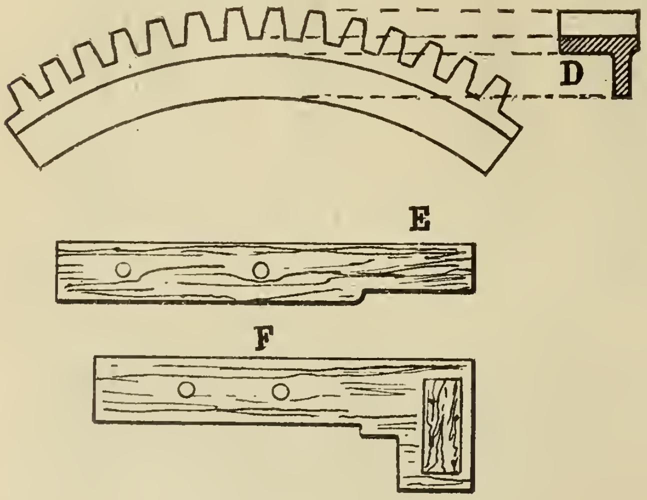


Fig. 9.

Fig. 9 is the plan and elevation of a set of arms for which, in many cases, it is advisable to make a full pattern.



Figs. 10, 11 and 12.

Fig. 10 shows a segment of the rim of the wheel, and a number of teeth attached. If the distance is not too great, it is well to make this segment long enough to take in two arms, as shown in Fig. 16. This, however, is not of much importance, as from fifteen to twenty teeth are generally a sufficient number.

Figs. 11 and 12, or *E* and *F*, are "strickle" boards, the utility of which will be seen when we come to the molding part of our work. The face of the strickle board, *E*, is made to fit the top of the rim at A, Fig. 15, and that of *strickle F* is the form of the inside of the rim at *B*, Fig. 10.

Now, if we are pushed for time in the pattern shop, or for any other reason, it is not convenient to make a pattern for a full set of arms as mentioned above, we should make a pattern of the hub and one arm, as shown at Fig. 13. In either case, the hub and print must have a hole through the center to fit the spindle used in the foundry.

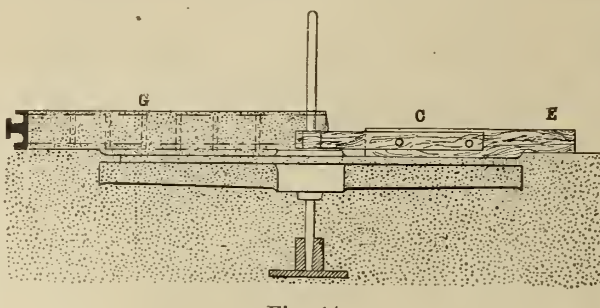


Fig. 14.

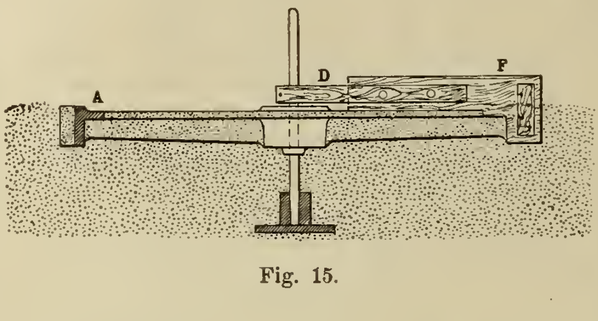


Fig. 15.

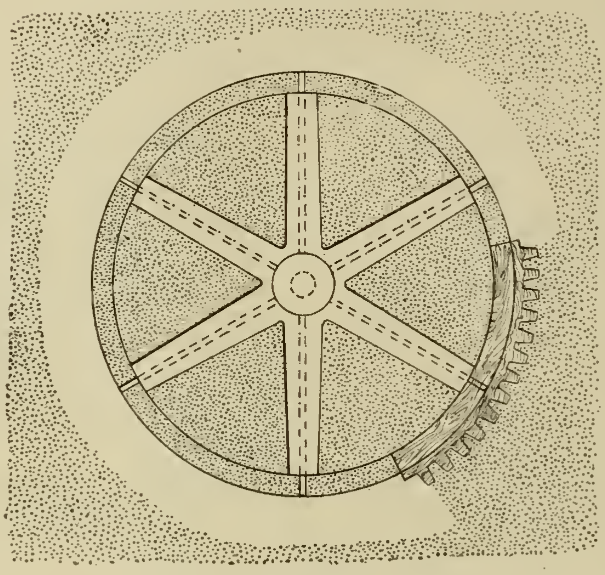


Fig. 16.

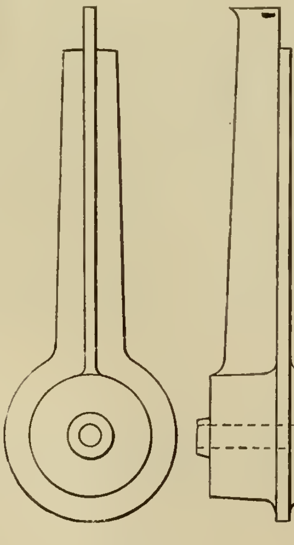


Fig. 13.

MOLDING.

Having prepared the floor and set the spindle-step or bearing, we bed down the arm pattern and mold it up level with the top. We now take the strickle board, *E*, and bolt it to the arm of the spindle, as shown at *C*, Fig. 14. This will scrape off the top of the mold level with the pattern, and leave the correct form for the bottom of the cope and top of the rim.

We now take off the strickle, make parting, lay on the cope-flask, as shown at *G*, Fig. 14, ram it up and lift it off again. This being done, take strickle-board, *F*, and bolt it to arm of spindle, as shown at *D*, Fig. 15. With this scrape away the sand around the outside of the arms, leaving a level and smooth bottom for segment of rim and teeth. Having done so, set pattern of segment in position, and press it down hard enough to leave the impression of the ends of the teeth in the sand; or, what is perhaps better, shake a little flour between the teeth. Then lift it and move it around from place to place until the circle is completed. Should it fall short or overreach a little in the circumference it can be adjusted by a slight change in the diameter of the wheel.

Having thus decided on the correct position for it, we set the segment and ram up the teeth, as shown at *H*, Fig. 16. Then draw it from the sand and move it around to the next position, ram it up again, and so on to the end of the circle. Then draw from the sand the pattern of the arms, finish, and close the mold.

When the pattern of hub and one arm is used instead of the full set of arms, as mentioned above, we must first take the strickle-board, *E*, and scrape off the top of the mold, make parting, set on cope-flask, *G*, ram it up, and lift it away again. Then use strickle-board, *F*, as shown at *D*, Fig. 15. Bed in and mold the hub and arm, draw it from the sand, and move it around to the next position, ram it up again, etc., etc., until finished, and ready to use segment of rim and teeth as before.

[To be Continued.]

"IN THE ROUND-HOUSE."

Number I.

By Berkeley Powell.

Locomotive drivers of to-day have reason to congratulate each other upon the improved condition of their calling. They are entrusted with magnificent machines, ample in heating surface, simple in construction, symmetrical in outline, approximating ever toward theoretical correctness in detail, and altogether the best heretofore placed upon the rails. Locomotive builders and railway master mechanics vie with each other in producing engines fully competent to handle their loads. They equip them with every imaginable modern improvement, and, whether internal or external, the tendency is toward the comfort, health and convenience of the driver. It is now being recognized that drivers, firemen, shop-hands, and others interested in the welfare of the present locomotive, are awakening to the fact that their own progress has scarcely been so marked as that of the iron steed. There is, fortunately, spreading along lines of railways a keener spirit of investigation than ever before. Railway men are becoming anxious to read, mark, and learn; they discuss the whys and wherefores after painstaking thought and study; they are endeavoring to acquaint themselves with the locomotive anatomically and physiologically. Marks of progress are everywhere visible, and the future will show rapid advancement. When we look into the lives of those railway men who, by sheer force of brain and muscle, by perseverance and pluck, have raised themselves from the vise, the drawing-table, or the foot-plate to positions of honor and trust, we find there was nothing lacking on their part. If there was anything new to be seen, heard, or read, they were sure to find it out. Patient and persistent, having an almost ignominious love for details, they let nothing escape them. Their ears, eyes and brains were ever ready. These men have secured keys which unlock and obtain possession of locomotive knowledge; and just by so much as there is of this inquiring spirit in a man will he achieve success.

Having said this much (or rather this little), I will go to the real subject of these articles—locomotive work and details "in the round-house"—by inquiring, what are the ends to be obtained by a locomotive? These are: high speed, when compared with horse traction, for freight trains, and excessively high for passenger trains. Ability to draw heavy loads, even in the case of passenger trains, but much heavier in the case of freight trains. It must not be overlooked that the locomotive cannot always fulfill these ends upon a line which is level or without curves, and it is necessary that these ends should be obtained under the additional conditions of economy and of safety.

A locomotive, therefore, must be able to develop sufficient power, and utilize this power as traction. It must have an economical steam-engine and a safe boiler. The boiler must be quite independent of the frames, and free from the strain of tractive power. The locomotive must accommodate itself to the curves of the line, and must be able to travel over a rough road without, by its joltings, injuring itself or that on which it runs. There are three distinct arrangements combined in the locomotive for obtaining these conditions. The source of power lies in the boiler and firebox. This is applied to produce motion within the machine by means of the valves, cylinders, pistons and their attachments. The running gear, which secures the locomotion of the impelling machinery by adhesion to the rails, and from surplus power the draught of various loads upon the rails; this also guides the locomotive into and around curves, and distributes and equalizes the weight of the engine. Of all three, the boiler is the most important. It is the soul of the locomotive, and upon its proportions depends, in a large measure, the success of the whole. A locomotive may have many eccentricities and faults, or it may be covered with threshing-machine paint and equipped with all the latest appliances, but if unprovided with a large margin of power in its tubes and fire-box it will always prove a source of disappointment to every one interested in it.

It is required to boil off in ordinary locomotives from 12,000 to 18,000 pounds of water per hour, or from 200 to 300 pounds per minute. To do this it is necessary to use an adequate quantity of fuel, and also have enough surface to carry off the heat evolved and transmit it to the water. It is found in practice that seven pounds of water will be the average evaporation from one pound of coal, so that from 1,700 to 2,500 pounds of coal must be consumed per hour. To burn the weight of fuel mentioned there would be provided in an ordinary land engine, or even in a marine engine, a grate area of ninety square feet of surface. Such an area is impracticable with the width possible in a 4′-8½″ gauge engine, as it would necessitate a fire-box thirty feet long inside! Of course, this would be undesirable, and therefore, in order to consume the requisite amount of fuel, reliance must be placed not only upon the grate area but upon the mass of fuel contained in the fire-box. Massing fuel, however, renders perfect combustion a still more difficult operation than it is under ordinary circumstances. And under ordinary circumstances, with a large grate area, a lofty chimney, and the fuel evenly spread, it is a difficult matter to obtain an adequate and uniform supply of air to the fire.

[To be Continued.]

MODERN MACHINE TOOLS.

BY J. RICHARDS, *in Engineering*.

Under this head it is proposed to notice what may be called the slide mountings of machine tools—parts moved for adjustment and in feed movements. The common gib joint, Fig. 13, is employed in most cases; so generally, indeed, that it requires some boldness to criticise it, yet it is far from filling the required conditions for a tool slide. In the form, Fig. 13, the screw, *a*, being seated in the gib, *c*, as shown, the arrangement is inoperative in so far as performing the supposed function of holding the surfaces, *m*, *m*, in contact. If the screw is driven down on the gib, *c*, the latter is forced into the corner at *e*, and the faces at *m* are drawn apart. The lateral strength of the joint is represented by the end of the screw at *s*′, or is, as we might say, destroyed. If arranged as in Fig. 14, the point of the screw beveled off, the result is better, the thrust being normal on the face of the gib, *c*, and the joint at *m* is pressed together in the manner required. This seems well enough, and is so, were it not for the slight bearing surface afforded by the points of the screws, even if they be bedded into the gib, *c*, as well as possible. Such joints being hidden from view, and producing a firm movement under moderate strain, are deceptive. They will soon yield under screw stress, and cannot support a tool for heavy cutting as it should be done. The corners, *i*, Figs. 13 and 14, shown in dotted lines, are usually planed out. This adds nothing to the working surface, weakens the part, *a*, and demands a gib piece with two beveled edges, also of greater width. In all joints of the kind a wedge, as shown in Fig. 15, is not only preferable, but is really the only means adopted in ordinary practice for securing firmness on such slides. The expense of fitting is but little more. Such wedges made of phosphor-bronze answer very well.

There is no operation better for proving such joints than supporting milling cutters to work on wrought iron or steel; cutting the teeth of wheels, for example, with cutters of coarse pitch. With the old form of cutters, having fine teeth, the strain is so nearly constant that a bad sliding joint will not be detected, but with cutters, as now made, the pitch of which is not less than that of the wheel teeth to be cut, a sliding saddle will soon give evidence of bad mounting or bad fitting. It may be mentioned that these remarks are written after some tolerably thorough experiments with gib joints of each kind shown in the last three figures.

Fig. 13

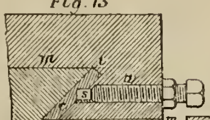


Fig. 14

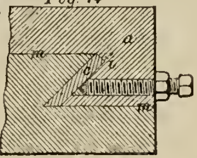


Fig. 15

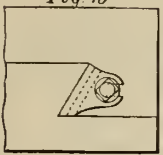
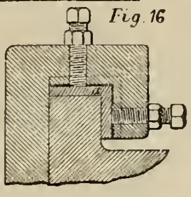


Fig. 16



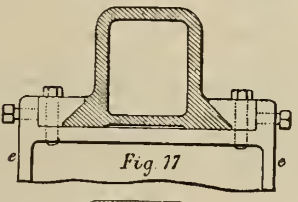


Fig. 17

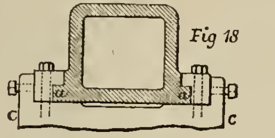
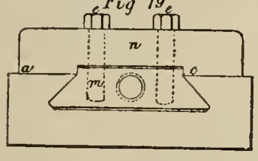


Fig 18

Fig 19



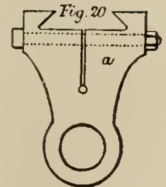


Fig. 20

The joint, Fig. 16, is one of the gib kind that gives a substantial bearing with adjustment in two planes. The engraving shows it as applied to the tool saddle of a planing machine. The gib piece, *a*, can be made whole, and is preferable in that form. The screws made as shown have a good bearing at their ends, and should be as many in number as there is convenient room for. Three screws in a saddle 8 in. long, and four screws in one 12 in. long, are few enough.

Fig. 17 shows the ordinary shaping-machine form of slides, one of the best when beveled surfaces are employed. As there is adjustment required in two planes, and the bevel surfaces cause more friction, the form shown in Fig 18 is preferable, although something more expensive to fit. The vertical and side thrust upon the guides of shaping and slotting machine cutter bars is much the same in average working, so the edges, *a*, *a*, should have a bearing wider than their depth. Cutter bars or "rams" mounted in this manner have given excellent results, both as to steady movement and endurance. The width of base from *c* to *c* required for a sliding joint of this kind is an obstacle to its use in many cases.

Fig. 19 is a plan for lathe tool slides, recently applied by the writer, that seems to possess the advantage of great rigidity. The block, *m*, is fitted in the slide, *n*, and the screws, *e*, *e*, are made to fit hard in this block. Their heads may be countersunk in any case where they would cause obstruction. The side strain upon the slide produces fulcra at *a* and *c*, so that considerable width is desirable.

Fig. 20 shows another method of gibbing applied to a sliding spindle bracket such as is employed in American drilling machines, and suitable in any case where a spindle requires end traverse. This construction has not yet been long enough in use to speak definitely of its practical value, but it seems a substantial and simple way of providing such compensation as a joint of the kind requires. It is open to the objection that the bearing surfaces of the bracket, *a*, do not move parallel in case of closing them in the guiding way, and also that the disposition of the metal in the bracket, *a*, is such that there would be some yielding in case of heavy lateral strains on the spindle; but these are only possible objections, and there is much to recommend the arrangement, especially if the bracket or saddle is made in two pieces, so as to be easily mounted in place or removed.

PORTABLE ELECTRICITY.

Prof. Henry Morton of the Stevens' Institute of Technology, recently gave the result of experiments to demonstrate the practicability of using electricity as a motive power. He had used as a basis of his experiments the improved Sellon-Volckman accumulators, and the tests applied were of the most practical character. Each battery was contained in a box of one cubic foot, and the force of one of them could propel a car from one end of New York city to the other. If the battery's energy could be applied, it would be able to lift itself over four miles high.

The battery consists of plates, each made up of a fine lattice work of metallic lead, filled in with a porous mass, which has in each alternate plate either metallic lead or the black peroxide of lead. Each cell would yield a continuous current of about thirty-two amperes for nine hours, with an electro-motive force of about ten and two-tenths volts. This quantity of current would supply forty-four of Edison's incandescent lamps of sixteen candle power. The entire weight of each cell ready for work is eighty pounds, and thus, as a simple rule, it might be stated that for each light of sixteen candles for one hour ten pounds of battery should be used.

Regarding the use of the battery as a motive power, Prof. Morton said that his measurements showed that each eighty-pound battery contained energy equal to about 1,800,000 foot-pounds, or one horse power for one hour. There could be no doubt of the utility of the batteries. He had himself established this by placing some cells in his house and using them to operate electric lamps in his rooms. In three months the battery had to be recharged but four times.

Edison says that storage batteries owing to conversion of the material and local causes, depreciate about thirty per cent. annually.

FORCE EXERTED IN MAKING PIPE-JOINTS.

The leverage of the pipe-tongs or wrench, employed to screw a tube up, is largely multiplied by the action of the screw itself in converting the force into the longitudinal direction; and the tube end being, moreover, shaped as a conical plug of slight taper, the longitudinal force results in a greatly intensified pressure of contact between the threads of the tube and its socket. For example: The ordinary pitch is 11½ threads per inch for a tube of 1 inch nominal diameter inside or 1·31 inch actual diameter outside, and the taper of both the tube end and the inside of the socket is 1 in 32 to their axes. After the tube has been entered into the socket as far as it can readily be screwed up by hand, one-quarter turn more with the pipe-tongs is generally sufficient to make the joint steam-tight. In this quarter-turn of the tube the difference of diameter is in the ratio of 1 : 11½ ×

16 × 4, and is therefore equal to 1-736th of an inch. Meanwhile the hand, acting on the tongs at a radius of usually about 16 inches, will move through an arc of 25 inches, giving thus an effective leverage of say 18,000 times. The bursting pressure thereby produced within the socket, or the compression upon the tube end, is concentrated on about $\frac{1}{2}$ inch length of the socket or tube, and the mean diameter is there about $1\frac{1}{4}$ inch; whence the pressure per square inch tending to burst the socket is roughly about 11,000 times the manual force exerted on the tongs, if the frictional resistance to turning be neglected.

In practice it is really by the frictional resistance to turning that the limit of bursting strain actually thrown upon the cast-iron socket in screwing up is determined. For supposing the limit be taken to be a radial pressure of say 5,000 pounds per square inch, it is seen from the foregoing that, after overcoming the frictional resistance to turning, an insignificant $\frac{1}{2}$ pound would be all the extra force required on the pipe-tongs for throwing this great bursting strain upon the socket. Allow now 15 per cent. as the co-efficient of friction—a value not unreasonable when it is borne in mind that points of metal are brought into contact, and that the great pressure between them destroys the continuity of the imperfect lubricant. Then neglecting the screw-thread, and regarding the tube end and the casting as a plain conical plug and corresponding socket, the resistance to turning, offered by the $\frac{1}{2}$-inch lengh of tube-end of $1\frac{1}{4}$ inch mean diameter, is $5{,}000 \times 0{\cdot}15 \times 3{\cdot}1416 \times 1\frac{1}{4} \times \frac{1}{2} = 1{,}400$ pounds acting at a radius of $\frac{5}{8}$ inch, which is equivalent to about 55 pounds exerted on the handle of the tongs of 16 inches radius. A skilled workman judiciously keeps well within this limit in the force which he exerts; and the cast-iron fittings being made according to the proportions hereafter given, the thickness of metal left outside the thread after tapping them is amply sufficient to stand the tensile strain so exerted, which rises probably to 10,000 or 12,000 pounds, say 5 tons per square inch of section of metal. In practice, moreover, it is found that a joint can safely be screwed up with the tongs through even one whole turn, instead of only a quarter turn; the wrought-iron tube-end yields permanently under the compression, while the limit of elasticity of the cast-iron socket is not exceeded, and hence, neither metal has its strength impaired. Complete facility is thus afforded for leading off bends, or branches, in any desired angular position.—*Robert Briggs.*

THE MODERN LIGHT-HOUSE LAMP.

For a long time it was deemed impossible to use kerosene in light-house lamps, and it is only recently that improvements in the burners have been made which render it available. We find in the *Telegram*, of this city, an interesting account of the modern American light-house lamp. We quote:

"A description of this first-order lamp, in this age of light and lightning, cannot fail to interest many. The reservoir, formerly above, is now under the lamp. It is a drum-shaped brass vessel, 14 inches diameter, 18 inches high, and contains $8\frac{1}{2}$ gallons of mineral oil. A plunger or piston, wound up by a crank, and a chain connected with a steel arbor, has a valve in the center for admitting the oil. The weight of the descending plunger presses the oil beneath it, and forces it through a tube which leads to the 'float chamber,' a small glass vessel, on a level with the burner which it feeds in a uniform flow.

"The 'float' is the invention of Mr. Funck and surpasses every previous expedient for regulating the flow. Nothing could be more simple. It is a cone of light sheet brass, with a hole through its vertical axis. A strap or 'bridge' at the vertex receives the threaded stem of a smooth little steel plug or valve. The stem has two vertical channels which insure a steady stream, and holds the float at a constant level. Briefly, when the oil enters the float chamber it lifts the float, and the point of it 'plugs the vent.'

"The burner has seven concentric rings and five wicks, the outside wick being $4\frac{1}{2}$ inches diameter, and the inside one 1 1-16 inches. The outside wick has two air spaces, and the seventh ring, or core of the flame, is a conical tube for a central current of air. Outside the burner are two perforated jackets, the inner holes oblique to the outer, to equalize and control the supply of air. Five ratchets and pinions, worked by buttons, raise and lower the wicks. The wicks are trimmed by wiping off the crust with a rag.

"The chimney is of the brass-bound order, $5\frac{1}{2}$ inches at the base, with obtuse shoulder and 18 inches high. Clasping the top of this is the damper tube, of copper, and of 'conico-funnel' shape, passing up through the crown-piece of the magnificent lens, which with its annular prisms and dioptric zones of French glass, surrounds the whole, as with a crystal cloak, from floor to ceiling. If the damper-tube were cylindrical, the too rapid rarefaction of the air would cause an unsteady flame. The damper, which cuts off surplus draft and insures adequate combustion, is worked by a handle and cog wheels. The difference between lard and kerosene oils is thus shown: The lard gives an illumination of 400 sperm candles; the kerosene gives 425. The consumption of lard was one quart per hour; kerosene, two quarts. The cost of the lard this year is eighty-two cents per gallon; of kerosene only seventeen cents. The heat thrown out by the first order lamp may be inferred when the normal temperature was 60 degrees; at four feet from the lamp the thermometer stood at 85 degrees. The lard was liable to coagulation; the mineral is limpid ever.

LINES OF WEAKNESS IN CYLINDERS.

It has long been known to boiler-makers and to the users of cylindrical pipes of many kinds, that, when a tube is exposed to internal fluid pressure, the resolution of forces is such that the material of the walls of the tube is exposed to twice the stress in the direction tending to produce longitudinal rupture, that it is in the direction to produce circumferential fracture. By longitudinal fracture is meant the fracture by a rent parallel to the axis; by circumferential fracture, fracture by rents running round the cylinder. In consequence of this, makers of boilers always lay the fibre of their metal around the boiler; and the same is true with the makers of gun-barrels. I have never seen any good and simple illustration of this law until I met it in blowing glass. If a thin bubble of glass be blown out in a spherical form, and then exploded, it will be found that the particles tumble into totally irregular shapes, showing no special direction in the molecular structure of the material. If, now, a bubble of glass be blown out, and so manipulated that it will take a cylindrical form, and then be exploded, it will drop into ribbon-shaped pieces from end to end; and the only parts that will be found to differ from this form will be the two hemispherical ends, which will remain whole, having a fringe of ribbons representing the lines of fracture from the cylinder. The main point of difference between this experiment and the accidental explosion of large boilers appears to be, that in a boiler the shell goes at its weakest point, and once the rent is started it tears the boiler to pieces without much regularity of lines; while in the glass cylinder the walls are so nearly of the same strength that it can hardly be said to have a weakest point; when, therefore, it gets to its limit of strength, and is on the verge of exploding, there is no one place to initiate the explosion, and the glass explodes everywhere. This it does as it should do, by tearing into innumerable ribbons parallel to the axis of the cylinder. If P = the pressure, and D = the diameter of the cylinder, then $\frac{P\,D}{2}$ =stress tending to longitudinal rupture, and $\frac{P\,D}{4}$ = stress tending to circumferential rupture.—*Prof. R. H. Richards.*

Professor Richards illustrated his statements by experiments with glass-tubing with complete success before the American Society of Mining Engineers.

GREASE IN BOILERS.

M. Bour engineer to the Lyons Boiler Association, lately read a paper before the *Societe des Sciences Industrielles* of that city on a difficulty encountered with a boiler of a steamer, which he attributed to the presence of grease in it. The boiler, with internal flue, riveted at the front end, and return tubes, was carefully made and certified for a pressure of 85 pounds per square inch. It was started in May, 1882, and after working well for a few days showed signs of leakage. The tubes were tightened up, and the number of stays connecting the ends diminished to lessen the rigidity; but, after four or five voyages the leaks began again. After more elasticity was given without satisfactory result, it was decided to renew the boiler. As the same difficulty was still encountered, M. Bour was requested to inspect the new boiler. No defect was discovered, but a quantity of light, whitish, greasy mud was taken out. On treating this substance with hydrochloric acid, a large proportion of grease was found. M. Bour advised that the boiler should be filled, and a few kilogrammes (2·2 pound) of soda crystals and quick lime added, so as to produce caustic soda; that it should be washed out and refilled, and that on starting again it should be fed directly from the lake. The boiler went on well until an attempt was made to again take the feed from the condenser. It was then decided to draw entirely from the lake, and thenceforth no difficulty was experienced.

The company has another steamer navigating the lake, the boiler of which is fed from the condenser without causing any difficulty; but in this case the pump draws from the lower portion, thus keeping clear of the grease. Now, the old boiler of the *Allobroge,* fed in the same manner as the new, never caused any difficulty. It would, therefore, appear that grease exercises an injurious influence only under certain circumstances, which are not yet explained. M. Bour has found that when the steam draws along with it a certain quantity of water, the calcareous salts contained in the water form, with the grease of the cylinders and steam chests, a solid soap, the hard pieces of which cause a breakage of the cylinder covers. This is not the case, however, where mineral oil is used, which, therefore, appears to be a remedy.

Van Nostrand has in press a plain reference book, to be entitled "The Machinists' and Steam-Engineers' Pocket Book." The author is Mr. D. B. Dixon, the foreman of the Pittsburgh, Fort Wayne & Chicago R. R. Co's shops at Fort Wayne, and knowing the wants of the practical men under him, has compiled this work for their use and the class of workmen in similar shops throughout the country. For the use of working engineers, the work will be unique. It will appeal to the machinists, locomotive engineers and firemen, boiler makers, stationary engine drivers, and to men firing marine, stationary and all land boilers. It is written in a plain, popular, but polished style, and will be put up in leather, pocket form, and will sell for about $1.50.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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New Series. Vol. V.—No. 12.
Enlarged 1883.

New York, June 9, 1883.

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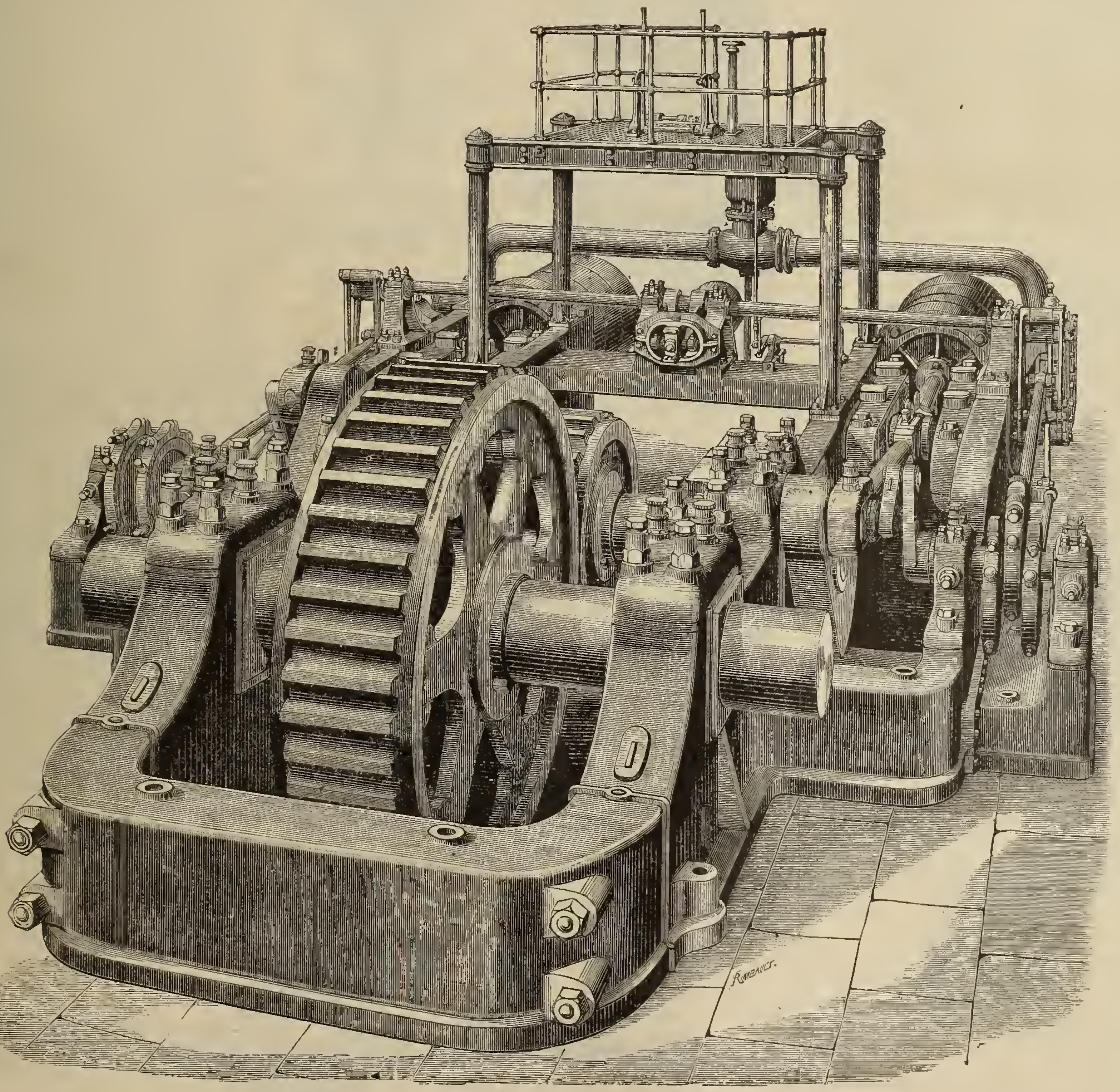
ENGLISH ROLLING MILL ENGINES.

In a previous issue, No. 10, we illustrated a pair of horizontal engines of a design similar to those here shown, and by the same maker. These now presented have some peculiarities not embraced by the others, and form an interesting example of the practice of English engineers in the line indicated. It will be seen that they are not automatic, as some American engines in rolling mills are, but the valves are driven by, and under control of, the usual link motion.

The valves are balanced and the reversing is effected by a steam cylinder shown between the two engines near the gallery. The dimensions are: Cylinders, 40″ by 5′; the cranks are of cast steel, with counter balances cast on; the shafts are 16″ diameter in bearings, and 20″ in middle. The jack-shaft is 20″ in bearings and 24″ in the middle. The gears are 2 to 1, 8″ pitch, 24″ face. The total weight is about 140 tons. We take this illustration from *Engineering.*



AN ENGLISH ROLLING MILL ENGINE.

[illegible]

The sum of $2,500 has been offered as a premium by a gentleman in England to any one, either in or out of the United Kingdom, who shall during the present year invent a portable electric or other lamp, which working miners can conveniently carry from place to place in the mine, and which will not, under any circumstances whatever, cause an explosion of gas.

The gentleman above mentioned is like John Gilpin in one respect—he is "of a frugal mind." A lamp like that described would be worth nearer $25,000 than $2,500.

The most remarkable collection of locomotives, both ancient and modern, ever brought together, will be exhibited at the National Exposition in Chicago. Nearly all the leading locomotive builders in the country will show their latest and most perfect products. Among these will be the largest locomotive ever built, weighing over seventy tons, and fitly called the "Mastodon."

* * *

We are under obligations to the Hartford Steam Boiler and Inspection Company for a bound volume of *The Locomotive* for 1882. We always read this journal by instalments with satisfaction, and we have yet to see in it anything "subversive, incendiary or destructive" to engineering, both practically and theoretically, as regards steam boilers.

* * *

"*Caution,*" of Troy, N. Y., wishes us to say to the gentleman who wrote for Indicator cards, published in this paper, that he has but one set, and regrets that he cannot oblige him.

* * *

Recently the propeller *Boscobel,* on Lake Michigan, broke her crank-pin "brass" while under way. This is a peculiar accident, due, doubtless, to the detail in question not being brass, but a patent alloy which proved to be too brittle for the strain.

* * *

We acknowledge the receipt of a card of invitation to the opening ceremonies of the National Exposition of Railway Appliances, but regret that our duties will not allow us to be present.

WAGES OF ENGLISH MARINE ENGINEERS.

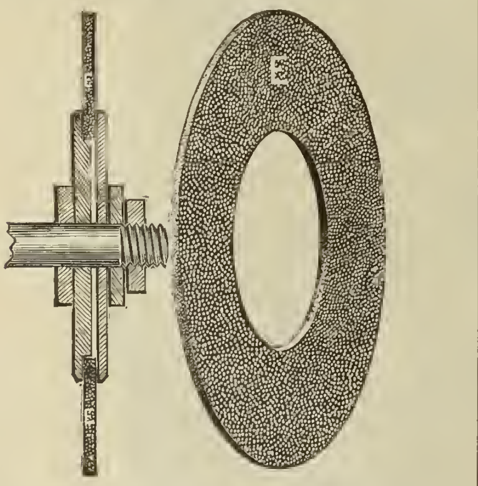
Summarized, it shows that the salary of the first engineer in a steamship of 500 tons was in the year 1850 £11 4s. 4d. per month, and after a little fluctuation it rose until for the year 1882 it is given as £13 9s. 2d. per month; while similarly the salary of the second engineer is given as £7 3s. 9d. for the year 1850, and for the year 1882 £8 17s. 11d. per month. Somewhat singularly, in vessels between 500 tons and 1000 tons there has been a reverse movement, according to these tables. The first engineer had in 1850 £15 17s. 3d. per month; the second engineer, £11 7s. 5d.; and the third, £8 6s. 8d. per month; and last year these amounts were less by 17s. 3d., 17s. 5d., and £1 8s. 8d. respectively. Similarly, in vessels of between 1000 and 1500 tons the salary of the first engineer is reported to have fallen in the period referred to about £1 10s.; that of the second engineer over 11s.; and that of the third engineer, £1 16s. The salaries of engineers of vessels between 1500 tons and 2000 tons are given only from the year 1855, but between that time and 1882 there was a declension of £3 in that of the first engineer; of over £1 13s. in that of the second; and of nearly £2 10s. in that of the third. In vessels of 2000 tons and above we have tables for the same period as that just referred to. The salary of the first engineer was £21 11s. 4d. per month in 1855, according to the tables, and in 1882 it had fallen to £18 7s.; that of the second engineer was at the earlier date £14, and at the later £13 17s.; and that of the third, £10 19s., and at the close it had risen to £11. There is no explanation given of any of the causes that have conduced to these fluctuations, but the probable one is that of demand and supply.—*London Engineer.*

We regret to see that a contemporary goes out of its way to make a scurrilous attack on Cornell University, alleging that its mechanical department needs attention, etc., etc. An expressson of opinion is always in order, providing the parties who offer it are fit to judge, but when they give an opinion on a Technological Institute without personal knowledge in the matter, but are compelled to echo the views of another, it savors of mere wantonness.

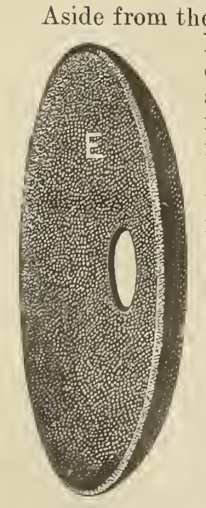
It is well known to the profession who the instigator of this attack is, and if our contemporary knew as much as it pretends to, it would be careful to get all the facts before it strikes out savagely. There are two sides to all questions.

THE CELLULOID EMERY WHEEL.

One of the most useful of the many applications of celluloid in the arts is in combination with emery for grinding and polishing. Such wheels are made by the Celluloid Emery Wheel Company, 238 Market street, Newark, N. J., and have been on the market for some years. During that time they have been fully tested, and, it is claimed, are applicable to all purposes for which such tools are used, having, besides, many peculiarities not found in others. These are the readiness with which they can be turned true at a slow speed with an ordinary tool, the free use of water on them, and their great strength and toughness, which admits of very thin wheels being made. Some are as light as $\frac{19}{1000}$ths of an inch in thickness, and three inches diameter, while others of $\frac{1}{32}$nd and $\frac{1}{16}$th, respectively 6″ and 12″ diameter, are common to these manufacturers. These wheels are, it is stated, very free cutting, and do not glaze under any circumstances.



Aside from the wheels, the company make a large variety of shapes for general uses in the trades, such as hones, steels for sharpening knives, polishing blocks for metal, etc., etc.



The engravings represent two varieties, among others made by this concern—a ring-wheel and a dish-wheel—which are applicable to many purposes.

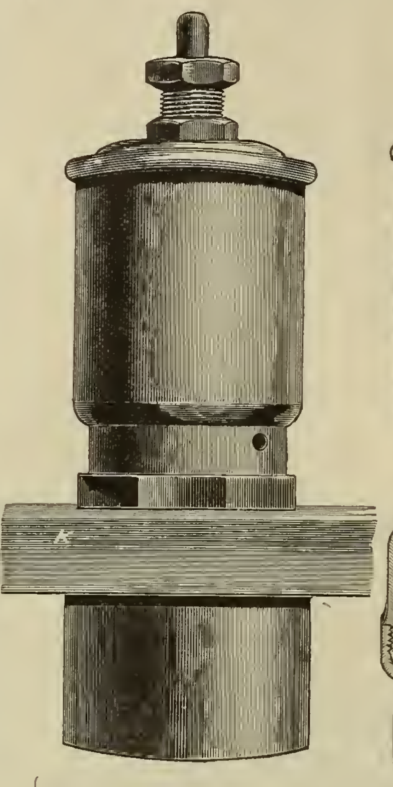
Price lists will be sent by addressing as above.

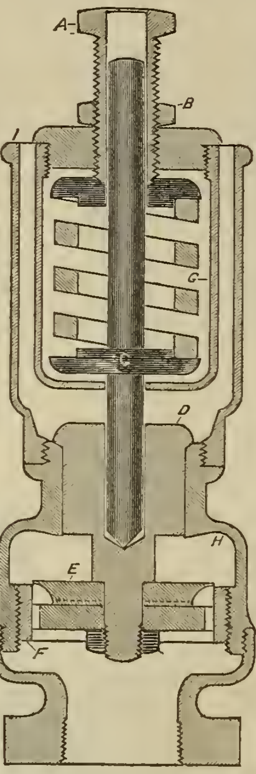
The accuracy of a long lead screw when cut in a lathe is seriously affected by a change in temperature of the room. A fall of 3 degrees only is sufficient to make a material irregularity. A prominent tool maker assures us that in running the last cut over a long feed screw, a window open near the tailstock of the lathe exerted an observable influence on the size of the chip taken from that end and the one at the end furthest from the window.

PEARSON'S POP SAFETY-VALVE.

By the Osborn Engine and Manufacturing Co., East Boston, Mass.

These illustrations represent a new safety valve of the "pop" class, which is now being put upon the market by the above-mentioned manufacturers. It has some points which recommend it for general use. The makers say that it relieves the boiler easily, and closes in the same manner, avoiding the sudden strain common to valves of its class in general. It has no tight fits, except on the valve seat, and is not liable to be corroded and stick fast. It will close with a very slight fall in pressure, and the time of closing, or the adjustment of the valve for any pressure, can be effected without removing the valve from the boiler. As will be seen, the spring is inclosed in a case by which it is protected from the action of the steam in blowing off, or from cinders or dirt liable to lodge in it where it is exposed.





The section shows the details, and these are as follows: *A B* is a guide-nut, which not only carries the upper part of the valve spindle, but also serves to adjust the tension of the spring by bearing on the cap of it; *D* is the valve itself, and *E* is a piston which gives increased area for the steam to act on; *F* is an adjustable cylinder, by which the valve is regulated to give warning before it blows hard; by screwing it up it will diminish the time of opening and closing, and by lowering it, longer warning will be given before the valve blows hard. It is stated that the action of this valve is almost noiseless when blowing off, and the manufacturers say they will send valves upon trial, to be returned at their expense if not satisfactory. Address them as above.

A writer in an English paper is of opinion that the loss of useful effect in hydraulic presses is not due wholly to friction of the packing on the ram, but in some measure to indirect pressure on it, which cocks the ram, with obvious results. His position is indicated (and invalidated) by an illustration, which shows a ram about $\frac{9}{16}$ths of an inch diameter, canted at an angle of 5 degrees; to obtain which eccentricity it has a clearance of $\frac{1}{16}$th in the sketch, say 1 in 9. On the same scale a 9″ ram would have 1″ clearance, an amount, it is needless to say, which is never found.

Eye glasses are often a source of permanent injury from the fact that they shift their positions easily, and stand obliquely to the line of vision. Also, the glasses, from center to center, are not the same distance as the eye, from center to center, and continual effort is made to adjust these conditions, which, with a given glass, is perhaps impossible. An eye glass should have its focal center in line with the focal center of the eyes, not at either side of them, and it should never be used in an oblique position with reference to the face. Spectacles are far better and safer to use than "nose-pinchers," so-called, for reasons that are obvious.

The *Manufacturers' Gazette* says: "The New York & New England Railroad Company has issued a circular to the effect that, beginning May 1, premiums will be paid monthly to engine men and firemen, based on results as shown by performance sheets, for the lowest number of pounds of coal consumed by engines per car per mile on passenger trains and per loaded car per mile on freight trains, calculating five empty cars as being equal to three loads. Each premium will amount to $10 for the engine man and $5 for the fireman."

An English contemporary says that car axles are treated in this way by some shops in that country:

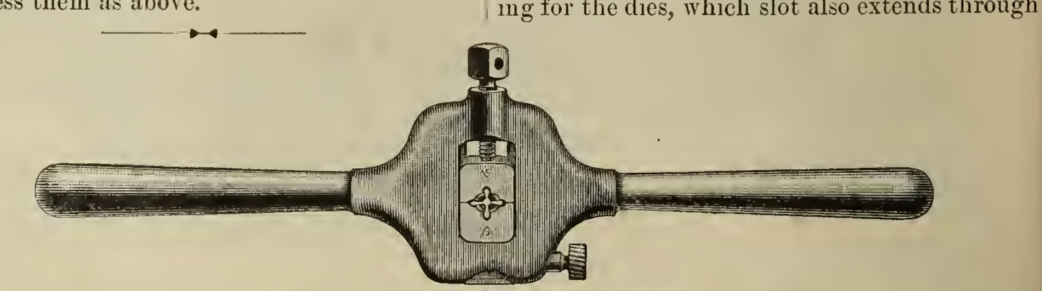
"The practice of some firms is to hammer-harden the journals, and to allow $\frac{3}{8}$ in. upon the finished diameter of the journals for turning, and $\frac{1}{4}$ in. upon the diameter of the wheel seat. Thus an axle intended to finish in the journal 7 in. × $3\frac{1}{2}$ in. would be forged $7\frac{1}{2}$ in. × $3\frac{7}{8}$ in. As regards hammer-hardening, when the journals are turned down to within $\frac{1}{8}$ in. of the diameter they are to finish to, they are beaten with a hand hammer while in the lathe, which closes in the iron, and hardens it, and when thus reduced to within about $\frac{1}{16}$th of the finished diameter they are turned down to it, and so finished. Sometimes the journals are also polished."

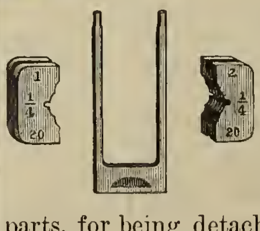
We don't know what would be said to a man in this country caught hammering work between centers in a lathe, but it would be something stirring! Journals are always polished in this country; water finished.

CARPENTER'S NEW SCREW-PLATE.

The screw plate is a standard tool in use in nearly every shop in the country, and although some make a distinction between the screw-plate proper, and the stock and dies, the manufacturer of this tool calls it by the name given in the heading.

The improvement in this tool consists in a method of making the ways, which hold the die in the stock, removable, so that the dies can be taken out with great facility. The plate has a slot milled in it, along the sides of the opening for the dies, which slot also extends through the frame. The ways are fitted to this slot, and when in place are locked fast by a small screw seen projecting on one side.

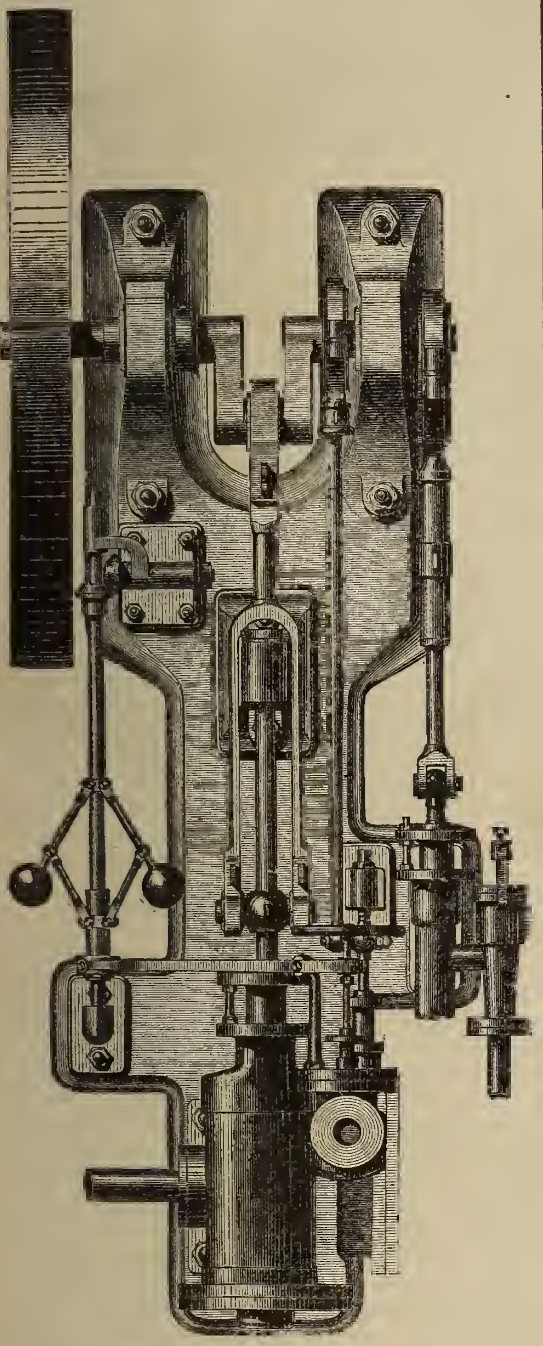




This method gives free access for cleaning all parts, for being detachable they are readily got at, at the same time they are held solidly in place when ready for use. This tool is made by J. M. Carpenter, Pawtucket, R. I., and can be had of all principal dealers.

AN ENGINE FOR LINE SHAFTING.

In some parts of the country small engines are connected directly to the line shaft, where it is long, to the great saving of large belts and pulleys. Our engraving represents an engine of this class as built in Germany, and, it is needless to say, looks rather antiquated to American eyes. It is to be fastened to a wall and serves as an example of practice abroad in the line indicated. The style of guide adopted for the piston rod has been abandoned for years in this country. We do not know one builder who makes it.



The manufacture of fictitious endorsements of books is a silly practice that is sure to be detected. There is a sameness about the enthusiasm, and a wondrous likeness in the different certificates which betrays their parentage at once. Several engineers have called our attention to some recent examples of what we comment upon, and wondered at the fatuity of the writer.

* * *

In Breslau, a chimney shaft fifty feet high is composed entirely of paper pulp, which has been chemically impregnated so as to resist combustion. Paper has been put to some extraordinary uses, but this is perhaps the most astonishing violation of preconceived ideas yet attempted. The next thing in order now will be gun-cotton crucibles.

* * *

ENGLISH METHOD OF BOILER CONNECTIONS.

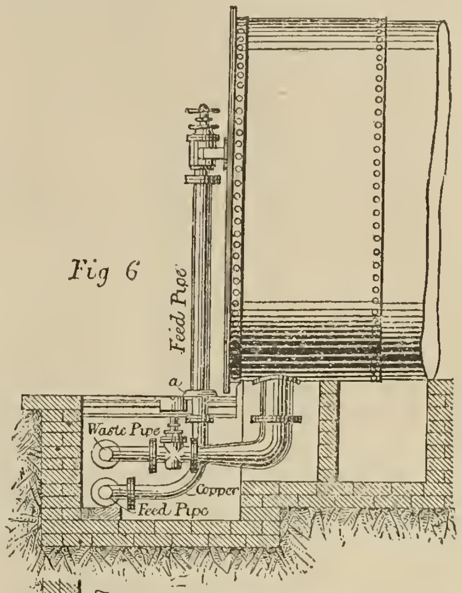
We give herewith some engravings representing a method of connecting feed and blow-pipes to boilers, which is used by some engineers in England. It will be found interesting in comparison with the systems employed here. We quote from the *Mechanical World*:

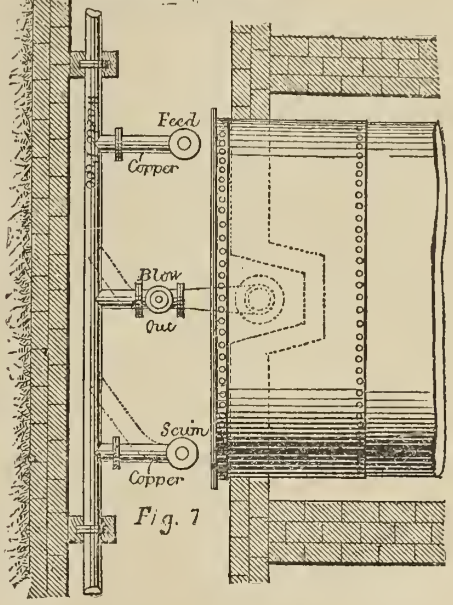
"These connections are usually four in number—the blow-out at the bottom of the boiler, the scum tap at the working level of the water, the water supply or feed valve, about 4 in. above the level of the furnace crown, and the main steam valve taking steam to the engines, etc. Often there may be a second steam valve, which should have equally elastic connections as the main valve. At Fig. 6 is shown a good arrangement of blow-out pipe. In this arrangement the elbow pipe requires to be made of sufficient strength to carry the weight of the waste-pipe, which should be otherwise unsupported in any way, so as to partake freely of every motion of the boiler without danger of breaking. This arrangement is shown at Fig. 7, where the boiler is one of a row of two or more boilers. The hearth pit in front should be a continuous trough, no partition wall being allowed between the various lengths of the pit in front of the several boilers. Thus the waste-pipe which is common to all the boilers, is carried by the several elbow pipes alone.

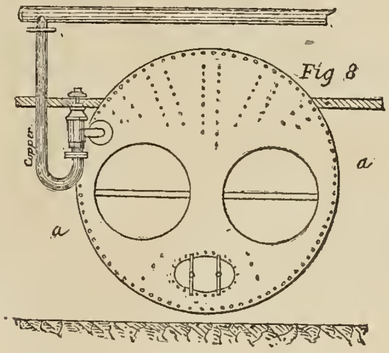
We cannot give this plan our entire approval for several reasons. First, the several boilers all blow into one waste pipe, and when a boiler is not at work, and has its blow-out tap open, it is liable to become drenched with water and sludge if the blow-out tap of another boiler under steam is opened. This liability to backing up is dangerous, and might lead to the serious or fatal injury of any man who might happen at the time to be in the vicinity of the blow-out opening of the boiler at rest. The backing up is caused by the method of junction of the blow-out tap to the waste pipe, the pipes being joined at a rectangle. This should not be. The junction should take place in a down-stream direction, as shown by the dotted lines in Fig. 7. The more nearly the two pipes can be brought parallel to each other the better will be the results obtained, and the greater the security not only against backing up but also against choking of the waste-pipes.

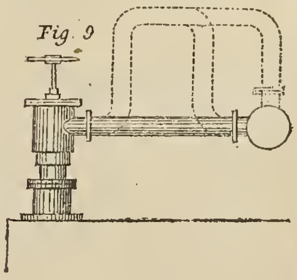
To insure the elasticity of the scum connection, it is best to introduce a bend of copper pipe between the vertical pipe from the scum tap and the blow-out, though it is commonly made at right angles, as in the full line, and leads to the possibility of accident as above pointed out. The hole in the floor-plate through which the scum pipe passes should be at least an inch larger in diameter than the outer diameter of the pipe. To prevent ashes falling through, a collar, fitting easily on the pipe, should be slipped on it. Such a collar is shown at *a* in Fig. 6, around the vertical branch of the water feed pipe. When the feed pipe is brought through the hearth pit it is usually laid below the blow-out waste-pipe, as in Fig. 6, and is carried clear of the floor by blocks placed below the flanges. The vertical feed branch must be connected to this by means of a copper bend, as shown in Figs. 6 and 7, and the same remarks apply to the feed pipe as to the scum pipe connections, excepting that the necessity of making the connection at an obtuse instead of a right angle is not here necessary. A better arrangement of feed pipe is the overhead system shown in Fig. 8, where the water pipe is carried above the front ends of all the boilers in a row, and drop branches, which may be wholly or partially of copper, are carried down with a siphon bend to each feed valve. This arrangement has the advantage of visibility, elasticity, and freedom from the corrosion engendered in the ash pits. A copper bend is sometimes used to connect the blow-out tap to the waste pipe. It may be arranged somewhat similarly to the copper connections of the feed and scum pipes, as shown in Fig. 3 of the last article. Sometimes, also, the elbow pipe is itself made of copper.

It is usually the practice to attach the main steam valve to the boiler crown at about its half length. This is done so that any settlement, which is usually at one end, may affect the valve as little as possible. In order to insure elasticity in this connection the main steam pipe should never be less than 6 feet from the valve, to which it should be connected by a horizontal pipe, as in Fig. 9. When, from unavoidable circumstances; the steam valve is obliged to be placed near to the main pipe, the connection may be made by bringing the branch out of the side of the valve box parallel to the main pipe, to which it is connected by a bend at least six feet distant from the valve box. Thus, in a range of boilers so circumstanced, the steam pipe from any one boiler would enter the main pipe above the crown of the boiler next adjoining it, either to the right or left. Great elasticity is often given to steam-pipe connections by arranging the pipes as shown by the dotted lines in Fig. 9. The bends should be to as large a radius as practicable, to avoid loss of pressure. These bends are often made from copper. It is hardly necessary to observe that the square entrance of branch steam pipes into the main pipe, as shown in Fig. 9, is not good, tending as it does to friction.









[We do not know whether these engravings are made from scale drawings, or are merely sketches. If the former is correct, these boilers are very different from American flue boilers, as regards the position of the flues in them. We like more steam room in this country.—Eds.]

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

THOSE "ROSES IN THE ENGINE-ROOM."

Editors MECHANICAL ENGINEER:

Reading inquiry in No. 10, current volume, "why roses do not thrive in an engine-room," by "A Fancy Engineer," I thought I would give our brother engineer a little advice that I believe, if he chooses to follow, will enable him to grow roses, or almost any other kind of flowers, very successfully in his engine-room, or at least very close to it.

Let our friend go to any dealer in sashes and blinds, and buy three pieces of glazed sash, one of the same size as his window, the other two of the same height as it and as wide as he would wish his bay window (as it might be called) deep. The bottom or floor can be built of pieces of matched flooring on suitable brackets, just on a level with the bottom of the window in the wall. The narrow sash can be fastened to the wall by light angle-irons, that is, one side, and the wide sash, or front, can be attached to the edge of this by screws. The other narrow sash is attached to the wall by light hinges or butts, and forms the door. The top can be made of any light material tacked on with brads. The bottom edges of the stationary sash should also be fastened with brads to the floor, to keep them in place.

This may not be a very clear description of how the affair should be made, but our friend may be able to get some hints from it which, with his own inventive genius, will enable him to construct a "conservatory" that will give him a great deal of pleasure. He will find that the cost will be but slight compared to the real pleasure that one, inclined to cultivate flowers and enjoy their sweet presence, will derive from it.

Not only will roses do well, but nearly all kinds of beautiful flowers can be cultivated very easily, and with very little trouble. I would here advise that, if possible, a south or west window should be selected, to get the most sunlight. The temperature can be kept at the proper degree by raising the bottom and lowering the top sash of the outside window, which also admits pure air. I have never had any trouble in having flowers in bloom the year around, and I think our friend will find that his roses, instead of fading and "giving out," will thrive, and well repay him for what expense he may be at should he follow my plan.

I quite agree with you, Mr. Editor, that his question needs no apology, but rather deserves commendation, for I have yet to find the first person who really enjoyed flowers and their cultivation who was a bad man, and I will venture to say that, should we make a visit to our friend's engine-room we would find it in first class order, at least so far as circumstances would permit. All proprietors do not always second an engineers desire to have things in good shape in the engine room; if they did I believe it would be vastly to their own interests. I trust our friend will see his way to try my plan, if he can make out what it is, and at some future day report his success.

I forgot to say that he can get the sash in whole pieces instead of halves, as his window probably is. Let him also use some finely pulverized charcoal around the roots of his plants, as it will give them vigorous growth and far better shades. I feel an interest in such matters, trivial as they may seem, as this long letter will testify, and if I can help anyone with advice I am glad to do it; I am also glad to know that there are men in the engine-room who can find pleasure in cultivating flowers, and will venture to say that this disposition will detract nothing from his worth to his employer.

KINGSTON, ILL. L. P. HARVEY.

MARINE ENGINEERS ASSOCIATION, NO. 38, SEATTLE, WASHINGTON TERRITORY.

Editors MECHANICAL ENGINEER:

Herewith please find list of officers of No. 38, Marine Engineers Association, of Seattle, W. T. They organized April 18th, with 47 members, all first-class men.

R. Moran, Pres.; Felix O'Neil, V. P.; H. Rounds, Treas.; D. H. Callahan, R. S; W. A. Perry, F. S.; F. W. Bird, C. S.; J. Dunham, Conductor; G. Gelsen. Doorkeeper; A. Cutler, Chap.

They are full of enthusiasm in our cause, and I think will prove a most valuable accession to it.

DETROIT, MICH. JAS. H. REID,
Pres. National Association, M. E.

FROM ANOTHER BOILER-MAKER ON FEEDING BOILERS.

Editors MECHANICAL ENGINEER:

Having just commenced to take your paper, I notice a number of communications in it on feeding batteries of boilers. In our own practice we never use stop valves, as shown in some of your correspondents' sketches, our theory being that uneven firing, or irregular pressure from any cause will force the water out through the feed pipes of the one which has the greatest pressure on into some other. When the engine is not running, this trouble does not exist, as the steam pipe across the boilers will then act as an equalizer, and allow any excess of steam to pass into the others. So long as the pressure is equal all round you will find very little disturbance in the water level.

Of course, when the engine is not running, the connecting steam pipe cannot act in the capacity mentioned above, and, to overcome the trouble, we put in a separate pipe, or an equalizer as we call it, from 3" to 4" diameter, connecting with each boiler. This gives a perfect distribution of pressure throughout the battery. and our water level is uniform.

Also, we never use valves in our feed-pipe connections, and have no trouble from any cause. This may not suit the ideas of some, but it answers admirably in practice, and we fit up a great many boilers in this way to avoid the trouble mentioned, and obviate it where it already exists.

ISAAC BARSTOW,
Superintendent West Branch Boiler Works Williamsport, Pa.

[We are pleased to see that boiler-makers are taking an interest in these questions, and are obliging enough to give their experience for the benefit of all. We hope that others in this line will follow suit. "In a multitude of counselors there is wisdom."—EDS.]

FROM SECRETARY DAVY.

Editors MECHANICAL ENGINEER:

In answer to numerous letters received from engineers residing where there are no associations organized, asking how they can join the National Association, I take the liberty of answering them through your valuable paper.

1st. There is no way of joining the National Association, as it is composed of delegates who are elected by organized associations to represent them at the annual meetings of that body.

2d. The correct way for engineers who want to enjoy the benefits arising from connection with the National Association is to organize societies in the different cities in which they reside, and apply to the Secretary of the National Association for charter.

It is surprising to read some of the excuses offered by engineers for not organizing. The principal one is the opposition of employers. Now, Mr. Editor, it appears to me that if those employers knew the cornerstone upon which the stationary engineers built regarding wages, they would not oppose but would encourage their engineers to organize.

No engineer subject to the authority of the N. A. can interfere with another regarding *wages*.

No engineer can leave his engine during a strike in the mill or factory where he is employed without subjecting himself to *expulsion* from the society.

No engineer can recommend an appliance to his employer upon which he is to receive a commission without being *expelled*.

An engineer who is intemperate shall be *expelled*.

From these few facts employers can see that the enrollment of their engineers under the rules of the National Association will be an advantage to their interests. Perhaps some parties would prefer to hear from employers regarding their experience with our societies. Let them address William A. Harris (with stamp), of Providence, R. I. Although he has not authorized me to use his name in this connection, I take the liberty to do so, knowing his extended reputation.

A. M. DAVY,
Secretary National Association.
175 ELMWOOD AVE., DETROIT.

FROM THE BALTIMORE BROTHERHOOD OF STATIONARY ENGINEERS, NO. 1.

Editors MECHANICAL ENGINEER:

In regard to the letter you published from me in No. 10, concerning our "*Brotherhood of Stationary Engineers*" in this city, there are some misprints, which please correct. We pay sick and disabled members, in good standing for six months last past, five dollars per week, not five cents; and our President's name is W. J. Lee. not W. I. Lee,. Secretary J. B. McClure's address is 212 Elliott street, Baltimore, Md.

I want to say that in the near future the stationary engineer will be recognised as a man of some importance in the community and not looked upon as a Jack-of-all-trades, as some seem to think he is now. It is a common thing to see advertisements like these:

WANTED—An Engineer that is accustomed to filing, setting and running circular saws.

WANTED—An Engineer who understands tempering clay in a brick yard.

WANTED—An Engineer in a paint mill; one who understands heading up barrels and sewing up bags of paint for shipment.

WANTED—An Engineer in a printing office; one acquainted with making ink and cleaning rollers; no other need apply.

If this sort of thing is kept up, an engineer will have to come at five o'clock in the morning, in some places, and then go and clean out the stables, and get the horses' breakfast ready. When he gets a chance, he may look after the boilers, occasionally.

If an engineer will not submit to this, and tells his employer so, he is informed that there are plenty who will do it, and that he can leave. If he is in debt, and does not know where to get another job at the moment, he *has* to do things which he knows are not his business.

A portion of the men in charge of stationary engines have no fitness for their places, and there is but one way to get them out, and that is to have a stringent license law, to enforce it, and to keep politics out of the matter altogether.

I am glad to be able to say that our *Marine Engineer's Association* No. 32 is in a flourishing condition. Our entertainment was a great success, but our Worthy President Schultz did not enjoy it to any great extent. An alarm of fire struck about nine o'clock, which sent him to his boat in such haste that he stopped for nothing, and was kept on duty the balance of the night.

DAVID E. HALL,
President Brotherhood Stationary Engineers, No. 1,
Baltimore, Md.

PEOPLE WHO USE SCREENINGS FOR FUEL.

Editors MECHANICAL ENGINEER:

We were much pleased with your article in No. 10, current volume, under the head of "Figure Closer," especially that part referring to your conversation with a manufacturer in regard to burning screenings and coal slack, and his reply that he did not want to buy dirt; "you can't make steam out of dirt." We have heard this so often from a certain class of steam users that we have come to expect it. Another similar expression is: "If everybody goes into burning screenings, they will be as high as the best grades of coal."

Now, what one manufacturer can do successfully can be followed by others, if they will only give the same care and attention. We claim that a ton of cheap fuel burned in our furnace will evaporate as many pounds of water as a ton of the best grades of anthracite coal in the common setting. In pounds of water evaporated for one dollar's worth of fuel, it is from twenty to twenty-five per cent. cheaper.

We have over two thousand furnaces in operation; one half of them use this class of fuel, and some of them have been doing so for four years, The following concerns are using pea coal and screenings with the Jarvis Furnace: Willimantic Linen Company, Willimantic, Conn.; Yale and Towne Manufacturing Company, Stamford, Conn.; Holly Hat Works, Danbury, Conn.; P. & F. Corbin, New Britain, Conn.; Hartford Carpet Company, Thompsonville, Conn.; Seth Thomas Clock Company, Thomaston, Conn.; Falls Company, Norwich, Conn.; Wm. A. Harris Engine Works, Providence, R. I.; B. B. & R. Knight, Providence, R. I.; Rumford Chemical Company, Providence, R. I.; Peacedale Company, Peacedale, R. I.; W. F. & F. C. Sayles, Pawtucket, R. I.; American Curled Hair Company, Pawtucket, R. I.; Everett Mills, Lawrence, Mass.; Russell Paper Company, Lawrence, Mass.; Washington Mills, Lawrence, Mass.; Wamusetta Mills, New Bedford, Mass.; Potumska Mills, New Bedford, Mass.; Grinnell Mills, New Bedford, Mass.; Lawrence Corporation, Lowell, Mass.; Lowell Bleachery, Lowell, Mass.; American Linen Company, Fall River, Mass.; L. Waterbury & Co., New York, N. Y.; Henry Maurer, New York, N. Y.; George Q. Moon & Co., Binghamton, N. Y.; Binghamton Water Works, Binghamton, N. Y., and hundreds of others.

JARVIS FURNACE COMPANY.
BOSTON, MASS.

COSTLY WOOD.

The finest and most costly of the veneer woods is French walnut—a wood that does not come France, but from Persia and Asia Minor. The tree is crooked and dwarfed, and is solely valuable for the burls that can be obtained from it. These are large tough excrescences, growing upon the trunk. In this the grain is twisted into the most singular and complicated figures. The intricacy of these figures, combined with their symmetry, is one of the elements that determines the values of the burl. Color and soundness are other elements of value, which varies very widely. Burls worth from $500 to $1,000 each are not rare, and at the Paris exposition for 1878 one burl weighing 2,200 pounds was sold for $5,000, or upwards of two dollars a pound.

In buying burls much care is necessary to guard against fraud. Often decay or malformation results in leaving hollows in the very center, which, of course, greatly lessens the value. These hollow places are sometimes filled by fraudulent dealers with substances resembling the wood, and the whole is sold at a very much higher price than it is worth. Compressed manure is one of the materials used for this purpose. An even worse fraud than this, is that of placing stones in the hollows to increase the weight and thereby enhance the value of the burl. This not only cheats the buyer but is liable to ruin the valuable knives used in cutting the veneers. There are rosewood and mahogany burls, but, unlike those of the French walnut, they are but of little or no value. In those woods it is the trunk of the tree that is prized; the knots are discarded.

Next to French walnut, ebony is probably the most valuable of the cabinet woods. Occasionally a fine piece is found that brings even a better price than the French walnut. For a particular large piece, even $5 a pound might be paid. In ebony the main thing is size. It is difficult to get large pieces that can be used without cutting. Rosewood and mahogany are always in demand. The best mahogany is that of San Domingo. Next come the mahoganies of Cuba, Honduras, Mexico, and Africa. There is much less difference in value between different mahoganies and rosewoods than between different specimens of ebony and French walnut. Fair rosewood will sell in the log for 5½ and 7 cents per pound.—*Lumber World.*

Messrs. John Wiley's Sons, of 15 Astor place, agents for London *Engineering*, are issuing, in twelve monthly parts (four are already issued), "*Recent Practice in Marine Engineering,*" by Wm. H. Marr. This work will form a most valuable addition to the literature on the subject, for it comprises working drawings of the best English, American and Continental practice, not only in marine engines, but also in dredging machinery and engines for rope and wire haulage in canals and rivers. It is imperial folio in size, handsomely printed, with descriptive text and tables. Among the American engines will be those in the Pilgrim, Albany and some typical western boats; also several revenue cutters and swift yachts. The following, and many others, are fully shown: Parisian, City of Richmond, Devastation, Gallia, Coquette, Blue Bell, Lord Jeffrey, Wrangler, Aberdeen, General Admiral, Miranda, Fredrich der Grosse, Wanderer, Arizona, etc., etc.

TO THE STATIONARY ENGINEERS' ASSOCIATIONS OF THE UNITED STATES.

At our next annual meeting, the National Association of Stationary Engineers will be compelled to draft a Constitution and By-laws for the guidance of subordinate associations. Now, let the various associations discuss this matter, and furnish their delegates with such instructions as they think proper, which will be referred to the Committee.

Delegates should also be instructed in regard to the Aid Association, and the Convention will know what the feeling of the different associations is in regard to these matters. By discussing these points prior to the regular annual meeting, much valuable time can be saved to all.

An application for a charter has been received from Owasso, Mich., and there are many places in the West where societies ought to be formed. It is to be hoped that all who have their own interests at heart will put their shoulders to the wheel and give an impetus to the objects of the Association in their section.

We are indebted to the members of the several Marine Engineers' associations for valuable assistance. They know what their own society has done for marine engineers in general, and see what stationary engineers could do by united action.

In answer to many inquiries regarding the position of the National Association of Stationary Engineers on the wages question, Article IV of the Constitution is subjoined herewith:

> "*This Association shall at no time be used for the furtherance of strikes, or in any way interfere between members and employers in regard to wages; recognising an identity of interest between employer and employed, not countenancing any project or enterprise that interferes with perfect harmony between them.*"

All letters addressed to the Secretary will receive prompt attention.

A. M. DAVY, Secretary,
175 Elmwood Avenue, Detroit, Mich.

By the aid of a new material emery wheels are now made one-sixteenth of an inch thick and ten inches diameter, and can be used as saws for slitting hard metal.

ORGANIC SCALE; ITS FORMATION, PREVENTION AND REMOVAL.

A LECTURE BY N. W. WILLIAMES.

Pres't. Keystone Council, Stationary Engineers, No. 1, Philadelphia, Pa.

No. II.

You are all, no doubt, acquainted with the object of the special meeting this evening, as it is a continuation of the subject of last Tuesday evening—"*Organic Scale; Its Formation, Prevention and Removal.*" I have explained how some organic substances get into steam boilers, and I will endeavor to show, this evening, how to prevent it from forming, thereby greatly prolonging the life of the boiler.

Organic scale on steam surfaces, or along the water line of boilers, is never found until the water has reached the point of saturation. It is then that the surface scum commences to adhere to the shell, when splashed against it through the mechanical agitation of the boiling water. In case of the shell receiving heat from the brick-work in the steam space, in excess of the temperature due to the pressure carried, the scum burns on and hardens, which, by accretion and agglomeration, forms scale. In many cases it will be found six inches higher than the water line in the boiler, always where there is the least agitation of the surface. It is a true indication of the best place to locate a surface-blow. The denser matter falls to the bottom of the boiler, when the water ceases to boil, and will be found in the coolest part, generally in the back end furthest from the fire. If the fires are banked very high on the bridge-wall it will be found both front and back, in every case where soft water is used, and the boiler is not frequently blown down when not making steam.

There is very little use in blowing down a boiler when it is steaming. If the feed-water is shut off for half an hour, all the water in the boiler reaches the same temperature, and is constantly agitated by ebullition. Of course, all the glutinous, or muddy substances held in suspension will be thoroughly mixed, and the quantity of water blown out will contain a very small proportion of the organic substances in the boiler, even if we blow down a whole gauge of water. The proper time to blow out a boiler is in the morning, before the dampers are opened, and it is imperatively necessary that the blow pipe should be attached to the part that is coldest at night. This will be indicated by an internal inspection; for the greatest amount of deposit will be found in the locality mentioned.

I will make a comparison to illustrate the point of saturation with organic substances reached in some water. You are all familiar with the experiments which have been made here by saturating fresh water with common salt. You know that water will take up (dissolve) a given quantity of salt, and that, after this, all the salt added remains solid in the water, and is as insoluble as so much sand, and you have also seen it moved from place to place in a cylinder by the application of heat. Again, you have seen saw dust, when sodden with water, act the same. In all cases, when acted upon by globules of steam, these substanstances come to rest in the coldest part, and to get them out we must use the blow frequently.

We must remember that the use of alkalies to remove scale when driving the boiler to its utmost capacity, renders us liable to accidents from priming. One half pint of sawdust per week, in a 25 horse boiler, will assist materially in keeping it clean. Sawdust does not cause priming, neither does it endanger the boiler by making it foam. It is cheap, and can be procured anywhere. After a time it becomes water-logged and sinks; the grains swell to five or six times their natural size, and have a ragged surface, which collects the fine particles of matter precipitated by the heat. This is the simplest method known to keep boilers clean.

I would here remind the younger engineers present that they cannot keep their boilers in good order without being in the fire room at least half an hour before starting the engine, thus giving time to blow out half a gauge of water before drawing the dampers. Old engineers always allow themselves plenty of time in the morning to blow out boilers, fix the fires properly, and do any little jobs which require attention. They are all ready to open the throttle at the proper time, without any fuss, hurry, or bustle. It is of much importance, and in its way a source of economy; quite as much so as clean boilers, and adjusting the valves by the aid of the indicator. Bear in mind that all the coal saved is not gained by a knowledge of this instrument. While many are spending a good deal of time in the study of it, other engineers are beating a given performance, by evaporating a great deal more water per pound of coal than those who rely simply upon a card for economy. They can even run with poorly adjusted, and leaky valves, and make up these losses through proper attention to their boilers.

I have often heard the remark that it seemed wasteful to blow out so much water that had cost coal to heat. This is true, in one sense, but I am afraid there are many who have not taken all the circumstances into account. They have exaggerated the temperature before blowing down half a gauge in the morning, prior to opening the dampers. If the blow pipe is in the bottom of the boiler, in the coldest part, and the fires banked to keep 50 lbs. pressure over night, you will be astonished on measuring the temperature of the water blown out in the morning. Apply your hand to the bottom of the boiler, on the front end over the door, and you will find the shell to be at least one-half less than the temperature on top. This is owing to the volume of heat from the banked fires not being sufficient to fill the combustion-chamber, the volume being comparatively small, and the temperature low, it passes up the sides of the boiler to the fire line, and communicates heat to the water at that point, leaving the bottom comparatively cool.

In cases of externally fired boilers many must have noticed the snapping and bubbling sound at the bottom, after pulling down the fires with a strong draft on, prior to blowing down. This is due to the "mud" (organic and inorganic substances), which have settled during the night, while the boiler was losing heat on the lower side; the water becoming comparatively quiet on the inside. Under such circumstances the boiler may be compared to a pot of boiling mush. The steam bubbles are made at the bottom, underneath the mass of mud, and when sufficiently buoyant, come in contact with the colder water above, and are condensed, forming a snapping noise in collapsing. This never occurs in a clean boiler, with comparatively pure water.

I would also call your attention to the experiments previously made here with a cup filled with sand and water, put over the Bunsen burner. You have seen the water rise on top of the sand without boiling, while some at the bottom is converted into steam; even the solder on the cup you have seen melted, and yet the surface water would not indicate 212°. A dirty boiler is in just this condition in the morning, and the experiment is a very forcible illustration of the evils entailed thereby.

I do not wish to be understood as an advocate of blowing boilers completely down every week, because this is a very injurious practice, quite as much so as pumping cold water in under steam, but I do assert that we should blow at least half a gauge out of a boiler every morning before opening the damper.

I will here call attention to the hydrometer, which is rarely found in use, but it is equally as important, for economy, as the indicator. It shows the density of the water in the boiler, and by it we are able to tell correctly when it should be blown down completely. The study of the hydrometer should be as interesting as the study of the card, for there is certainly as much importance in the one as in the other. Pure water, at a temperature of 60°, weighs 1,000 ounces to the cubic foot, at the pressure of the atmosphere, and the instrument can be procured at a trifling sum, as compared with the cost of an indicator. Beaume's hydrometer gives a range in degrees and density, from 1 to 70, and densities from 1,000 to 1,900 ounces to the cubic foot, complete, for $3, and I feel confident that with study of the boiling points at different densities, and the assistance it will give in keeping a boiler clean, you will never be without one.

With these remarks I will close this lecture, with some experiments with this instrument, and next Tuesday evening I will explain how to clean a boiler, and how to measure the amount of dirt taken out, by the aid of the hydrometer. I have just finished cleaning a very dirty boiler.

You may state to your friends, making inquiries as to these lectures, that they will be published in THE MECHANICAL ENGINEER.

THE
Mechanical Engineer.
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

BEARINGS.

No one detail of a steam engine has excited wider discussion than the bearings, and upon the sizes and proportions of them the greatest diversity of opinion exists. The pressure per square inch, the surface velocity, the extent of bearing that should be allowed, are all carefully considered, with the result, oftentimes, of producing one that gives endless trouble.

For ourselves we do not hesitate to say that calculating the size of bearings for ordinary work is labor for nothing, for the simple reason that empirical sizes exist, which, under usual conditions, prove entirely satisfactory, and which no man can hope to better. Where is the data from which to calculate the pressures per square inch a bearing should have? It is not in existence, and never will be, for the reason that conditions affect the amount of pressure per square in. on a bearing, and not the surfaces in contact.

Statements, indeed, are not wanting, purporting to be derived from the practice or experiments of this or that person, but the subject is one upon which an individual statement is not reliable, and wherein experiments cannot be set up with any hope of a satisfactory solution. No data regarding bearings can be tabulated, as we shall show.

Suppose a careful observer, and a competent mechanic to boot, should set to work and make such experiments with a view to fixing standard sizes for bearings, how would he arrive at his conclusions? Doubtless by making a set of journals of usual sizes, carefully fitted up as regards surfaces in contact, driven at certain velocities, loaded with certain weights, and lubricated in the best manner, by the most approved methods. Load upon load would be added, and the velocities changed, until, at some one of these loads, velocities, and pressures, it would be found that the limit was reached, and no more could be put on it without injury. Then the fact would be established that bearings of such sizes, at such loads, and under certain named conditions, would endure only so much. This course would be pursued through all the sizes and we should then have a list of standard sizes for bearings. Such a table as this would not be worth five cents, from any aspect. Journals made for experiment, and those made for work, are entirely different and distinct, and what would affect one would be ineffectual on the other. The bearing that would run well with one alloy in the brass would come to grief in another, and experiments, to be even approximately correct would have to be carried out with every kind of bastard mixture that ever went into a crucible, every kind of "Babbitt metal," every kind of cast iron, and of wrought iron known to man. In any other event only one set of conditions are obtained, which, perhaps, would be unavailable in practice.

If any fact is established in daily work it is that bearings have to be run upon their own individual merits and possibilities, without regard to precedents, or what somebody says they should do. Working engineers see this every day, and they know, of their own knowledge, that pressure per square inch is only one of many factors in the problem.

On some kinds of work a certain load will run satisfactorily, and a constructor says that he has at last found out the utmost it will carry. So he has, under his conditions doubtless, but under those still more severe, a very much greater load is put upon a smaller bearing successfully.

Possibly, in the minds of some, the inquiry arises—how were any sizes arrived at, and how were the bearings which run successfully proportioned? The answer is that they were guessed at. This does look very well in print, but it is the literal truth. It may sound better to say they were assumed, which is only another form of expression. This statement is proven by the fact that the average bearing of a steam engine, for average work, is not widely different from its progenitors of half a century ago. All that has been done is to improve its mechanical construction.

To come to our own time, and let the past take care of itself, the Master Car Builder's Association, reports through its members, that some roads are obliged to keep on hand as many as fifty-six different kinds of axles, and forty-six journal-bearings; another has to keep sixty-five journal-bearings to repair foreign cars. That is to say in the various roads which connect, or run into certain points, there are just so many differences in size. Probably it is not pure perverseness on the part of constructors which originates these departures, but individual conviction that the size used is the best for its work.

If the Master Mechanics' Association can devise one style of hat, or coat, which will suit all bodies, and meet all personal tastes, it will doubtless be able to fix a standard size for bearing; we think one conclusion will be reached as soon as the other.

MECHANICAL ADVANTAGES OF THE COMPOUND ENGINE.

While it may be proven indisputably that the compound engine has no advantages theoretically over a single cylinder engine of equal dimensions, pressures, and ratios of expansion, it possesses some mechanical advantages peculiar to itself.

For example, a compound engine has cylinders 51″ and 88″ diameter, the united areas of which are equal to a single cylinder of 101¾″, nearly. A single cylinder of this size taking steam at as high a pressure as the compound engine, and expanding in it in the same ratio as the compound engine, would have an exceedingly irregular distribution of power, to say nothing of the mechanical disadvantages of using steam of very high pressures upon an excessively large piston. These disadvantages are summed up in the friction engendered, which is necessarily great in order to keep the working parts tight.

A piston of the dimensions named, 101″, taking steam at say 90 pounds per square inch, and, expanding, as in common practice, in compound engines, about ten times, would have a mean pressure of about 21 pounds only, and a terminal pressure below the atmosphere, or about 12 pounds only; a condition of things highly unfavorable to the single cylinder so far as economy is concerned.

Again, the greatest pressure on the crank pin of the single cylinder would be at some point between the opening and closing of the steam-valve. As this closing takes place at about one tenth of the stroke, in our example, it is easy to see that the crank is not in a position to transfer the best effect to the shaft, and that losses are incurred of a serious character.

It is not difficult to demonstrate that the compound engine is theoretically defective, that the losses in temperature by condensation, in working steam through two cylinders instead of one, and by all the incidental leakages and waste of power through friction in a multiplicity of parts, are to be charged against economy, but the fact that compound engines continue to hold their places, where economy of fuel is of the utmost importance, that is on shipboard, is conclusive so far as their efficiency is concerned.

Single cylinder engines worked at high ratios of expansion are used by the Pacific Mail Steamship Company, but none of them are of high power. They are low pressure condensing engines, not high pressure condensing engines like the compound.

ANCIENT DEVICES REVAMPED.

"The whirligig of Time brings about its revenges," said the great dramatist, and we are forcibly reminded of its general applicability to mechanical operations by some practices to-day in regard to old devices. We behold, for instance, in a foreign contemporary, that Mr. W. Ford Smith of Salford, England, is at some pains to elucidate the fact that for certain purposes a short tool in a tool-bar, or holder, is more convenient and less expensive than a solid tool. He is correct; and the method named is as good now as it was half a century ago, since which time—if we judge by Mr. Ford's illustrations—no improvement has been made.

Also, in another part of the same paper, we observe a "new" form of swivel-joint for steam pipes, re-invented in Salford (this seems to be an enterprising town), which is identical with that of Nasmyth, brought out in 1843, forty years ago.

There seem to be fashions, or freaks, in mechanical devices akin to those which rage in social circles. Here is the oft-discarded, time and again rejected piston-valve now prominent among its congeners. Many who abandoned it years ago have found new merit in it, and are putting it forward on new machines. In minor devices, the old, old plan of putting a false teat, or an adjustable one, in a counterbore is revived, and even illustrated and commented upon as an instance of mechanical cuteness. It dates back to a time which it would be hard to fix positively, so ancient and venerable is it; a quarter of a century ago it was old.

It is difficult to originate new mechanical devices; for, though to the deviser and his immediate circle a thing may seem new, to the veterans of extended acquaintance and travel it is a familiar friend.

SOME ENGLISH EXPERIMENTS WITH BOILERS.

An English Association of Boiler insurers have recently tried some experiments, which, although not new, are interesting as confirming similar ones made many years ago in this country by the Franklin Institute. They serve to establish the fact that a boiler does not necessarily explode when red hot if cold water is pumped in. We quote:

> "A portion of the funds of the Association were devoted to experiments upon a boiler of the Lancashire type, which was the one in general use for mill purposes. A number of bursting tests under hydraulic pressure had been made, and were of great service in advising the members on questions of boiler construction, and these experiments had shown that the strength of the iron at the seams of rivets between the holes might be taken, as nearly as may be, at 20 tons per square inch, with fairly good iron; and the Association took a fourth of this, viz., 5 tons per square inch as the regular working load. Furnace tubes 2 feet 9 inches in diameter, strengthened with flanged seams 3 feet apart, made of $\frac{3}{8}$ inch plate, withstood a test of 310 pounds without injury. The flat ends $\frac{1}{2}$ inch thick, 7 feet in diameter, supported by gussets, and without any longitudinal tie bolts, also stood a test of 310 pounds, acquiring but a slight permanent set. *The cast-iron manhole mouthpiece and fitting branches gave way, but the wrought-iron manhole mouthpiece stood the test without injury.* Further, the experiments had brought out the interesting fact, not previously called attention to, that the seams of rivets stood a higher strain before rending, when pulled asunder in the boiler by hydraulic pressure, than when pulled asunder in a testing machine, the double-riveted seam attaining a higher breaking strain by 20 per cent. and the single-riveted seam by 40 per cent. It was thought that this increase of strength was due to the stiffening action of the belts formed by the double thickness of plate at the circumferential seams, which prevented buckling. This would point to the conclusion that narrow plates made a stronger boiler than wide ones. A further series of experiments was now being tried upon the Lancashire boiler to ascertain the effect of injecting cold water upon overheated, if not actually red hot, furnace crowns. The furnace crowns had been bared and brisk fires allowed to burn, until the plates were sufficiently hot to freely melt a lead plate and other lead strips laid on the top of the furnaces. The plate and strips were loosely attached, so that there was a film of superheated steam between them and the iron, and as they were rapidly melted the furnace crowns must have been much hotter than the melting point of lead, if not actually red-hot. Yet when water was suddenly thrown upon the furnaces, so far from there being an enormous quantity of steam suddenly generated, and the boiler rent in pieces, according to the generally received opinion, there was no explosion, no rent, no collapse, and no movement of the boiler, while the pressure gauges were scarcely affected."

An instance occurs in the above which shows how even intelligent persons sometimes draw erroneous conclusions. In experiments, the chief difficulty is in deducing correctly. The work is not done when the mere details are executed—it is only begun. What we allude to is contained in the passage which says that the riveted seams stood more stress in the boiler than in the testing machine, the observer adding that this would seem to point out that more seams (narrower plates) would make the boiler still stronger. By this method of reasoning, a boiler made out of rings six inches wide, riveted together circumferentially, is stronger than one made from sheets four feet wide.

Seams are inevitable, since boilers cannot be be made without them; but they weaken rather than strengthen, and the fact that they are stronger in the boiler than in the testing machine (which, by the way, is not established above) does not mean that the number of weak places should be increased.

A USELESS DIVERSION.

It is asserted by some that it would be an excellent thing to graft technical education upon our public school system, so that the pupils could be, in a manner, better fitted to learn trades when the time came for them to do so. From our standpoint we see the matter in exactly the opposite light.

It seems to us that it would be an excellent thing for the embryo mechanic to learn all he could while in school, so that when he goes to his trade he will be in a position to apply his brain training to some purpose. A smattering of mechanics—that is, a superficial knowledge of mechanical operations, is no advantage to a boy who intends to learn a trade. He is superficial, and is expected to be on the start. A knowledge of which way to turn a bolt to unscrew it, or how to drive a nail so as not to split a board, does not advance him in the least during his early service.

"Reading and writing come by nature," said Dogberry, and the sort of mechanical information alluded to is taken for granted by employers, but they do not immediately establish boys in a better situation by reason of it. Technical education in public schools must of necessity be superficial, and therefore useless, for the reason that there cannot be any time for it. It takes a young man six or seven years' constant labor, of ten hours daily, to get into a position where he can with any propriety call himself a workman, and even then he is only over his novitiate. The world of work, and how to do it, is all before him still.

Technical education in a college, or institute, devoted to a specialty, is another matter entirely, for in them one study supplements the other. A student executes a certain piece of work wherein the principles he has been taught are applied. He has a practical demonstration of the truth of them. The use of tools, so-called, taught in a public school, may serve to divert the boys and amuse them much more than the multiplication table would, but the latter is by far the most valuable to them.

THINK.

A much better remedy than energetic action, for some disorders incident to steam engines, is to do nothing with the hands, but a great deal with the head. Of the two operations this, to some, is by far the most fatiguing, and most readily shirked. Inactivity of any organ of the body weakens it, and while many a man's muscles are hard, and capable of any amount of strain, his brain is soft and lets nothing through. It is like a stopped strainer on a feed pipe. Big as it is, and strong as it is, the most trifling thing will sometimes paralyze a steam engine. Trifles are undiscernible, usually because undiscoverable at a glance, and it is the active mind, the thinker, who sees what is out of sight. With the eye of faith, he knows there is a cause for inaction, and though he may not be able to look around the corners of a steam port, or up through the chambers of a steam pump with his naked eye, he sees through all mysteries by the aid of second-sight, mental operations, and comes to the root of the matter at once.

The thinker who also works has the advantage of him who works but never thinks.

TOOL-ROOMS.

A contemporary raises the momentous question as to who first originated a tool-room in a machine shop, and confers that honor, to the best of its knowledge and belief, upon Mr. Webster of Waltham, Mass. This gentleman, it appears, conceived of a tool-room in 1860, and intends to claim the honor unless antedated.

We will cite an instance of a tool-room which existed in 1850, and for many years prior to that, in the Morgan Iron Works of this city. Many persons still living will remember the irascible Mr. Beebe in charge, who used to be thrown into convulsions of rage by whistling apprentices resorting to his place, ostensibly for tools, but actually to, let us say, wile away some tedious moments. Tool-rooms are quite common in the archives of machine shops, and we fancy it will not be difficult to establish the fact that some were in existence half a century ago.

"ORGANIC SCALE FORMATIONS."

The lectures by N. W. Williames, President of the Keystone Council of Stationary Engineers, contain a great deal of extremely useful information, and all steam users will profit much by heeding them. They will serve to call attention to that great bar to economy and durability of steam boilers—dirt—and very much conduce to closer figures. Few persons have any idea of the losses entailed in this respect. Very many do not care, but there are others who do, and to this class Mr. Williames' suggestions are invaluable. Their eminently practical character, devoid of any flavor of pedantry or assumption of great reading, commends them to the mass everywhere, whether employer or employed. We point out these lectures for two reasons, primarily by reason of their intrinsic value, and secondly as an example of the work engineer's associations are doing. No better evidence can be given of their intent and utility. Cutting loose from all other issues, stationary engineers societies devote themselves to legitimate objects and disseminate information which it has taken years to acquire. In this another end is gained indirectly, for by enhancing the value of individual members of the several associations they better their condition and command higher salaries and a more elevated station in society. These things inevitably follow in due course.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXIV.

Four thousand pieces of $\frac{3}{4}$ round iron two feet long, with a thread on one end and a drilled eye in the other! The thread is to be cut six inches long for a standard nut, and the eye is be drilled three-fourths. I don't know what they are for, and don't care for that matter; all I know is that we were asked to bid on them by a firm of machine-makers in a neighboring town, and we got the job. Many might think that this was a curious proceeding on the part of another firm—letting out work in their own line—but it is not. It often occurs, for the reason that, having no facilities for certain jobs, it is cheaper to send them out to other shops than to rig up for them.

We have taken this job low—very low—for the simple reason that we have two drilling machines out of use and two young men, not exactly boys, who will have a chance to stir their stumps and find out what they are made of.

When the work came in, Jake asked me how he had better do it—by day's work or piece work? We have never used the latter method in our shop, for the best of reasons—we never had any opportunity to do so—all our work being too small in quantity and too irregular in character; but on this job I proposed to let the boys see what they could do.

So I told Jacob we couldn't get anything out of it at day's work, but that he must job it out.

Jake said he thought that would be a bad precedent, because it would make the others dissatisfied, and all hands would want to work by the piece then. There would be trouble, he thought.

"Well," said I, "If you will tell me what jobs we ever had before, or are likely to have again, that can be contracted out, I will admit that it would create dissatisfaction; but, as our work runs, you will see that there is no probability of any ill-feeling on the subject, for there is no chance for piece-work."

"That's so," said Jake; "but I hate to disturb the harmony of the shop by seeming to give two a preference over the others."

"You look at the matter in the wrong light, my friend. There is no favor in giving out work that a man has to do his level best on to earn his daily wages, and more than his level best if he wants to make any money. Have you ever done any piece-work yourself?"

"No," said Jake; "I never did."

"Well, I have; and it is a very different undertaking from what it seems to be, viewed from afar off. When you get intimately acquainted with piece-work, you will find it is another thing from merely shaking hands with it, as one may say. Piece-work stands a man right up for all he is worth, and if he is of any value at all, he finds it out very soon, and if he isn't he also discovers that. Piece-work surprises many a man who never had a very exalted idea of his own capacity previously; for when he finds that he has not only to work his body at a livelier gait than he did before, but wrestle with his brains also, he appreciates himself much more when his contract is completed, particularly if he has lost money on his job. In this latter event, he thinks harder than ever, and sees lots of places where he lost time and went out of his way. Nothing so awakens a sense of the value of time in a man as piece-work. "Time is money" means something that it never meant before. I think piece-work has made more smarter machinists than any other one thing. It is a great educator; and the man who has never done any has a new sensation to experience."

"You are getting on to me now," said Jake. "I just told you I had never done any."

"Oh, well; you know what I mean, Jacob; we won't disagree on that."

"How much do you propose to give the boys for drilling and threading these bolts, or whatever they are?" said Jake.

"I don't mean to make them any proposition; that must come from them. They must learn to make their own estimates; and, according to the manner in which they undertake this part of the job, you can form some idea of their foresight."

"I suppose Lamb and Cephas Miles are to have the work! They are about the only two boys in the shop."

"I meant them. Call them in, and let us see what they say."

When they came into the counting-room, I asked them if they wanted to make a little money, or lose a little, according to their capabilities, and they promptly answered, with one accord almost, that they cared more about making some money than taking any chances to lose.

"Do you think you are smart enough to take this job (I told them what it was) and come out ahead on it at low figures?"

They were loth to express any opinion offhand, but each took up one of the bolts, turned it over, eyed it warily, as though it might go off in their hands, and ended by laying the bolt down as gently as if it were a dynamite cartridge. If they had been in the shop with it they would have chucked it ten feet off.

"What do you say, Miles?" Jake asked. "What will you finish these bolts for, like the sample shown? How much apiece? There are 4,000 of them, and it's nothing but a rough job."

"What have we got to do to them?" said Miles slowly, and laboring internally to such an extent that the perspiration stood in great drops on his forehead.

"Just what you see—drill a hole in one end, and thread them six inches up, in the bolt-cutter."

"Am I to take the bolts from the floor and deliver them on the floor, or will you handle them?"

"You are to take them from where they lie, outside the door in the yard, and deliver them on the floor. You are to make an estimate of the total cost of doing everything that you see, and we shall hold you to your bargain, whether it makes or breaks you. If you lose, it is your loss, not ours. So you have fair warning. You must dress your own tools, grind your own drills, lose your own time, be your own laborers, lace your own belts, and take the chances of the engine running continuously ten hours a day. It probably will run that time, but there is no telling what may happen; as soon as you get half through your job the shaft may break!"

"What do you say, Lamb? How many of these can you drill in a day?"

Lamb looked at the bolts in a distant sort of way, as though he now saw such a piece of iron for the first time in his life, and found voice enough, at length, to say that he wasn't quite certain, and wouldn't like to give his opinion. Then a dead silence fell on the room. No one appeared inclined to break it. I looked at them in amazement, and so did Jake, until, in a moment, a light seemed to flash upon him.

"Come out of this place," said Jake to Lamb, taking him by the slack of his sleeve. "I know what ails you two fellows; the counting-room sits heavy on you; you can't think in here; your brains won't move unless you hear a lot of belts flapping up and down, planers squeaking and lathes going."

"Now, then," said Jake; "that weight is off your mind; we are in the shop, and you can tell us what you will do the job for by the piece—that is, so much per bolt, 4,000 more or less."

"Mr. Hess," said Miles, "we would like to do this job, and will make an estimate if you will give us time for it. We can't make a snap offer, for we have a good many things to take into account. Give us till to-morrow morning, and we will give you an answer."

"All right," said Jake; and we turned to go into the counting-room. Near the door Jake went back and said: "No experimenting on this thing this afternoon, to see how many you can do. You hear me!" A livid grin on Lamb's face showed he had hit the bull's-eye. That afternoon I think but little work was done by those two young men, for their countenances seemed to say that they had met the great crisis of their lives. The next morning they came in, saying they had worked the thing up, and came to the conclusion that they would do the job for $100.

"WHAT?" roared Jacob; "you are wild! You don't know it, but that's more money than we get ourselves. How did you figure on it?"

No answer; but each looked at the other.

"How did you figure on it?" said Jake again, a little more decidedly this time.

"Why," said Lamb, who was the boldest speaker, "a man on piece-work ought to make better wages than a man on day's work, because he works harder. We are getting six dollars a week now, and we certainly ought to make twelve on piece-work, because we do twelve dollars' worth of work. It will take us about four weeks to do the job, and at that rate it would cost, at $12 per week for each of us, $96. We put on the other $4 to make up for accidents."

Jake waited a moment until the full force of this ingenious method of doing piece-work took full possession of him, and then he laughed like a woman with hysterics.

"Oh, my Lord!" he roared, when he had breath enough; "did I ever hear the like of that?" As for me, I found it convenient to smother my appreciation of the situation behind a paper, but I am afraid it shook some.

"Boys," said Jacob, in a graver tone, as soon as he could command himself; "you have gone the wrong way about, in estimating the cost of work. You should not allot yourselves a certain sum for wages, or deem yourselves entitled to it. Piece-work is not a scheme for doubling wages; it is a plan for doing more work in a given time, and thereby getting more money in a given time. It is a plan for increasing the work produced by tools by pushing them to their utmost; for saving time by wasting none; and for turning out more work by taking advantage of everything that will expedite it. Now, if you will say how long it would take you to drill one hole, we can get at the thing very soon."

Lamb and Miles appeared somewhat bewildered at the turn matters had taken, and chop-fallen withal; for, like the dairy-maid in the fable, who had already bought a great many things with the money she was to get from her chickens (when they were hatched), I am afraid they had had great expectations. They said, or Miles did, that they thought they could drill a $\frac{3}{4}$ hole in $\frac{3}{4}$ iron in about two minutes, if everything was ready and kept ready.

"Well," said Jacob, "that's all right; go on. How much for the hole?"

"Two cents," said Lamb.

"Young man," said Jacob, "You talk too sudden. Two cents a hole for thirty holes an hour is 60 cents, and ten hours a day is $6—a week's wages in one day! You will never get at this thing," said Jacob; "so I will for you. You can have this job for forty dollars, lawful money—no more and no less—and we will find everything, tools, power and facilities; you find everything else. You put your time against your ability. The sum named gives you nearly four weeks' wages for two weeks' work, if you can do it in that time; and if you can't, you needn't touch it. You ought to do it in just one-third of four weeks, say ten days, and you will find it so, when you get on the last of it. You may take your own figures—thirty holes an hour, which is slow for piece-work—and you will drill the whole four thousand in about thirteen days. You will do it in less time. One of you will take the bolt-cutter and the other the drill. You may speed the drill as fast as you like, but the bolt-cutter you will run on the regular speed, for the dies run fast enough now. If you break the tools you must make them good in your own time. You must get some sort of a rig fixed up so that there will be no centering or laying out to be done, but just drop the bolt into its place and feed away. When you, whoever you are, get one hole drilled, you can throw the piece in a box alongside, and when it gets full carry it over to the bolt-cutter. Now, go ahead. You will see what happens when you get on this thing; you will make money."

As I have strayed far out of bounds in this paper, I will defer the rest until next week.

"IN THE ROUND-HOUSE."

NUMBER 2.

BY BERKELEY POWELL.

In the case of locomotives, where as I have said there cannot be a proper grate area, the massing of fuel is a necessity. So far from having a lofty chimney to assist in drawing a sufficient quantity of air through the fire, locomotives must have a stack, the top of which stands about 14 feet from the rails.

Under these circumstances it has been found necessary to use a forced draught, and this is now universally obtained by means of the exhaust-steam blast.

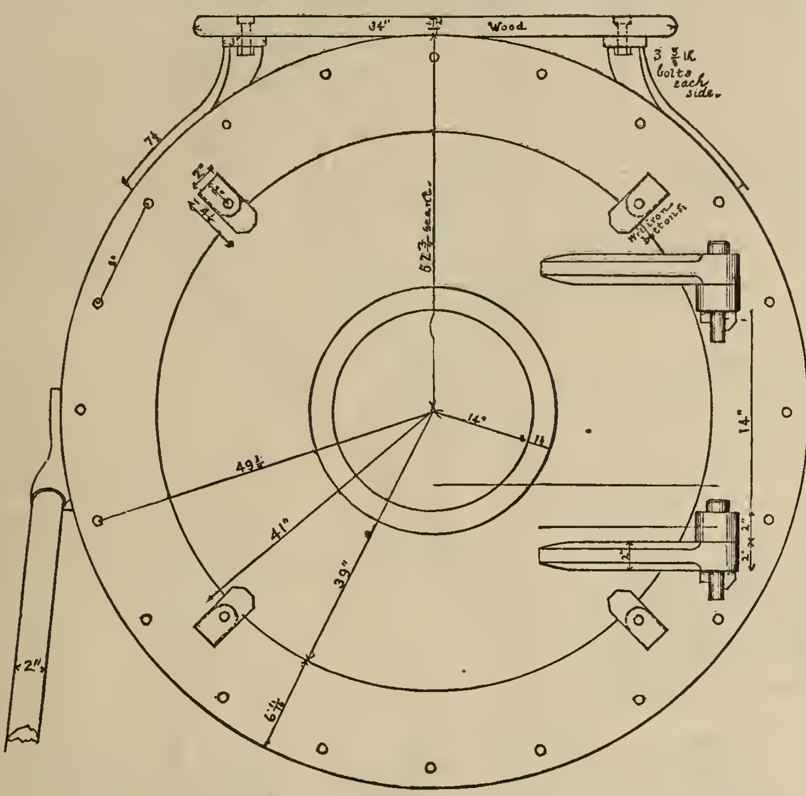
I was going on to speak of this perfectly automatic blast, and why it has been found desirable not to admit all the air to the fuel from below, but I fear I have been wandering from the intention of this paper. What an immense amount of time and money and ingenuity has been expended in perfecting the exhaust nozzles! They are legion in number, and with one or two notable exceptions, simply, inferior to the plain tip. It is found in practice that when a locomotive has a boiler too small for its successful working, that its steaming has been benefited by holding on to or prolonging the exhaust. To effect this the nozzles have cored chambers which surround the exhaust passages, with ports opening into them. A portion of the exhaust steam finds its way in through these ports, and issues from the opposite tip a trifle after the main supply. This form of exhaust is found to be satisfactory under the conditions mentioned above, but its disadvantage is that it causes a large increase to the back pressure.

I was personally interested in an experiment made a short time since, when two large chambers were cast in the cylinder saddle, with a passage from the exhaust-port opening into them—each chamber was connected with one exhaust only, and was entirely separate from the other—the idea being to prevent back pressure. In practice it worked well, and cards showed only the usual lines. I believe some such arrangement as this is the only solution to the problem of prolonging the exhaust without causing other difficulties, and it has the advantage of being out of the way.

Locomotive smoke-boxes have details enough inside of them at present. You and I know what it is to get into one to do some little, tinkering job, particularly when the smoke-box door is small, and the character and location of the work requires one to chip with one's left hand! It is dark away up in that corner, and somehow I never was particularly active with my left hand! How often my hammer has barked my right fore finger when an engine was lying over a trip in the round house! It is a constant source of wonder to me why builders will persist in putting such small doors on the fronts. It seems as though they were desirous of making it as difficult of access to the Hades inside as possible. Many of these engines with small doors have them fastened *inside* by means of devices so complicated in nature that one seldom cares to take them apart, lest there will be trouble in putting them in place again. These rattle-traps are usually out of order. I know of one, in particular, the other day, which would not move when it was required to open the door. The heat had warped the bolting machinery to such an extent that it became a question whether it would be desirable to take off the whole front or remove the stack! And the stack was removed. The "descent into Avernus" is not always so easy as it is generally supposed to be, at least the youth who was sent to crawl into the smoke-box from the top will be inclined to express himself strongly in the matter.

The engraving before you seems like common sense, at all events, when compared with the arrangements already spoken of. In the first place it has a large door, and secondly the door is held shut from the outside by four wrought iron buttons. With such a door as this any flue in the boiler could be taken out without disturbing the front. Such an arrangement as this is cheaper to build and maintain than the other, and it is simple, which is most important when applied to any portion of the locomotive. It is absolutely necessary that about the locomotive nothing should be complicated, there should be nothing used that is not substantial or durable, and if possible it should improve the longer it is used. The hinges for this door, it will be seen, are heavy and have stout pins held by split keys; the hinges are designed to be symmetrical, and equidistant from the center. It will readily be understood why that but little work is required to fit up such an arrangement. The door and front are faced as usual, on the big lathe, the hinges tooled, the buttons forged with a lip projecting down at either end, put on rough, and tightened by a stud and nut. Four bosses are cast on the front to receive the buttons; the top of these bosses comes on line with the door when finished, and the button held in the center presses firmly on both its ends.

I am very partial to using $\frac{5}{8}$ bolts (with T heads) set about 8 inches apart, for attaching the front to smoke-box ring; this ring to be about $1\frac{3}{4}''$ square.



GOOD WISHES.

Mr. Lewis F. Lyne informs us that he is to sever his connection with the *American Machinist*, to which he has been attached for many years as a writer on mechanical subjects, at an early day. This, he says, is occasioned by the state of his health, which does not permit a sedentary occupation. Mr. Lyne has our good wishes wherever he goes.

CHANCES OF HITTING A TORPEDO BOAT.

A writer in *Engineering* thus sums up the probabilities of hitting a torpedo boat advancing to attack an iron-clad. From his point of view these are somewhat remote.

"'Let me see! How fast would she be going? What angle is she making with the direction of the gun? How far off is she? I must allow so much for wind! Oh! there's our own ship moving ahead. I wonder how fast she is going?' He has not much time to think about it, as the enemy is fast approaching, but he adds and subtracts as necessary, and tells the captains of the guns what distance and deflection to use. This done, the gun is rapidly trained for the object and laid for elevation; to do this, however, the enemy must be seen to begin with, and the sights must be seen too, so as to align them, neither of them very easy matters in the darkness. Meanwhile, the torpedo boat is rapidly approaching, and the ship herself is moving.

We leave it to the reader to judge whether the chances are for or against the torpedo boat being hit, depending as it does upon:

The distance being known, the speed of the enemy, the direction in which she is moving, the speed of your own ship, the different deflections being rightly calculated and correctly put on the scale, the object being clearly distinguishable, the sight being raised for the proper distance, the sights being seen clearly, and the gun being properly laid and fired."

Enough! enough! The torpedo boat is safe.

Italian engineers never do anything in a hurry, and whoever orders work from them will get it—when they get ready to deliver it. They are very generous in promises but stingy in performance. A foreign contemporary says:

"The cruiser *Savoia*, ready to be launched last September, is still waiting for her engines, which the firm of Ansaldo, of Venice, had asked and obtained twenty months' time for. The term was now nearly up, but there was no certainty of the engines being forthcoming. The engines of the *Vespucci* should have been ready, according to contract, thirteen months and a half ago. For want of them the launch fixed for last July had to be put off. The engines were only now beginning to be erected in Venice. For the *Andrea Doria's* engines the Messrs. Ansaldo had required thirty months to run from the acceptance of the tender, making a total of thirty-eight or forty months. The English constructors undertook to deliver them within fifteen months. Four Italian firms, Messrs. Orlando, Odero, Guppy, and Pattison, had received orders for as many torpedo boats, and had been engaged during the last eighteen months in copying a first-class torpedo boat, such as Messrs. Yarrow or Thornycroft would deliver finished in six or eight months."

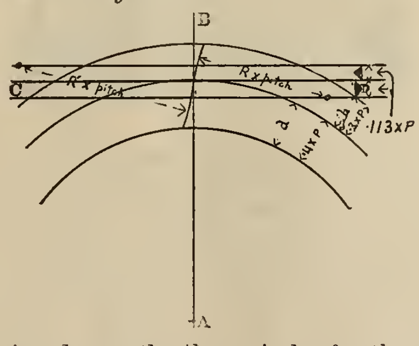
"To-morrow" is a good day in some countries.

PATTERN MAKING No. 13.

BY A PATTERN MAKER.

Reprinted from No. 11, with ommitted diagram.

After the Willis Odontograph came other contrivances, said to be improvements, whether they are or not, I do not wish to discuss, for the simple reason that I consider the whole of them worth next to nothing, beside the card I am about to reproduce for the benefit of the reader, said card being originally taken from a copy of the *London Engineer*.



Having drawn the three circles for the pitch, the points and the roots of the teeth, as in Fig. 97, draw a radius, *A B*. At the point of intersection of the radius and pitch circle, draw the tangent, *C D*. It will be at right angles to the radius. Above and below *C D*, draw lines parallel to *C D*, at a distance therefrom equal to 113 multiplied by the pitch; this distance is marked with a triangle in the figure. The centers for striking the tooth curves will lie in these parallel lines. In the table opposite to the number of teeth in the wheel, will be found the numbers *R* and *R'* for that wheel. *R* multiplied by the pitch, will be the radius of the face, or that part of the tooth which extends from the pitch line to the point. *R'* multiplied by the pitch, gives the radius of the flank, or that part of the tooth which extends from the pitch line to the root.

Example: Pitch of Wheel, 3 inches; number of teeth, 34.

From pitch line to point = h = ·3 × 3 = ·9 in.
From pitch line to root = d = ·4 × 3 = 1·2 in.
Triangle = ·113 × 3 = ·339 in.

Whole length of tooth, 2·1 in.

R for striking faces, ·80 × 3 = 2·40 in.
R' for striking roots, 1·4 × 3 = 4·2 in.

No. of Teeth.	R	R′	No. of Teeth.	R	R′
11	1·60	7·4	30	·78	1·5
12	·612	8·0	34	·80	1·4
13	·63	9·6	36	·81	1·37
14	·64	5·3	39	·81	1·33
15	·66	3·9	42	·83	1·3
16	·67	3·16	48	·83	1·25
17	·68	2·74	49	·85	1·25
18	·69	2·45	56	·85	1·2
19	·70	2·24	72	·89	1·15
20	·71	2·09	79	·90	1·14
21	·72	1·97	100	·92	1·1
22	·73	1·88	140	·94	1·07
23	·74	1·8	210	·96	1·04
24	·75	1·73	420	·98	1·02
25	·76	1·69	Rack	1·	1·
27	·76	1·6			

TABLE 1.

Pitch	Thickness of Teeth	Length of Teeth	Least breadth of Teeth	Velocity of the wheel at the pitch circle.				
				3 ft. per second	4 ft. per second	5 ft. per second	7 ft. per second	11 ft. per second
In.	Inches	Inches	Inches	H. P.	H. P.	H. P.	H. P.	H. P.
6	2·9	4·2	8·4	43·2	57·6	72·	100·2	158·4
5½	2·6	3·85	7·7	36·3	43·4	60·5	84·7	133·1
4	1·9	2·8	5·6	19·	22·5	32·	45·	70·5
3½	1·6	2·45	4·9	14·75	19·5	24·5	34·25	54·
3	1·4	2·1	4·2	11·	14·5	18·	25·	39·5
2½	1·2	1·75	3·5	7·5	10·	12·5	17·5	27·5
2	0·95	1·4	2·8	4·75	6·25	8·	11·	17·25
1¾	0·83	1·225	2·45	3·5	5·	6·25	8·5	13·5
1½	0·71	1·05	2·1	2·75	3·5	4·5	6·25	10·
1¼	0·59	0·875	1·75	2·	2·5	3·125	4·2	6·8
1⅛	0·53	0·7875	1·575	1·5	2·25	2·5	3·5	5·5
1	0·48	0·7	1·4	1·2	1·6	2·	2·8	4·4
⅞	0·41	0·6125	1·225	1·	1·4	1·75	2·5	3·8
¾	0·36	0·525	1·05	0·7	0·9	1·125	1·5	2·5
⅝	0·33	0·4375	0·875	0·5	0·625	0·75	1·	1·7
½	0·24	0·35	0·7	0·3	0·4	0·5	0·7	1·1
⅜	0·18	0·2625	0·525	0·2	0·25	0·3	0·4	0·6
¼	0·12	0·175	0·35	0·075	0·1	0·125	0·175	0·275
1½	2½	3·	2½	3·	3·	3·	3·	3·

TABLE 2.

Stress in lbs. at the Pitch Circle.	Thickness of Teeth.	Actual Pitches to which the Wheels would be made.
LBS.	INCHES.	INCHES.
400	0·50	1⅛ to 1¼
800	0·71	1½ " 1⅝
1,200	0·87	1⅞ " 2
1,600	1·00	2 " 2⅛
2,000	1·12	2¼ " 2⅜
2,400	1·22	2½ " 2⅝
2,800	1·32	2⅝ " 2¾
3,200	1·41	2⅞ " 3
3,600	1·50	3⅛ " 3¼
4,000	1·58	3¼ " 3⅜
4,400	1·66	3⅜ " 3½
4,800	1·73	3½ " 3⅝
5,200	1·80	3⅝ " 3¾
5,600	1·87	3⅞ " 4
6,000	1·94	4 " 4¼

TABLE 3.

N	X	N	X	N	X	N	X
8	2·6131	32	10·2023	56	17·8308	80	25·4713
9	2·9238	33	10·5224	57	18·1505	81	25·7963
10	3·2360	34	10·8396	58	18·4718	82	26·1096
11	3·5495	35	11·1584	59	18·7893	83	26·4304
12	3·8637	36	11·4737	60	19·1073	84	26·7595
13	4·1789	37	11·7913	61	19·4254	85	27·0645
14	4·4941	38	12·1100	62	19·7431	86	27·3989
15	4·8097	39	12·4240	63	20·0653	87	27·7076
16	5·1258	40	12·7454	64	20·3862	88	28·0238
17	5·4421	41	13·0642	65	20·7050	89	28·3471
18	5·7587	42	13·3838	66	21·0212	90	28·6537
19	6·0757	43	13·6975	67	21·3339	91	28·9923
20	6·3924	44	14·0207	68	21·6561	92	29·3134
21	6·7093	45	14·3355	69	21·9742	93	29·6160
22	7·0268	46	14·6589	70	22·2873	94	29·9515
23	7·3449	47	14·9709	71	22·6094	95	30·2680
24	7·6612	48	15·2897	72	22·9255	96	30·5638
25	7·9787	49	15·6085	73	23·2509	97	30·8931
26	8·2959	50	15·9259	74	23·5695	98	31·2012
27	8·6137	51	16·2491	75	23·8802	99	31·5184
28	8·9318	52	16·5617	76	24·1994	100	31·8632
29	9·2494	53	16·7143	77	24·5273	120	38·2015
30	9·5667	54	17·1984	78	24·8463	150	47·7491
31	9·8842	55	17·5134	79	25·1550		

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. III.

By J. P. Mullin.

WORM GEAR.

I think it was Josh Billings who said: "Some people spend a great deal of time trying to twist the untwistable, when they might as well sit down in a washtub, take hold of the handles, and try to lift the unliftable."

Now, this worm gear is a twisted question, and one in which Josh's words have been almost verified, as it has been the cause of more discussion with regard to the proper method of drawing, pattern-making, and moulding the same, than any other form of gear.

In consideration of this fact, I think the following, which has been proved to be good, will be of more than ordinary interest to some readers.

DRAWING.

Fig. 17 is a plan and sections of a screw and wheel, showing the two forms of teeth in general use, viz:—the straight and concave as shown at *F* and *G*. In the small drawing here shown, the curves of the faces of the thread of the screw, are portions of a cycloid, generated by the circle, *A*, the diameter of which is half that of the pitch circle of the wheel, rolling on the pitch line, *B C*.

And the curve of the faces of the teeth of the wheel, are portions of the involute of the pitch circle. But in making a large drawing, or one for practical purposes, the odontograph is a better form of tooth, as it is wider at the flank, and consequently stronger, and it is also better for moulding, as it draws from the sand much easier.

The manner of projecting the helix of the center of the face of the tooth, is shown at Fig. 18. The semicircle represents the diameter of the body of the screw, or worm.

Divide this into any number of equal parts as 1, 2, 3, 4 and *C*; from *H*, set off half the length of the pitch of the screw, and divide it into a number of parts corresponding with those into which the circle has been divided—viz.: 1, 2, 3, 4 and *C*. From each of these points, raise perpendiculars, and from the points correspondingly figured in the circle, draw horizontals, these intersecting will give the points through which the helix, forming the center of the face of the concave tooth, may be traced.

Now, by referring to Fig. 19, it will be seen that the pitch diameter at the end of the concave tooth, is larger than it is at the center of the tooth, and consequently travels further when revolving. For this reason the end of the tooth should be made as much narrower than the center of the tooth, as the difference in the distance of the travel may be; from where the tooth first comes in contact with the screw, until it leaves the same, as shown by the arrow, *E E*, Figs. 17 and 19.

The angle of the tooth, is as the pitch of the screw, to the pitch-circle of the same.

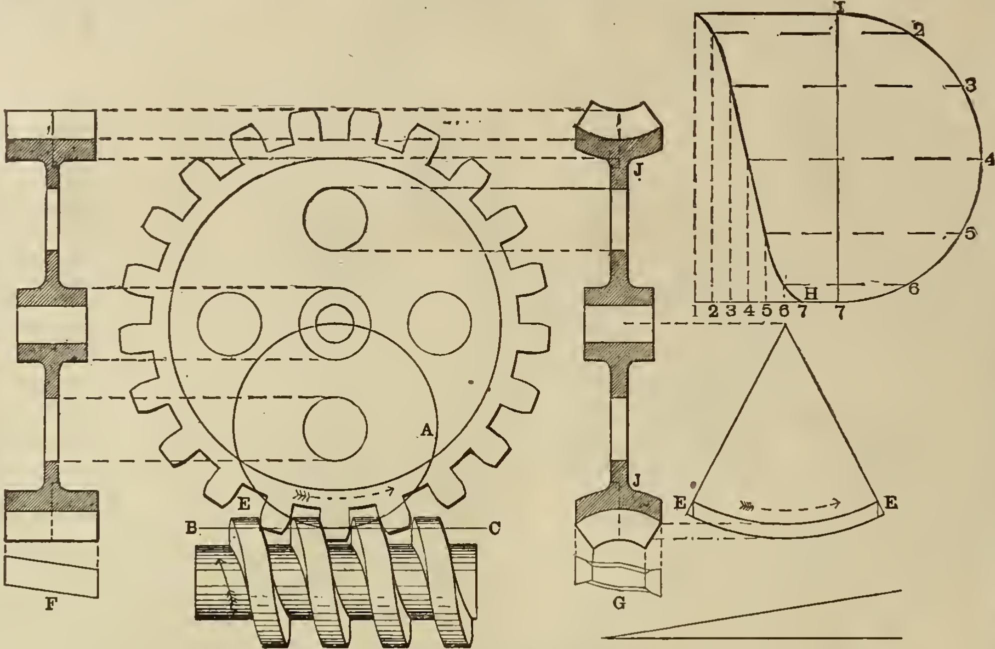
Example—Pitch of screw, 2″; circumference of pitch circle, 12″; angle of tooth, 2″ in 12½″, see Fig. 20.

The pattern should be made to part through the center of teeth and rim. at *J J*, Fig. 17. The hubs should also be loose, as they will draw from the sand easier.

MOULDING.

When moulding, use a two-part flask, bed the pattern in the floor, and make parting at points of teeth *K*, Fig. 21. Set on body of flask *L*, Fig. 22, fill in and mould outside of rim, and between the teeth, and make parting at points of same, as shown at *M*, Fig. 22. Now put on cope, *N*, ram it up, and make gate. We now lift off the cope, and draw the upper half of the pattern. While doing this the pattern must be turned to the right or left—as required—in exact ratio to the angle of the teeth.

Now lift body-flask *L*, turn it over, and draw the remaining parts of pattern. Set hub core, finish the mould, close it up, and you are ready to cast, as shown in Fig. 23.



Figs. 17, 18, 19 and 20.

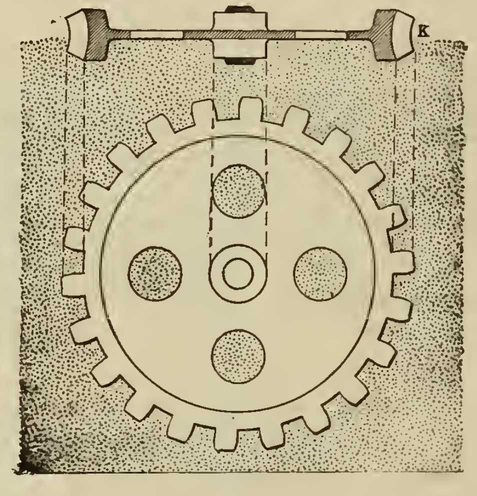
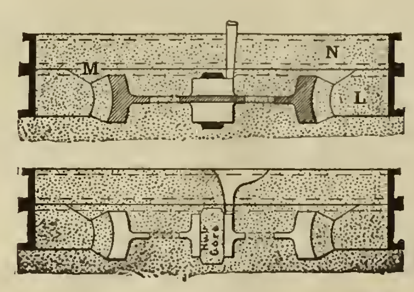


Fig. 21.



Figs. 22 and 23.

* * *

COAL ECONOMY IN STEAM YACHTS.

Coal economy in steam yachting is a very important consideration, and often it is hastily thought that, by driving a yacht at her greatest speed, she will, by covering the required distance in less time, consume less coal, as there will not be the time to burn it. The fallacy of this can readily be shown by a speed and indicated horse-power curve, where the coal consumption per horse-power is known. This consumption in the *Oriental* was found to be 2·12 lb. per indicated horse-power per hour; and on her trial trip the speed made with 52 indicated horse-power was 6·95 knots; with 90 indicated horse-power, 8·4 knots; and with 330 indicated horse-power, 11·4 knots. The coal capacity of the *Oriental* is thirty-three tons; and assume that she had to steam 3,500 miles, with no possibility of coaling on the passage, if she started at full speed, and maintained it by keeping up 330 I.H.P., she would exhaust her coal in 105 hours—4 days 9 hours—or when she had only steamed 1,200 miles; but if she started at eight knots, on 82 I.H.P., she would be able to steam the whole distance, 3,500 miles, with the thirty-three tons of coal; but the time consumed would be 438 hours—18 days 6 hours—instead of 307—12 days 19 hours—if she could have maintained full speed the whole distance; but to have kept up the speed of 11·4 knots for the shorter time she would require 45·2 tons of coal.

The saving of twelve tons of coal, as against thirteen instead of eighteen days' steaming, would not, perhaps, be considered a sufficient set-off under ordinary circumstances, but frequently a steam yacht, when making long passages, may be so placed that it would be of the most vital importance that she should be run at the most economical speed. A few years ago a case occurred in the voyage of the *Eothen* from America to England, when she ran short of coals; and, from ignorance of what the yacht would consume if run at a low speed of about six knots, she was driven at the top of her speed—which, however, did not exceed eight knots—with the result that she could not fetch her port, but had to put into a coaling station. In considering this matter it would also be right to note the effect of putting twelve tons extra coal on board. The coal consumption of *Marchesa* was from the trials made by the Marquis of Ailsa at sea. No diagrams were taken, but he had the coal carefully weighed day by day, and it was proved that 2¼ tons per 24 hours gave 8 knots per hour; 2¾ tons, 8¾ knots; and 3¼ tons, 9¼ knots; the increase of consumption being approximately as the cube of the speed.—*Dixon Kemp.*

* * *

TESTING EVAPORATION IN BOILERS.

The easiest way to make a test is to pass the feed-water through a water meter, and to have a record of the weight of the coal kept as it is delivered to the boiler room. A record of the steam pressure and of the temperature of the feed should be kept during the test, and it would be advisable also to have the ashes weighed, so as to have a correct idea of the quality of the coal. The weight of the water divided by the weight of the coal gives the evaporation under actual conditions. By a simple calculation, hereafter explained, the figures thus obtained are reduced to the equivalent evaporation from and at 212 degrees, which is a standard by which all tests may be compared.

Such a test as this may be made without interfering in any way with the regular running of the works. The water meter may be connected to the feed-pipe during the dinner hour, and it will register the water used for a week or a month if desired without any attention whatever. A record of each load of coal delivered to the boilers may be kept at the scale house. A comparison of the figures registered by the water meter during any interval of time will indicate the amount of power the boiler is developing, and an inspection of the coal record for the same time will show how much it costs to obtain this power. If the quotient obtained by dividing the weight of water by the weight of coal is from 8 to 10, it is an indication that the boiler is doing fairly well; if it is only from 5 to 7, and the coal is of fair quality, it shows that there is a serious loss of fuel somewhere which should have immediate investigation.

Where it is important to secure great accuracy in a test, as in a competitive test between two boiler makers, or to determine whether or not a guarantee has been fulfilled, several precautions are necessary. If a water meter test is decided upon the water meter should be tested to determine whether it correctly registers the water passing through it; or, if a tank or set of barrels is used to measure the water, the capacity of such tank or barrels should be carefully weighed or measured, and an accurate count kept of the number of times they are filled and emptied. The scales upon which the coal is weighed should also be tested, and the number of drafts weighed carefully checked. The boiler should be inspected for leaks, and any water blown off through the mud valve should be caught and weighed. To have the conditions fairly in favor of the boiler, it should be cleaned inside and out before the test, the brick work should be examined to insure that there are no indraughts of air, the coal should be of a quality ascertained and agreed upon, and there should be a skillful fireman accustomed to the working of the same coal under the same kind of a boiler. The amount of coal upon the grate and the condition of the fire should be the same at the end of the test as at the beginning, the water in the boiler should be at the same level and the steam at the same pressure. All of these precautions are quite easily observed, and should be within the comprehension of every one who is intrusted with the care of a boiler. There is nothing theoretical about them.

As there is a considerable chance for an error of judgment in estimating the amount of coal on the grates and the condition of the fire at the beginning and at the end of a test, it is customary in accurate tests to raise steam in the boiler before beginning the test, and to have the brick work thoroughly tested, as when the boiler is in its best working condition; then to draw the fires, removing all fuel and ashes from the grates and ash pit. A fresh fire is at once kindled with wood and shavings (the weight of which is taken as equivalent to 4-10 of the same weight of coal) and with weighed coal. At the end of the test, when the fire is in as nearly as possible the same condition as the fire which was drawn before the test, it is drawn and the grates and ash pit cleaned, and the fuel which was on the grate cooled with water, screened and picked to separate the coal from the ashes, and the coal and the ashes are weighed separately. In this manner the actual amount of coal used to evaporate a certain amount of water is much more accurately obtained than when the amount of fuel on the grate at the beginning and end of the test is merely estimated.

When still greater refinement is desired it may be necessary to test the quality of the steam escaping from the boiler—that is, to determine whether it is dry, saturated, superheated, or whether it contains "entrained" water or priming. A good boiler, properly proportioned, and not driven beyond its normal rating, and with good feed-water, when there is no provision made for superheating, should give practically dry steam—that is, not containing above 3 per cent. of moisture. If there is a superheating surface attached to the boiler, the steam may not only be perfectly dry, but heated to a temperature considerably above the temperature due to its pressure, while with a boiler having insufficient water surface, insufficient steam space, certain kinds of bad feed-water, or which is driven too hard, the amount of water carried over with the steam may be ten or fifteen per cent.—*William Kent..*

MODERN MACHINE TOOLS.

BY J. RICHARDS, *in Engineering.*

It is proposed to notice here some late improvements in screw feed for drilling machines, lathes, and so on that will go far to support the opinions just given. The invention is one of considerable importance, and from present performance gives promise of materially simplifying and cheapening the cost of making lathe gearing. The action of this feed motion as applied to lathes is illustrated in the drawings, Figs. 27, 28, and 29. Referring first to Fig. 27, suppose *c* to represent the apron of an engine lathe, *a* the leading screw, and *e, e, e, e* tangent or wormwheels meshing into the screw, *a*, as shown. These four wheels, *e*, when revolving freely on their axes exert no force or draught on the apron, *c*, except the friction upon their bearings, which is almost imperceptible in practice, but if these wheels are retarded in their motion a corresponding draught or force is applied to the carriage, *c*, or if locked positively they become in effect a nut of considerable length and bearing surface.

If these wheels are four in number and 3 in. in diameter, the aggregate length of their perimeters will be more than 3 ft., and so extended a bearing surface will give an endurance that cannot be equaled by a nut of the common kind. The number of power or tangent wheels employed can of course be varied to suit the degree of strain or the severity of the work they have to perform. They are usually made of phosphor-bronze, carefully cut to fit the screw threads, and in so far as two years' use can determine, show no signs of wear.

Fig. 27

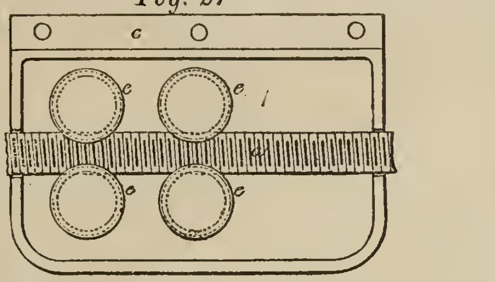
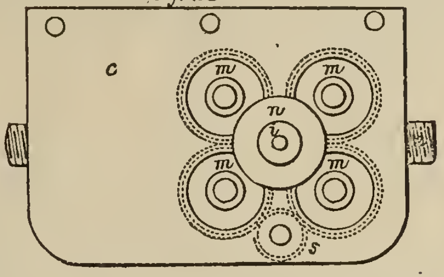


Fig. 28



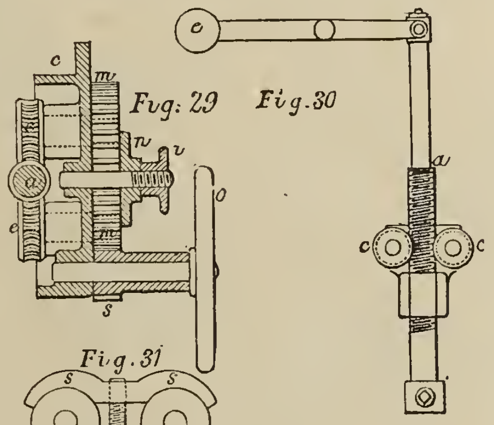
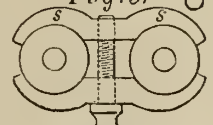


Fig. 29 Fig. 30

Fig. 31



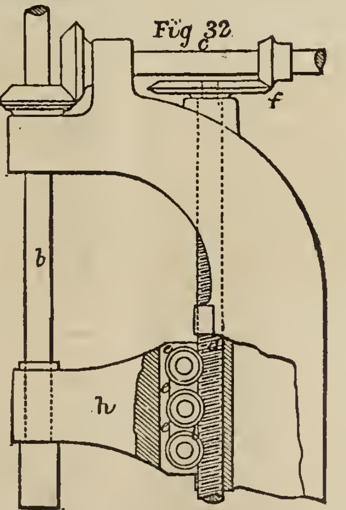


Fig 32

In Figs. 28 and 29 is shown the mechanism for connecting and controlling the tangent wheels, Fig. 28 being a front view of the apron, *c*, and Fig. 29 an end view partially in section.

Referring to Fig. 28, *m, m, m, m* are spur wheels keyed on the outer end of the spindle wheels, *e*. The upper and lower wheels gear together in pairs, and the two lower ones are in turn connected by the pinion, *s*. This pinion, besides connecting the train of gearing, answers for the hand traverse motion, as shown in Fig. 29, a hand-wheel, *o*, being attached in the usual manner.

The method of feeding will be understood from Figs. 28 and 29. The friction plate, *n*, is made to partially cover the four spurwheels, *m*, so that when screwed down by the thumb nut, *i*, it presses the wheels, *m*, against the flat part of the apron, *c*, causing friction and retarding the movement as before explained, giving a corresponding motion to the carriage. This motion is sufficiently strong for feeding purposes, but will yield if the carriage meets any positive obstruction.

In most cases a common open nut is added for use in cutting screws of coarse pitch, or in cases where there would be danger of the wheels slipping. As applied to an engine lathe this feed gearing has the following functions: (1) It acts as a rack and pinion for the hand traverse motion; (2) it acts instantly at any point, the feed starting as soon as the nut is turned up, and with a degree of force corresponding to that applied to the screw; (3) it answers as a friction feed, yielding in the case of accidental obstruction the same as the more complicated details employed in most American lathes; (4) it answers as a support for the screw, providing what is in effect a roller bearing and holding the screw firmly in all directions; (5) the wheel, *o*, becomes an index to indicate the starting-point in cutting screws, so that a back motion is not required, dispensing with considerable expense in overhead gearing and causing a gain of time in screw cutting. These are considerable claims to make in favor of so simple an invention, but they seem to be fully borne out in practice. Less perfected modifications of this principle of feeding machine tool slides and spindles have been previously applied, notably that of Sir Joseph Whitworth for feeding and traversing the spindles of drilling machines, illustrated in Fig. 30. In this case the tangent wheels, *c, c*, meshed into a screw-threaded spindle, *a*, so that when these wheels were retarded by friction they gave a corresponding thrust to the spindle; *a*, and when released the spindle would rise rapidly by means of the weight, *e*. A gripping clutch, Fig. 31, was applied to two disks, *s*, keyed to the axes of the tangent wheels, *c, c*, Fig. 30, so that the downward thrust could be regulated at will, the disks slipping to the extent of the difference between the pitch of the screw and the rate of feeding. The diagrams are drawn from memory and may vary in some respects from the original mechanism, but it is thought not in any essential point.

The analogy of this to the free motion previously described is wanting in several features, mainly in respect to the rapid slipping motion, which was no doubt the difficulty encountered in practical working. The slipping motion on the friction disks, *s, s*, might have been maintained between surfaces of polished metal and leather or wood, but those on the spindle, when the wormwheels meshed into the screw thread, must have proved a perishable arrangement. There would be only a line contact and the pressure too great to be resisted successfully in that manner.

In Fig. 32 and 33 is shown an application to drilling machines of the feeding mechanism described in connection with Figs. 27 to 29, the tangent wheels being carried on the moving parts and actuated by a screw, the movement of which gives the required rate of feed motion without continuous or excessive slipping.

The feeding screw, *a*, is placed parallel with the spindle, *b*, and connected by gearing with the horizontal driving shaft, *c*. As shown in the diagram, bevel wheels are employed. This with a screw of ordinary pitch will produce a feed motion too fast for drilling unless the tangent wheels, *e*, are allowed to slip with considerable speed. Tangent or worm gearing at, *f*, is preferable, so arranged that the fastest feed will suit for ordinary work. The diagram is made to illustrate the method of operation and is not intended for other use. The three wheels, *e*, are not, as in the case of the lathe gearing, connected together. The upper and lower wheels revolve on a free axis or stud. The center one, *e'*, is provided with a spindle long enough to receive the handwheel.

This wheel is employed to move the bracket, *h*, and spindle, *b*, up or down by hand, the same as with a rack and pinion, accomplishing what is called a quick return motion of the spindle, with the difference from other methods, that the range of movement is not limited, and may be 3 ft. or more if required. The bracket, *h*, is counterweighted so as to move easily, and remain at any point without fastening. The wheels, *e*, Fig. 33, are retarded by the bar, *i*, which presses on all three by means of the screw, *m*, which is employed to start and stop the feed motion. By making the stem of the wheel, *e'*, hollow, the screw, *m*, can pass through and receive a thumb-nut outside the handwheel, *g*. This is more convenient in most cases. The feed imparted by this gearing may be called one of pressure, and is for that reason preferable to a positive movement. Drilling in metal is an operation that scarce admits of a positive and uniform feed. The conditions are constantly changing; even in drilling a single hole, the drills become dull sooner than other tools, and the rate of cutting should diminish as the depth of a hole increases. Drills are liable to be obstructed at any moment by the point breaking, and the feed, if positive, would destroy the drill or break a machine if not arrested. So many objections apply to a positive feed motion for drills that a great many, perhaps most, mechanics contend that power feed is not expedient. We once shared this opinion, and we yet believe that no automatic feed at all is better than a positive one for drilling, especially when expensive milled drills are employed. The objections that apply to positive feeding are all removed by the pressure method, which is the same in fact as hand feeding.

It is a simple matter to arrange the feed motion of drilling machines to operate in this way; it requires only a friction clutch that will slip when the required degree of pressure is exceeded, but a common cone clutch with metal faces is wholly unsuited for the slipping action required. Fig. 34 shows a form of clutch that will give good service, and will slip for any length of time, or under any required pressure, without abrasion or wear. The disk, *a*, is made of leather, and should be cut a little larger in diameter than its seat in the tangent wheel, *c*, so it will drive in fast enough to be turned true in a lathe. The inner face of the disk, *e*, should be polished where it bears upon the leather. The collar, *s*, retains the wheel, *c*, which runs loose on the shaft, *m*, and imparts motion by means of the friction ring and the plate, *e*, which moves on a feather as shown. The feeding movement is stopped and started by means of the screw nut, *n*, the force upon the drill varying according to the pressure applied here. The driving power is applied by a worm. Set in the opposite position, with the shaft, *m*, vertical, this clutch is applicable to most drilling machines as now constructed.

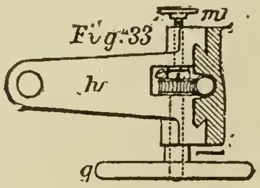


Fig. 33

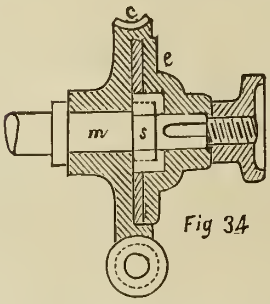


Fig 34

Looking over the whole field of contrivances applied, during ten or fifteen years past, to feed tool slides, spindles, and so on, it is much to be questioned if the result is commensurate with the cost. In the case of lathes, for example, there is no doubt much convenience gained by feeding with a rack and pinion if we compare this with a common screw feed, or screw feed as it was formerly arranged. The main difference in the two cases has already been pointed out—starting instantly, stopping in case of obstruction, and convenience in changing from slide feeding to screw cutting or the reverse. Assuming these differences to exist, there would be much in favor of applying the rack and pinion feed, but as has been in some measure pointed out, these differences need not exist.

It has been shown that a screw feed may start instantly and give away in case of obstruction. It has also been shown how a screw may perform the functions of a rack for hand traversing without danger to either the screw or the gearing that meshes into the screw, and in a chapter on engine lathes yet to come, it will be shown that the wheel changes for sliding and screw cutting may be arranged almost as conveniently as when a rack and pinion feed is employed.

Had the same amount of effort been made in improving the ordinary screw feed that has been expended on complicated and perishable rack motions, the result would no doubt have been a gain over existing practice.

NEW STEAM CRUISERS FOR THE UNITED STATES NAVY.

These vessels are to be built in accordance with the acts of Congress of Aug. 5, 1882, and March 3, 1883. They are all to be constructed of steel, of domestic manufacture, having, as near as may be (according to the tests to be provided for in the contracts), a tensile strength of not less than 60,000 pounds to the square inch, and a ductility in eight inches of not less than 25 per cent.

The dimensions of the 4,500-ton cruiser will be: Length between perpendiculars, 315 feet; extreme breadth, 48 feet, 2 inches; depth of hold from top of spar deck beams to inner bottom, 31 feet and 4 inches; mean draught, 19 feet. The vessel is to be constructed with a double bottom of 42 inches in depth, extending through the entire space occupied by the machinery, boilers, and transverse coal bunkers, over which also will be fitted a deflective steel deck 1½ inches thick, the outer edge extending about 4 feet below the load water line.

The machinery will be two complete sets of compound beam engines for twin screws, each engine with one high and one low pressure cylinder of 45 and 72 inches diameter, with piston strokes of 52 and 54 inches respectively. Each set will have one condenser, with a condensing surface of not less than 4,800 square feet, and one independent combined air and circulating pump. There will be 14 steel boilers of 9 feet diameter and 10 feet long, each capable of sustaining a working pressure of 100 pounds, with an aggregate grate surface of not less than 802 square feet, and a heating surface of not less than 20,000 square feet, all fitted for forced combustion, with four blowers of sufficient capacity therefore and for ventilating the ship. There will also be required the necessary steam pumps for fire and other purposes, and two screw propellers, each 15 feet 6 inches in diameter, with 22 feet 6 inches pitch.

The dimensions of the 3,000-ton cruisers will be: Length, 270 feet; breadth, 42 feet; depth from top of main deck beams to top of flat keel plate, 26 feet, 1½ inches; mean draught, 17 feet. The vessels are to be constructed with double bottoms 40 inches deep amidships, extending through the entire space occupied by the boilers, engines, and transverse coal bunkers, over which also will be fitted a protective steel deck 1½ inches in thickness.

The machinery will be a back-acting compound engine with one high and two low pressure cylinders of 54 and 74 inches diameter respectively, with a piston stroke of 42 inches, two condensers with a condensing surface of not less than 5,500 square feet, and two independent combined air and circulating pumps. There will be eight cylindrical steel boilers of 11 feet 8 inches diameter and 9 feet 9 inches long, each capable of sustaining a working pressure of 90 pounds, with an aggregate grate surface of not less than 400 square feet, and a heating surface of not less than 10,000 square feet, all fitted for forced combustion with blowers of sufficient capacity therefore and for ventilating the ship. There will also be required the necessary steam pumps for fire and other purposes, and a screw propeller 17 feet in diameter, with 20 feet pitch.

The dimensions of the dispatch boat will be: Length, 240 feet; breadth, 32 feet; mean draught, excluding keel, 13½ feet; and the vessel will have a displacement of about 1,500 tons.

The machinery will be one compound engine, with two vertical overhead cylinders of 45 and 78 inches diameter respectively, and a piston stroke of 48 inches, with one surface condenser having a condensing surface of not less than 3,400 square feet; an air pump worked by a beam connected with the cross-head of the low-pressure cylinder, and an independent circulating pump. There will be two steel boilers of 11 feet diameter and 18 feet 3 inches long, each with two furnaces at each end with separate back connections, and two steel boilers of 11 feet diameter and 9 feet 6 inches long, each with two furnaces, all the boilers to be capable of sustaining a working pressure of 90 pounds, and to have an aggregate grate surface of not less than 275 square feet, with a heating surface of about 6,600 square feet, all fitted for forced combustion, with three blowers of sufficient capacity therefore and for ventilating the ship. There will also be required the necessary steam pumps for fire and other purposes, and a screw propeller of 14 feet diameter and a length and pitch for a speed of 15 knots.

* * *

The Weekly Mechanical Engineer seems to be unpopular with all that have spoken and written to us on the subject. A marine engine builder, of Hamilton, Canada, paid us a visit last week and said that he considered it would be entirely unnecessary and injurious, inasmuch, from the quantity of reading matter now in the paper, one could not possibly assimilate it weekly. Another friend, Mr. James H. Reed, President of the M. E. A., of Detroit, writes that he hopes we will not make it a weekly; as it is he likes it better, for it gives time to read it fully. Moreover, it is now within the reach of all in price; if it were increased he knows many who would be obliged to drop it.

These are all good arguments, and seconded by us, but we suppose none of our friends will kick violently if we add a little more matter next year; or will they?

It is too early yet to rally for the fall campaign, but we think when the season comes we shall have steam up, and make our regular schedule time, with a notch to spare.

* * *

We wish to say that members of firms in our line, from all parts of the country, call upon us very frequently, and that their attention is often called to engravings of tools and engines on our walls. In many cases these gentlemen are buying goods, and we know of more than one instance where sales have been brought about by the pictures. We shall be glad to give our friends an opportunity to show their productions in this way, only stipulating that the photographs, or whatever they may be, shall be properly framed and forwarded free of expense to us.

* * *

The *Scientific American* suggests the use of hollow shafting for shop lines, urging, with some propriety, that it has now a great deal of useless weight. There might be some difficulty in cutting key-seats for pulleys, unless the walls were very thick, in hollow shafts.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. John Becker, 28 Oliver Street, Boston, Mass.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

BOILER SCALE.—Parties having fine specimens for Sale of Loan for Exhibition, address.
JAS. F. HOTCHKISS, 84 John St., N. Y.

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THE MECHANICAL ENGINEER.

New Series. Vol. V.—No. 13. Enlarged 1883.
New York, June 23, 1883.
Single Copies 8 Cents. $2.00 per Annum.

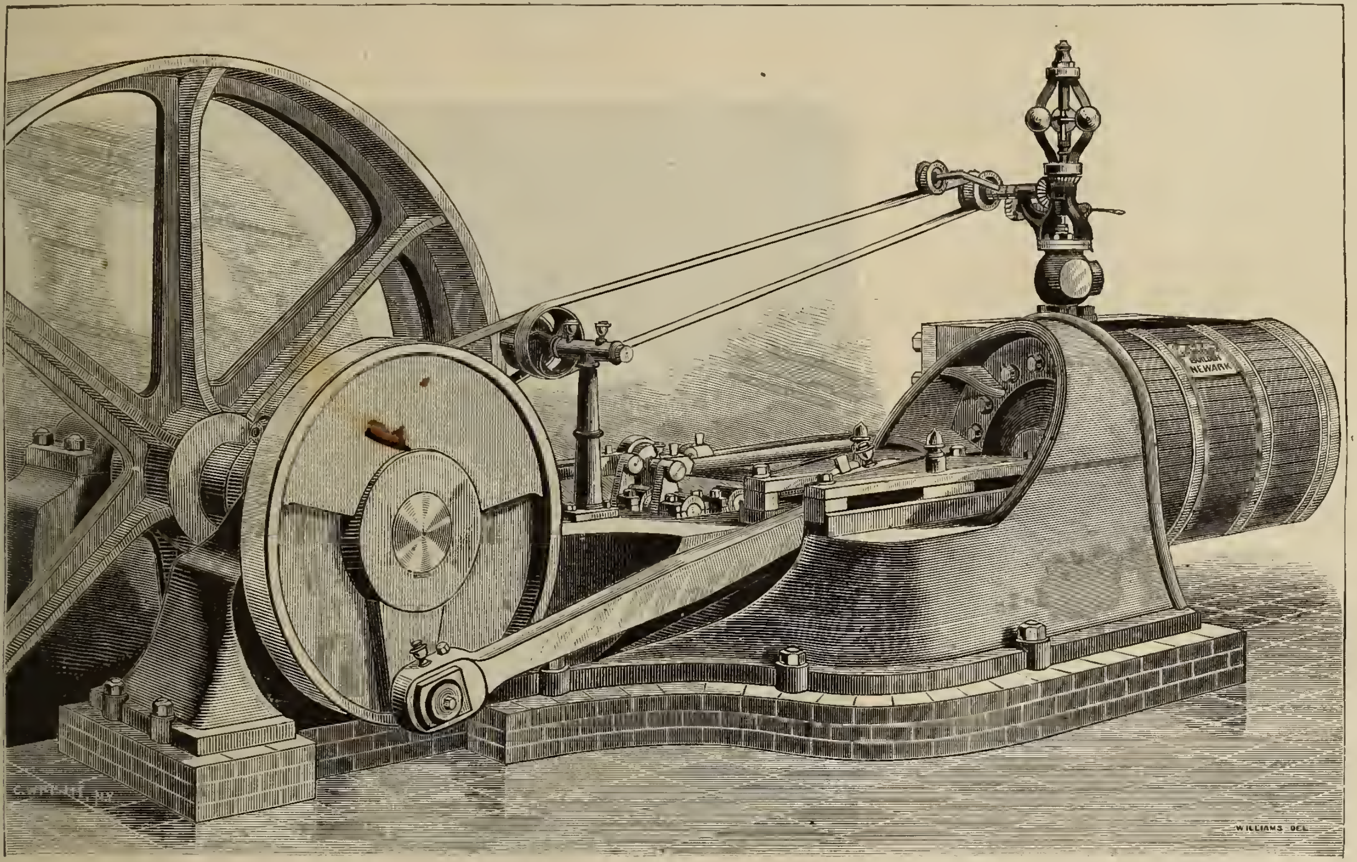
NEW STATIONARY ENGINE.

By J. S. Mundy, Newark, N. J.

Our engraving represents a new style of stationary engine, built by J. S. Mundy, 22 to 34 Prospect street, Newark, N. J., which has some excellent features about it, not the least of which is its accessibility in all parts for inspection and adjustment. Every engineer knows the annoyance and anxiety caused him by an engine which is boxed in, so to speak, by its frame, so that he can neither get at it for packing or keying, or see the wearing surfaces without a light. These objections do not apply here, and while no sacrifices of strength are made to attain the end, repairs or adjustment and the condition of the working surfaces, can be made and seen at a glance.

The cylinder is overhung, as will be noted, and the shape of the frame, peculiar to this builder, is such as to give rigidity under the strains it is subjected to. The engraving shows a throttling engine, or engine regulated by a governor, but an automatic, or a fixed cut-off, is attached, as desired by purchasers. It is intended for general manufacturing purposes, and to that end is made of the best material and workmanship.

Catalogues and price-lists will be sent on application as above.



NEW IMPROVED STATIONARY ENGINE

⁂

A curious instance of want of foresight occurred in painting the New York and Brooklyn bridge. The main structure was painted first, and subsequently the suspenders overhead, with the result of daubing the work already done so much that it had to be re-painted.

⁂

The article elsewhere printed, entitled "Fast Drilling in Metal," gives details of some extraordinary performances with drills in England. It is an achievement to drill 3,000 holes with one drill without grinding it, but some might feel that it would be all the better if it had been ground. The article will repay perusal.

⁂

The *Chicago Railway Age* appears in a new and striking head, and with a cover of a deeper tint than its old one. Its appearance is much improved, but not its quality, for that was as good as it could be before.

CLOSE WORK.

A dispatch from Canton, O., May 14 to the Cincinnati *Enquirer* tells this exciting story :

A marvelous piece of railroading was accomplished on the Pittsburgh, Fort Wayne & Chicago Railroad this afternoon, by which a fatal catastrophe was averted. The 3:41 west-bound passenger, the heaviest train of to-day, was an hour late, and the first section of a lot of west-bound freights side-tracked here was given orders to go to Massillon. Several minutes after it had departed a message was received here stating that the passenger train had left Massillon and was speeding towards Canton. A freight engine was at once sent after the departed freight train, and, by doing some terrific running, succeeded in overtaking it about two miles west of here. An engine was dispatched on a similar errand from Massillon, and overtook the passenger train. When overtaken by the messenger engines the two trains were within a few minutes of each other. Massillon is only eight miles from Canton, a run of fifteen minutes, and when it is considered that both trains had been on the road for several minutes before the error was discovered, it will be seen that it required the quickest kind of work to avoid a collision.

⁂

Some machine-shop philosopher has remarked that from the scrap heap of any given establishment a fair estimate can be formed of the mechanical ability existing therein ; arguing that the failures consigned to that machinists' "morgue," testified for or against his judgment. Our experience leads us to believe that fallacious opinions would be formed in this way, the scrap-heap being too public a place to exhibit botched jobs. The last resting-place of all such is generally under the bench in the darkest corner, with no name affixed as the author of the misdoing.

MISLEADING.

It is well known to those who have given the subject attention that in quick running engines the pressure on the crank-pin is not expressed by that on the piston. At the beginning of the stroke the pressure is greatest, but the piston, connecting rod, etc., undergoing acceleration, absorb energy, and the crank-pin does not experience the full effect of the steam. During the latter half of the stroke the steam is falling rapidly in pressure, but the piston-rod and connecting-rod are moving at a reduced speed, and therefore restoring energy, so that the pressure on the crank-pin is kept up.—*London Engineer.*

The above is liable to misinterpretation—"the pressure is kept up" is misleading. The pressure on the crank-pin, lost through expansion, is reinforced only to the extent of the momentum of the parts in question.

VERY SIMPLE.

Some extraordinary devices are originated occasionally, and the one here mentioned—cut from a contemporary where name is purposely omitted,—seems to be unapproachable :

> "A great many devices have been invented for preventing smoke, but none of them have been introduced to any noticeable extent. A Washington inventor has brought out another device of the kind, which is said to be "successful." The plan is to convey the exhaust steam from the engine, in all large establishments where the engine is used, to the chimney, forcing it in the form of spray diagonally upward and across the chimney. This is accomplished by a perforated pipe running round the inside of the chimney, with the perforations so set as to throw the spray upward to a common center. This sheet of spray, with which the smoke comes in contact, it is said, causes the carbon and other matter arising from imperfect combustion to fall back into the furnace, where it is consumed; only a colorless gas finally escaping from the mouth of the chimney. The system, it is claimed, also aids in regulating the draft of the furnace, and proves a fuel saver as well as a smoke consumer."

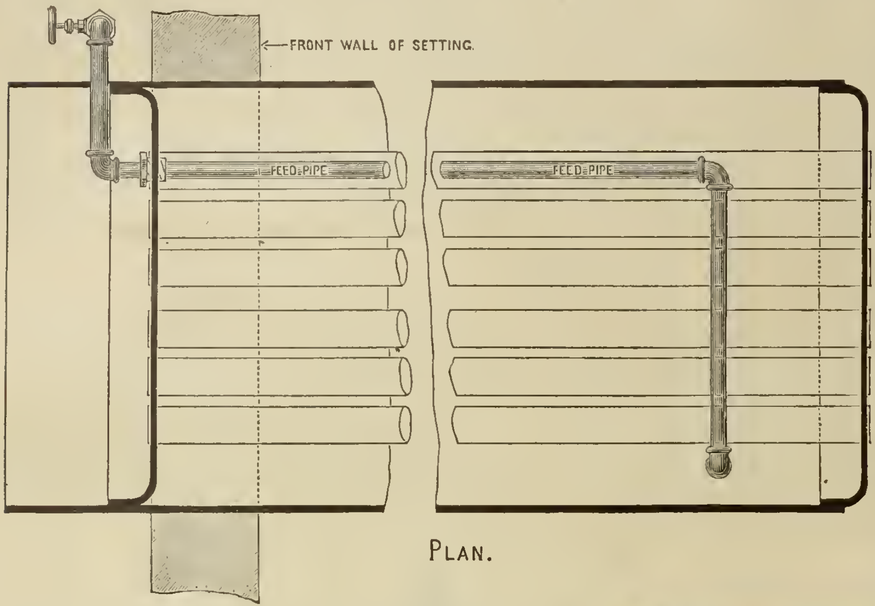
Exhaust steam will not "spray" to any great extent, but if it did, and "fell back into the furnace" it would have to fall around a good many corners, for the furnace is not usually at the bottom of the chimney.

⁂

Young men are sometimes taken to task for mistaken judgments and for errors committed through want of experience, but this is an injustice to them. A man may take certain statements upon trust, or because others say certain effects spring from certain causes, but he cannot say what will follow from a cause new to him Young men make mistakes because they are young, and so long as they do not commit the same error repeatedly should be leniently dealt with. Old men make mistakes too, sometimes.

CONSTRUCTION OF FEED PIPES.

Probably no one detail of the boiler is more widely different in plan than the system for feeding it. Our columns bear witness to this in the past volume, as many illustrations have been given of the methods adopted in different parts of the country. We append herewith some diagrams, which show the plans in use in New England generally. We take the matter from *The Locomotive,* and are indebted to it for the use of the diagrams:



"Fig. 1 is a horizontal section through the shell of an horizontal tubular boiler with a projecting front, showing the essential features of the construction. The pipe enters the front connection through the side of the projecting portion of the shell, then turns and enters the boiler through the front tube sheet, about three inches above the top of the upper row of tubes, then passes along to within about eighteen inches of the back tube sheet, then crosses over to the other side of the boiler, and finally turns downward, so that the feed water is discharged between the tubes and the shell in the coolest part of the boiler. The feed water, being compelled to traverse the entire length of this long pipe, has time to acquire a high temperature before coming in contact with any part of the boiler shell, and thus any injury to the shell from local contraction is prevented.

"Fig. 2 shows the arrangement of pipes for a battery of two or more boilers. In this case a larger pipe, from two to two and one-half inches in diameter, according to the number of boilers in the battery, is run along the front, just above the furnace doors, and the individual pipes for each boiler lead out of it. Each of these pipes should be provided with its own independent stop-valve and check-valve, and each should have one flanged joint as shown. This makes it a very easy matter to disconnect either one of these pipes for repairs without disturbing any of the others. In the cut, two boilers only are shown. In a battery of two boilers, the tee shown at B′ would have a plug screwed into its end and the pipe would stop there; for more than two boilers, the pipe would be continued past this boiler as shown in the cut at A′, and so on for any required number of boilers. The whole arrangement is very neat, convenient and accessible, and is one generally adopted by the most experienced engineers throughout the New England States.

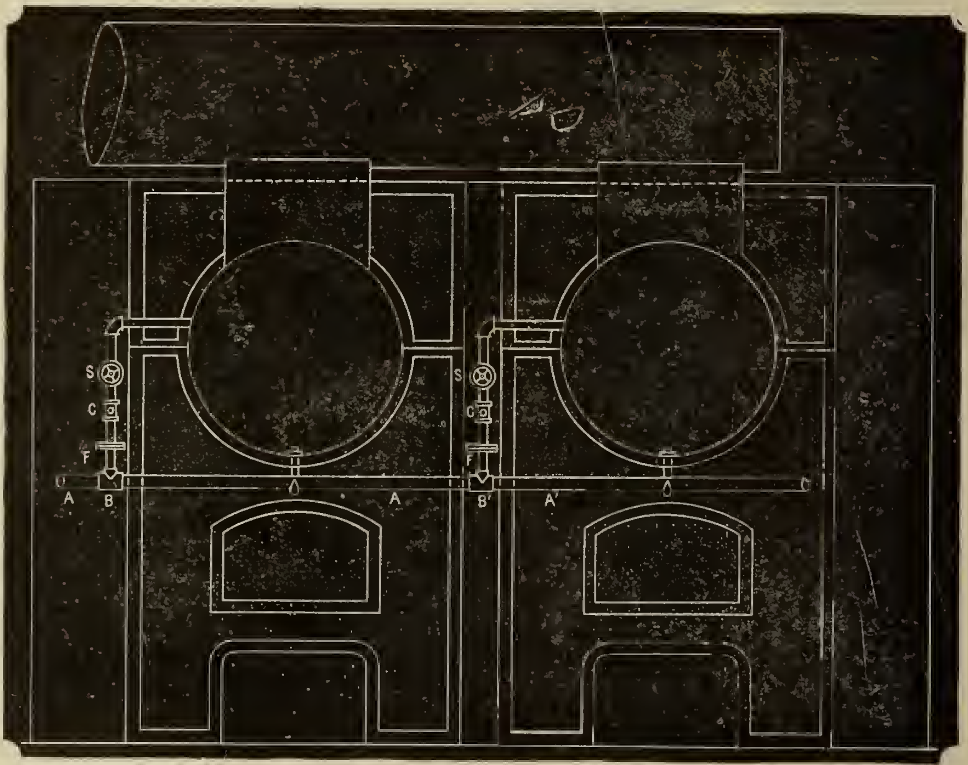
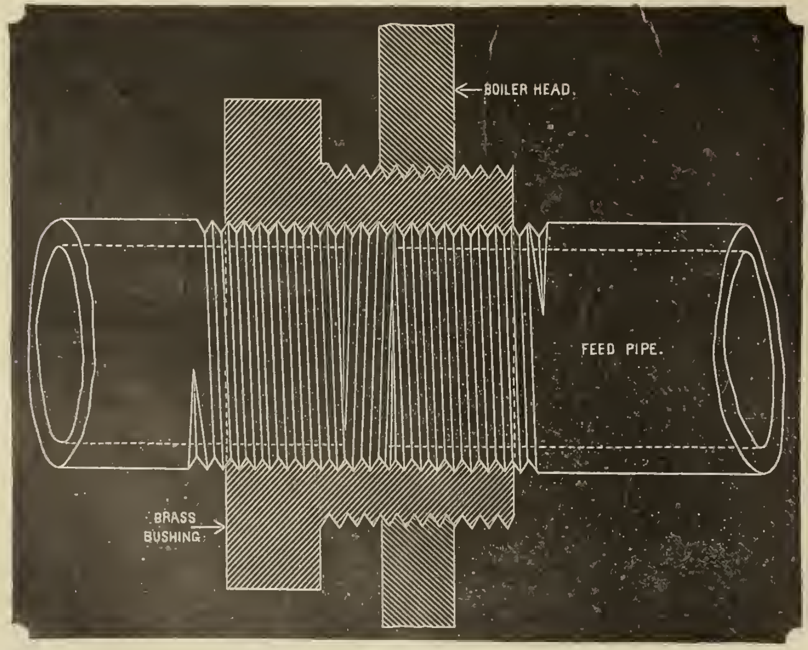


Fig. 3 shows the method of making the connection through the front tube sheet. A brass bushing is screwed tightly into the tube-sheet. This bushing is drilled and tapped to receive the ends of the feed-pipe, which are firmly screwed up to make a good joint without their ends meeting. This makes a very substantial and durable job.



Boilers made by this company's specifications are always provided with this style of feed-pipe, and in many cases where fractured plates have resulted from the use of cold feed water, with pipes simply entered into the head or shell, this arrangement has been substituted upon our recommendation, and no further trouble has occurred.

A lathe to carry a big chip must have a big spindle. Put a 2″ bar in the lathe and turn it down to ¾ths of an inch for some distance, then turn it end for end, and take a big cut on the 2″ portion. The conditions are about the same as those existing where a lathe with a small spindle has to resist the strain of cutting on a diameter many times greater than its own.

Some exchanges who deem it necessary to have technical departments compile the same from mechanical journals without credit, and attach the names of fictitious persons as contributors. A recent article in one paper of this class has the name of "Jas. Moore" as the author of an article on the compound engine, and in another paper, owned by the same publisher, it appears with "William C. Devine" as the author. This seems to be very small business, particularly as the article in question was written by neither of them but compiled from a technical paper.

◆

Evidently one English firm has great faith in the permanence and stability of THE MECHANICAL ENGINEER, for they send us a subscription for nearly five years in advance. Two years' subscription in advance from home friends is not uncommon, but the enterprise of our English friends is phenomenal.

◆

Two V-shaped blocks carried on ways, having an upright on one end, with a center adjustable vertically, form a most useful device for "spotting" shafts or other round work before it is centered. It is "as old as the hills," and much more useful in a machine shop than they would be.

◆

Suppose we have to make a tank to hold a given quantity of water, say for a tender, or any other purpose, how shall we find the dimensions? Very easily by this rule: Find the cubic contents in feet and multiply them by 6·232; after pointing off three figures from the right, the remainder will be the number of gallons it will hold.

In the above it is necessary to assume some dimensions to start with, and the cubic contents in feet are ascertained by multiplying the length in feet by the breadth in feet, and this again by the depth in feet.

◆

The weight of a safety valve ball (cast iron) can be found, when no scales are handy, by multiplying the diameter of any ball into itself twice, and the product by 1377, this will give the weight very nearly. Example of a 9″ ball: 9 × 9.=81 × 9=729 × 0·1377=99¾ lbs.

◆

Plate iron $\frac{1}{16}$th thick weighs 2½ lbs. per square foot; add double for every eighth of an inch thicker; thus: $\frac{3}{16}$th iron weighs 7½ lbs.

◆

We acknowledge the receipt of an invitation from the faculty of Cornell University, to attend the exercises on commencement week, but regret our inability to be present.

GAS APPARATUS FOR EXPANDING TIRES.

The accompanying engraving represents an apparatus for this purpose, which was described in the *Revue Industrielle*, which states that :—The use of gas for putting tires on iron wheel centers effects a noticeable economy ; but for renewing them, the cost is nearly the same as the older processes. The apparatus for using gas mixed with air for heating tires consists of a tube 1¼ inch in diameter, surrounding the tire at a distance of 1 inch to 1¼ inch, and pierced throughout its interior circumference with little holes symmetrically disposed, so that the flames escaping from them strikes the tire at three points of its height. Finally a tank connected at one point with this circular pipe receives from a reservoir placed at a certain distance a mixture of gas and air. As is seen, this is a very simple way of heating, and its use is justified when putting on tires for obtaining an expansion a little in excess of one one-thousandth of the diameter, and where the time required to reach that expansion can be utilized in the preparatory operations. But the attempt made to apply it in removing tires has been unsuccessful ; it has, nevertheless, often been necessary to cool the center with water. To overcome this, the apparatus here described has been designed. The gas burner is composed of two converging cones, of which the central one, A, receives air at a fixed pressure ; the outer one, B, conducts the gas necessary for the mixture. When the proportions of gas and air are well observed, the jet, burning but not illuminating, leaves the blue tint and reaches the rose tint within about 4 inches or 4¾ inches, the point where there exists the highest temperature.

The outer cone, A, receives the air at four points of its circumference by cocks, R, connected with a circular tube 2 inches in diameter, which itself is fed by two channels.

The second is the interior ring, B, which receives the gas likewise at four points by cocks, R¹, connected with another annular tube, of 2 inches diameter, and supplied at two opposite points with gas issuing from a meter under a pressure of 1½ inches of water. It will be understood that the cocks serve only to regulate the supply of gas and air for the thirty blow-pipe burners, C, which complete this apparatus. Observations made when this apparatus was working most favorably have given the following results :—Air pressure in the ring, A, in height of columnof water, 8·4 inch; pressure of gas in the ring, B, height of water, 0·3 inch ; consumption of gas per minute, measured by the meter under a pressure of 3·2 inch, 1 cubic meter.

Simple calculations show by increasing the diameter of the burners from 0·16 to 0.224 inch, and keeping the supply of gas the same, with a fan blower, the necessary air can be furnished to the thirty burners, provided that this blower works under a minimum pressure of 5·6 inch and supplies two cubic meters of air per minute —sufficient for two forge fires. Experience shows that a tire of 36 inches interior diameter, and weighing about 460 pounds, is raised to a temperature of 300 degrees (= 572 deg. Fah.) in eight minutes. The simple and cheap construction of the gas burner, the low cost of keeping it in order—almost nothing—and the ability to produce or extinguish instantaneously a fire, whose intensity can also be regulated, the regularity of the heat attained at all points on the tire, which is an essential matter for cast steel, are so many considerations in favor of its use for occasional work, and that which lasts but a short time.

◆

A novel form of soap has been invented at Vienna. It is in the shape of sheets, about the size of a playing-card, arranged as a book, from which a leaf can be torn as required. In another the soap-sheets are mounted on cardboards, so as to be hung up in lavatories.

◆

An engineer of a locomotive on a suburban road was so interested in racing with another locomotive on a parallel road that he failed to notice a freight train on his track ahead, and ran into it at full speed. That man must feel cheap.

It is possible to save a portion of the heat of hot water that is blown off through the surface blow by driving it into a tank with a double bottom like a steam kettle, and pumping from that into the heater. In this way the tank-water would not come in contact with the dirty water blown out. On the principle that every gain, however small, is economy, this would save something.

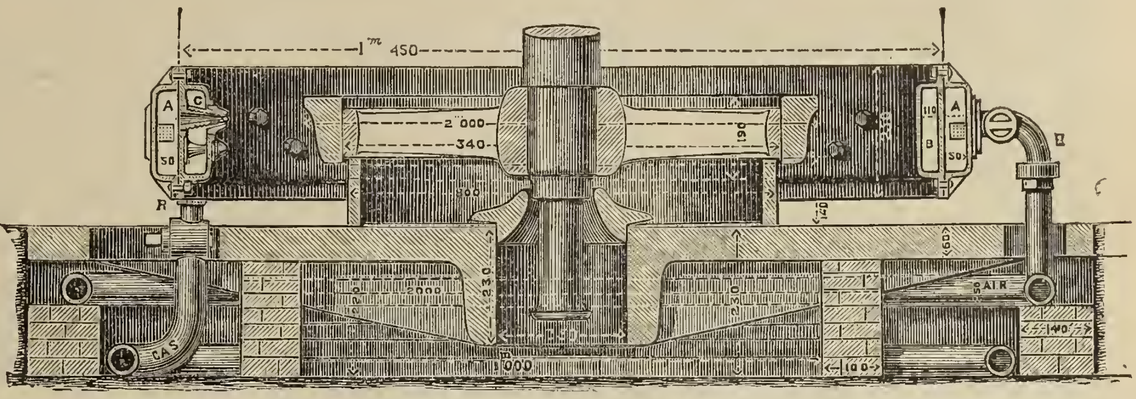
◆

Locomotive engineers and firemen are paid by the day in England, receiving on one road seven shillings, about $1.75 of our money, for the first, and four shillings, or $1, for the last.

The Rochester *Post-Express* says that a robin has been building a nest on the main frame of engine 340, of the New York Central road, which runs between Rochester and DeWitt, going east one day and west the next, ever since Sunday last, and, notwithstanding the noise and motion, has it all completed. The engineer and fireman are very proud of their feathered tenant.

◆

James Nasmyth, the Scotch engineer, claims to have been the first to superheat steam and use it in a steam engine. This occurred in 1826.



NEW FOOT LATHE FOR AMATEURS.

The engraving represents a new lathe now being put in the market by William C. Young & Co., Worcester, Mass. It is well adapted for the class it is intended for, being well made in all respects, carefully fitted and all steel in the working parts. The lathe swings 6″ over bed and takes 13″ between centers. The spindle has coned bearings, adjustable for wear in line with centers, and also a ¼″ hole through it to take wire rods of some length. The face plate screws on the lathe spindle and the cone pulley has two steps for a flat belt, which is far better than the round belt often put on small lathes. The centers are properly fitted to reamed holes. These lathes are sent out ready for work and will give good satisfaction. A list of all the articles given with it as also prices of slide rest and other extra fixtures, can be had by addressing the makers as above.

◆

The most extensive agricultural machine shops in the world are at Springfield, Ohio. There are five in all. A good idea of the immense size of one workshop may be obtained by imagining a building almost seventeen thousand feet in length by sixty feet in width, a continuous room three miles and over in length. At each minute a completely made machine is rolled from the stocks and housed or shipped to its destination ; six hundred machines from sunrise to sunset—an annual production of one hundred thousand implements.

FOUNDRY PRACTICE.

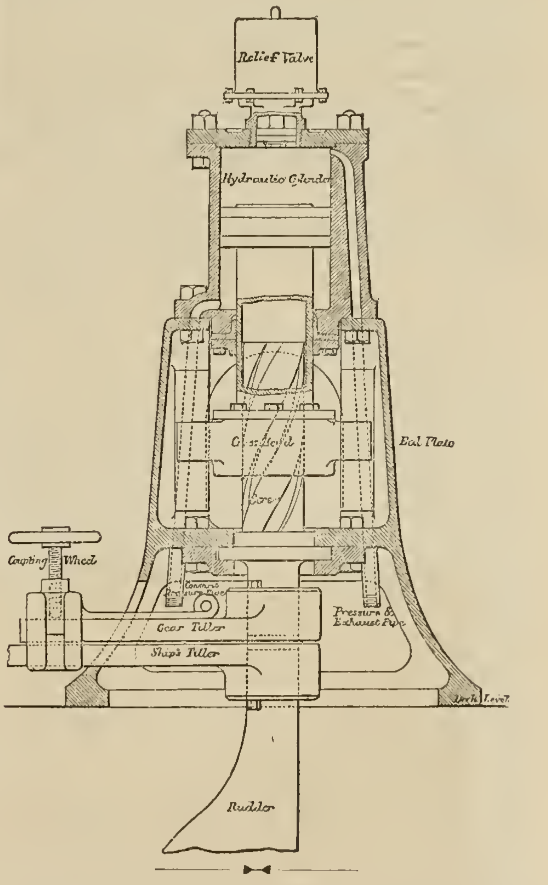
In the last article under this head the example here given was misprinted:

"Example—Pitch of screw, 2″; circumference of pitch circle, 12″; angle of tooth, 2″ in 12½″; see Fig. 20."

The circumference of pitch circle, 12″, should read 12½″.

A NEW SHIP-STEERING GEAR.

A new hydraulic steering gear has been brought out abroad, which consists of a cylinder using water at 700 lbs. pressure. A piston works in this, and the trunk of it is connected directly to the rudder-post, over which it stands vertically. A thread of quick pitch is cut on this, and a nut or crosshead fitted to it, and the rudder is turned by working the pistons up and down. The engraving, taken from *Engineering*, illustrates it fully.



◆

Professor Thurston states that the co-efficients of friction of lubricated surfaces under pressure, as given in text books, are much too high ; instead of four to seven per cent., as stated therein, he has obtained as low as one-fourth of one per cent. with sperm oil. This, he says, is the best he ever found for heavy pressures, and he has made experiments all the way from very light up to fifteen hundred pounds per inch of surface. The crank pins of beam engines on steamboats, where a thousand pounds pressure to the square inch is not uncommon, run as low as one-half of one per cent. for the friction.

◆

Copper loses strength rapidly with heat ; from zero to 212 it loses about five per cent., while at 550 degrees it loses twenty-five per cent.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

CHICAGO ASSOCIATION OF STATIONARY ENGINEERS, NO. 1.

Editors MECHANICAL ENGINEER:

Having seen lately several reports in your valuable paper about different engineers' associations, I thought I would just drop you a few lines about *Stationary Engineers' Association*, No. 1, of Chicago. Will say they are just booming, taking in new members all the time. We have a membership of about 300, after No. 2 was formed, as several of our members branched off into a new lodge, thinking there was plenty of room for them on the west side. None can be admitted to membership to either lodge until the name is read before both lodges. No. 2 is a new lodge, so, of course, her membership is small yet, but steadily increasing. She will be heard from at the next convention by an able delegate.

We have discussions on different subjects at nearly every meeting At the last, the safety valve was discussed, and drawn on the blackboard, showing the many kinds and the usefulness of the same, and how to find the weight and pressure, etc. On June 4th we give a public entertainment, with music, singing, recitations and elocution, short addresses, and wind up with a hop of ten dances. We don't have standing room for all, they have become so popular among our friends. At our next regular meeting we discuss boiler explosions, and continue the same until all have given their opinions, Our attendance averages from 90 to 150 at each meeting, so you see there are plenty to talk.

We have a conundrum which we would like to have some one answer, viz: Why is a boiler any safer on shore than on board of a boat in charge of an incompetent engineer? This seems to be the decision of the public at large, for the man to runs the boat must have a license, but the man on shore don't need any! Kind readers, please solve this, and ease the minds of many. Our association will soon appoint a committee to make arrangements for the delegates, etc., for the National Convention, and I assure you they will receive a hearty welcome by the Chicago Association.

Now, Mr. Editor, I, with many others, will vote to keep THE MECHANICAL ENGINEER as it is It is a first class engineer's paper. If you make it a weekly, you may have to do as some others do, fill it with geology, bogus philosophy and astronomy, all good things in their proper places, but engineers want a good, cheap, reliable paper. We have no time to study those other subjects It bothers us now how to figure to keep down our coal, oil and machine bills to suit our employers They pay us for that study, and should you follow others' example we would have to pay for it or stop the paper. I think the paper just fills the bill.

INVINCIBLE.

CHICAGO.

A GEARED ENGINE BREAK DOWN.

Editors MECHANICAL ENGINEER:

I little thought that the fly-wheel of that 350-horse power engine of which I wrote lately would burst, but such is the case. The power in this engine is transmitted by gears, and ever since it was started it has caused anxiety by its breakdowns; this is the third in less than a year. Some idea of the damage done may be formed, when it is stated that $2,000 will not cover the expense of repairing the crank-shaft, gears, etc. It was the intention of the proprietors to couple this engine, and it is claimed that the frequent disasters are caused by its being overloaded.

I derive much profit from reading the lectures by Mr. Williames on boiler management. I know the value of what he says concerning blowing off. It has long been my custom to fill up my boiler before six with hot water by means or an injector, and then in the morning, before disturbing the fire to blow off for a few seconds and occasionally during the day, but I never neglect the morning operation Right across the road from me is another steam boiler. The engineer complains of scale I do not exaggerate when I say I have measured pieces 9-16ths thick. Every Sunday a pailful of soda (not dissolved) is emptied in through the safety valve. I use no solvents, and am scarcely troubled with scale. Now, whether it is owing to the management or to the water, I do not know; but the water in two wells not eighty feet apart would hardly differ in quality. Both boilers are tubular, and are worked about equal, and blowers are used on each. I think it is a foolish custom to blow out boilers—for the purpose of cleaning them—with a high pressure of steam, or when the masonry is hot. I say never completely empty a boiler unless you intend to open the hand-holes and remove the scale.

I have a question to ask, which is this: After blowing off say three inches of water, I can detect no reduction in the steam pressure. I know the gauge is correct, but perhaps it is not very sensitive. How is it?

Will some one kindly describe the manner in which large stationary engines are got off their dead centers? My engine is small and easily handled, being only 20-horse power. I am entirely unacquainted with the "starting-bar."

I thank all the many friends who replied to my question of boiler-feeding. Please keep the wheel revolving and work expansively in correspondence; by no means carry compression too high.

WALTER BURDEKIN.

SOUTH FRAMINGHAM, MASS.

[There should be no loss of pressure from blowing off, for the water is surcharged with steam, which, by the slight agitation of blowing, more than makes up what is lost by blowing. No steam is lost; it is water forced out by the pressure above it. Large stationary engines are got off their centers by not allowing them to get on, as Pat might say. If they do, by chance, it is very easy to pry them off by a fly-wheel arm, if one comes handy, or possibly by the crank.—EDS.]

TROUBLE WITH AN EXHAUST PIPE.

Editors MECHANICAL ENGINEER:

Please inform me if you know of any device, or if your readers do, to put on the end of an exhaust pipe of a high pressure engine to keep back the water. My pipe is very long and goes from the area to the roof, with the result of annoying some neighbors by the spray of condensed water carried up When the wind is in a certain direction this spray is blown into the windows of a shop near by. As these are open in summer time their goods are injured. They threaten the boss with a law suit. Would a net of wire cloth over the top be of any service?

NEW YORK. J. E. McC.

[If the top of the exhaust pipe was enlarged very materially, say a twelve-inch head on a four-inch pipe, a brass wire cloth might arrest the spray, the only trouble would be a slight increase in back pressure, none at all if the area was large enough.—EDS.]

HARD BRASSES.

Editors MECHANICAL ENGINEER:

Please give proportions for a hard brass for a bearing, the hardest you know of, just as hard as it can be worked with a tool, and oblige a constant reader.

HARD BRASS.

NEW YORK

[Bell metal is the hardest alloy of copper that can be worked with a tool; its proportions are: Copper, 16; tin, 5 Send your boxes to some bell foundry to be cast; it will be cheaper than experimenting yourself, if there is only a small lot—EDS.]

THREE EXHAUSTS ON A LOCOMOTIVE.

Editors MECHANICAL ENGINEER:

An engine goes by this shop every day which makes only three exhausts to one revolution of the wheels; now what I want to be told is where the fourth one goes to.

This is a fact and no catch, for I have watched it many a time. The exhausts are uneven and sound as though the valves were set wrong.

NEWARK, N. J. R M.

[Probably two exhausts are merged in one, if the valves are wrong; that is one exhaust one side and one on the other occur at the same time.—EDS.]

ANOTHER NEW TOOL-POST.

Editors MECHANICAL ENGINEER:

Noting that you advise engineers occasionally about their business, I would like to have your opinion on a device for adjusting the tool in a lathe for center height. I set the tool in a square block moving vertically in a mortise in the carriage, and raise or lower it by a small hand-wheel and screw from below, out of the way of dirt and chips, or injury from work above. In this way I can—by a device—raise the tool bodily, or raise either end of it. Do you think this is new, and will it pay to patent it?

NEW YORK. TOOL-POST.

[We have never seen any device like that described, and cannot form any opinion as to its merits from the description given. We are of the opinion, however, that it would be very slow of sale. There are many such in the market now, but we never heard of any one getting very rich selling them. Neither have we ever found any trouble with the ordinary devices in use—EDS.]

A STIRRING APPEAL.

Editors MECHANICAL ENGINEER:

Every day we read in the daily papers of terrific boiler explosions, and every day coroners' juries bring in the old stereotyped verdict, "Low water caused by carelessness of the engineer."

That verdict is a relic of barbarism, and those who return it know no more of a steam boiler and boiler explosions "than a jackass knows of Baxter's Saints Rest" To the engineers of this country I will say: If you allow another such a verdict to be returned you are no better than accessories, for it is slander of the blackest type to say of a man that is cold in death, whose voice is forever hushed, that he had low water. All but some *fearfully* practical engineers will agree that low water is not of necessity a cause for boiler explosions

I will tell you the cause of nine-tenths of them—it is that the engineer has more work than he ought to do. In many of our machine shops he has to run the bolt-cutter, oil the main and counter shafting repair belts, and (besides doing his own firing) be handy man in both shop and yard. What has been said of machine shops may be said of many factories I know of a case where the "handy man" was up in the fourth story fixing the elevator, and the governor belt did not wait for him to get down to the basement before it made up its mind to jump the track. Results—damage, $850 It served those proprietors right, but it did not teach them a lesson No; they knew too much already. Another case: Engineer of a flour mill wanted to shut down and repair his boiler His employer said: "No; that boiler has run so long, and will run until the first of the month." Two days later that abused machine kicked the life out of both employer and engineer.

Brother engineers, over nine-tenths of boiler explosions are not caused by carelessness of the engineer, but by the cussedness of boiler owners and users. And the reports of boiler examiners and insurance companies will bear out that assertion.

When a firm will ask a man to do more than attend to his engine and boiler, and an accident happens, the facts should appear in the evidence, and the verdict ought to be in every such case, "Caused by avarice of the employer." And the employer ought to be obliged to care for the families of those who were killed or maimed. A few such verdicts as that would do more to advance the standard of engineers than all the acts that can be passed by all the legislative bodies in the country.

Now, to bring this about engineers must be organized; and then, in case of explosion in their vicinity, appoint a committee of their best men to attend the inquest, probe the matter to the bottom, and, if the fault is in the maker or employer, insist on that verdict. In no case be one to help blacken the name of the dead engineer.

GRUMBLER.

DETROIT, MICH.

BAD WATER FOR STEAM USERS.

Editors MECHANICAL ENGINEER:

We have read THE MECHANICAL ENGINEER now for some time, with much interest. We use water with a good deal of impurities in it Just what it is we do not know. We have used boiler compounds and tried different heaters, and still the scale is rather gaining on us We were told by a professor of chemistry that boiling water would deposit carbonate of lime. This might be in some waters, but it will not in ours. We read that lime water would settle all impurities in water, this we have tried on a small scale, and it will not do We have tried on the same scale, feeding in soda ash. This makes our water soft, so that it could be used for washing after it had stood long enough to settle Now we would like to know if softening the water would keep the boiler clean, and if it would be necessary to put in two cisterns, or vats, so that we could use out of one while the other was settling? Perhaps some of your correspondents have had the same trouble and know just what to do.

We use an open heater, and are now pumping into heaters about twice as much water as we use. We have an over-flow pipe about eight inches higher than the pipe which goes to pump. The over-flow goes back to the well, as we do not always have water to spare. Could this over-flow water be run into a vat, and when filled, soda ash put in, and after settling be good?

We think that some of the steam users who are readers of your paper can tell us just what to do; we are green in the use of steam, as we have always been water millers.

CANANDAIGUA, N. Y. SMITH BROTHERS & CO.

[This letter is received just as we go to press, too late to answer it in detail; we shall refer to it in our next issue.—EDS]

In answer to an inquiry, the New York *Journal of Commerce* says: If a debtor owes $500 and pays $450, and his creditor executes an acknowledgment which states that for and in consideration of this payment he discharges the said obligation of $500, he can make no further claim on the debtor. But a simple receipt for $450 "in full" will not release the $50. No debt is canceled until it is paid or discharged by an executed release. Much less will a check which states that it is in full for a certain debt, so often given with the idea that it bars the claim for an additional sum on the same obligation, have any effect in canceling more of the debt than it suffices to pay. The payee may indorse the check, collect it and sue for the balance due him.

An extraordinary instance of liberality on the part of a company is given in the *Railroad Gazette*. It says:

"The Pennsylvania Railroad Co., it is said, has ordered that the men thrown out of employment by the destruction of the shops at the Hackensack Meadows be retained on the pay-roll at full wages until the structure is rebuilt. They will also pay to every man the loss he sustained by the destruction of tools."

If this is correct it is the first instance of the kind on record.

The various communications from correspondents published in our columns reveal nothing more clearly than the fact that there are many ways of doing work and arriving at the same results. The lesson conveyed is that no one should be too positive that the plans followed by him are the only possible. It is by no means uncommon for men in high positions to feel and assert that their methods are the only ones which could have been made to work in certain cases, when palpable evidence could be adduced to the contrary.

For the ratios of cylinders of compound engines, one to the other, the *National Car Builder* has the following rule: Ascertain the initial and terminal pressures at which it is intended to work the steam, then divide the initial by the terminal pressure, the quotient equaling the number of times the steam has been expanded. Find the square root of the quotient, and as the root is to the square, so must be the area of the high-pressure to that of the low-pressure cylinder.

Speaking of pirating machine designs, the *Lumber World* says:

"I called on Bussey & Son, machine builders, and, after telling them about Robinson & Co.'s experience with copyists, they said that was nothing at all. Jones had borrowed a new machine, took it apart, sent it to their foundry and had a set of nice castings made for patterns, and then repainted the machine and sent it home."

It must have been a queer lot of castings that were made from the machine itself. Some castings can be so made, but not many, and this looks like fiction pure and simple.

The American Society of Mechanical Engineers meets at Cleveland, Ohio, June 12.

Among the papers already in hand are the following:

"The Marine Engine of the Lakes, with a device for getting them off their dead centers," J. F. Holloway; "History of the Winding and Pumping Engines of the Anthracite Regions," H. Green; "Balancing Vertical Engines," W. F. Durfee; "The Bower-Barff Process," G. W. Maynard; "Standards in Pipe Fittings," Wm. J. Baldwin; "Ingot Cranes," G. Curtis; "Spiral Springs—Compression and Tensile," O. Smith; "A New Method of Constructing a Crank-shaft," J. E. Sweet; "A New Method for Casting Flanged Pipe," J. E. Sweet; "A Note on Effect of Prolonged Stress in Iron," R. H. Thurston; "A Note on the 'Water Hammer' in Steam Pipes," R. H. Thurston; "Beton in Conjunction with Iron as a Building Material," W. E. Ward; "Cranes—a Study of Types and Details," H. R. Towne.

Other equally interesting papers are promised.

A SUGGESTION.

We note that many of the stationary engineers' associations in the country are called by different names, such as "brotherhood," "council," etc., etc. We suggest for the consideration of our friends in this line whether it would not be as well to unite under one general title, which could be proposed and considered at the next general convention. As it now stands, so many different names rather detract from the idea of unity and solidity in organization, implying to the public at large that there are scattering associations all over the United States, with but a slight tenure of existence, and with purely local objects in view. That is the way it strikes some who have mentioned the subject to us, and we lay the matter before our friends for their consideration.

STEEL CASTINGS.

Great differences of opinion seem to exist abroad—at least in England—as to the value of of steel castings. One side—the makers—asserting them to be equal to wrought iron, while others, practically engaged in making machinery, assert that there is the widest variation in the quality. This refers to large castings, apparently, for the discussion on the matter referred to crank shafts for marine engines, etc. At a recent meeting of the Iron and Steel Institute, members said:

"There were crank-shafts at work that had run from 50,000 to 100,000 miles, which had never been touched with the hammer. Of course forged steel, when properly treated, was better than cast steel, but hammering large shafts did more harm than good, because the blows did not penetrate the mass, but only affected the exterior, expanding it and putting it into a state of tension. Then the internal portions were unable to contract, and the result was a cavity in the centre, at first round, then becoming under the hammering oval, and finally star-shaped. It was beyond a doubt that small shafts should be forged, but large ones must be cast."

Sir Henry Bessemer said that he had found that there were very few views held by practical men that were not founded on fact. There was, he knew, a prejudice against Bessemer steel castings founded upon the bubbly nature of the material, an objection that could not be brought against either open hearth or crucible steel, in which the bubbles got away quietly in the long process of melting, or during the rabbling and shaking. In the Bessemer process, as carried out in the manufacture of rails, there was violent and rapid ebullition, and if the same method were adopted for making castings the oxygen and carbon would often run into the mold together and combine there with extreme agitation, the result being extremely faulty work. Such a method of working was totally inapplicable to the manufacture of castings, and Mr. Allen had shown how it must be modified for that purpose. So successful had he been that it was possible to produce a hundred castings without the appearance of a single blow-hole. Instead of dashing the two materials into the mold Mr. Allen agitated them in a ladle, allowing the chemical combination to take place there, until quite suddenly the evolution of gas ceased and the metal ran perfectly quiet. The stirring of the metal was the great point to be attended to, and if the agitation were properly carried out there would be no failures.

AN EXPERIMENT WITH FOLLOWER-BOLTS.

We witnessed a few days since an interesting experiment in relation to follower-bolts. An engine that had recently been fitted with new pistons was detained because the lugs for the bolts cracked when the bolts were screwed in. The metal around the bolts was not as heavy as usual, and the fit was tight. After screwing the bolts in about two-thirds their length, the lugs cracked lengthwise. The following explanation of the matter was offered by an old machinist: The bolt when screwed down is a tight fit in the threads, because the air beneath is compressed, the pressure thus created being sufficient to burst the lug: The apparent tightness of the fit is due to a great extent to the resistance of the compressed air. To prove this he took one of the bolts, and with a file cut a notch like a key-way in it lengthwise, after which he screwed it in with comparative ease with his fingers, the notch allowing the air to escape. To prevent follower bolts from rusting they are usually oiled; but as lard oil develops an acid, the bolt frequently corrodes and twists off, when it is necessary to take it out. If, however, the bolt is smoked or rubbed with plumbago, it will come out with no signs of corrosion, even when it has been in place for years; the philosophy of which is that soot or plumbago is largely composed of carbon, which is practically unaffected by the changes which cause lard oil to corrode when heated.—*National Car Builder*.

SOMETHING ABOUT ASBESTOS.

Some minerals take the shape of long, needle-like crystals, lying side by side like hairs or fibres. There are a multitude of such minerals, but the most remarkable are the different varieties of *asbestos*. The southernmost extremity of England is a rocky mass of beautiful variegated mineral, called *Serpentine*, smooth, shiny rock, streaked with rich green, purple, crimson, and cream color; very compact, yet soft enough to be turned in a lathe. In some parts of this are veins of silky fiber that anybody unacquainted with would pronounce to be vegetable fibers or the web of some kind of silkworm, but such is not the case. It is as truly mineral as the soapstone lying by its side. One mode of showing this is to attempt to burn it. It resists fire with remarkable obstinacy, more so than granite itself. But Cornish asbestos only occurs here and there in small quantities, and getting it is somewhat costly. In Piedmont and some parts of Italy it is found in larger accumulations, and fine qualities, with very long fibres, have been imported. The writer has seen samples in which the fibres were about two feet long, quite straight, and lying together like closely compressed carded wool. These fibers are sufficiently flexible to be woven into fabrics resembling woolen cloths. Quite an old experiment is that of making a bag purse of this material, filling it with money, then throwing it into the fire, and withdrawing the purse and contents red hot and unscathed; the only risk being that of melting the coins, which may happen at a temperature incapable of injuring the purse.

More than a year ago a company made a display of fireproof paint, manufactured from asbestos. Linen, cotton and gauze fabrics were partly painted and fire applied to them. The unpainted parts blazed away to tinder, but the flames stopped on reaching the paint, those portions with it remaining uninjured. The next experiment was made with blocks of wood. some painted and others not painted. These were both cast into the same fire. The unpainted blocks were entirely consumed; while those which were painted resisted the action of the fire for a long time, until some blisters were raised, and the fire penetrating these parts finally burned the wood within, but the coat of paint remained.—*Oil Trade Review*.

DRAUGHTSMEN.

It may be said that to no class of men is the engineering and mechanical world more indebted for progress than to draughtsmen, and yet how small is usually the credit allowed them. There are, however, "draughtsmen and draughtsmen." There are those for whom the name "draughtsmen" is almost too comprehensive. Happily, this is only a very small proportion of the whole, and the majority are men for whom the name is too limited—who are, in fact, mechanical engineers in every sense of the word. To fulfil their duties satisfactorily, they must be such. They must know every operation which every part of a machine will have to undergo during its manufacture, and all the conditions under which it will work when in the finished machine. These requirements demand an amount of close observation of the practical departments of engineering, together with a thorough training in theoretical investigations, which, generally speaking, make them men of more than average ability.

As we have said, draughtsmen, as a rule, get small credit for their share in an engineering achievement, and yet it is, in the main, their ideas and their instructions that have been carried out throughout the work and its execution. The manager, or perhaps the foreman, is looked upon as the man on whom to bestow praise, while the plodding draughtsman, who designed the work perhaps months or years before its completion, is entirely forgotten, although the talent displayed in his department may be much more worthy of eulogium than any special tact shown in the execution of the work. It must be understood that we do not wish to underrate the value of managers and foremen, whose assistance cannot, by any means, be dispensed with, and whose practical abilities must in every case conduce to the perfect accomplishment of engineering work; and, further, we do not forget that in many establishments the managers and employers are practical men, who give valuable practical assistance and take an active part in the drawing-office work; the draughtsman acting, in some respects, under their instruction. The suggestions made by them, however, are often, from limit of time and other causes, necessarily of a broad nature, and it is left to the draughtsman to use his ingenuity, practical knowledge, and powers of discrimination in "getting out" the details, which, as a rule, constitute the most intricate and vital part of the work.—*The Mechanical World*.

THE

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

CLOSE OF VOLUME V.

This issue closes the current volume, and we think it will please our friends and supporters to know that, aided by them, THE MECHANIDAL ENGINEER is in a far better condition today than at any time since it was established. Even in this dull season, good lists of subscribers continue to come in from the most unexpected sources, and we feel that our hopes of establishing a paper addressed to the masses, to workers everywhere in our line, are in a great degree realized.

What we have done is nothing to boast of, and we do not wish to be understood as calling on the world to witness a great event. We are satisfied in having a paper that appeals to and supports the best interests of all concerned in manufacture and care of steam engines. It is for this that our enterprise was originated, and to which it will be mainly devoted; and it is to this large class that we look for support.

We think one reason for our success with our connection, is the palpable evidence THE MECHANICAL ENGINEER gives, in every issue, of genuine sympathy with all that affects those whom it addresses. Not alone the mere driving of a rivet, the threading of a bolt, the boring of a cylinder, or the cleaning of a boiler, but with every incident and detail of the lives of men, who, though occupying humble social positions are possibly, the base on which all social and political fabrics rest. Workingmen are not deceived by fictitious sympathy, by fair words, by fine promises. And it is not necessary to tell them in so many words that one is well disposed toward them. They know it intuitively—by instinct--they scent a friend in the air, and once satisfied that he is worthy of their esteem, they are for all time.

It is the atmosphere of sympathy which surrounds THE MECHANICAL ENGINEER which has made it possible, for it knows of its own knowledge their disabilities, and the needs of its friends. It rose from the ranks itself; it has been a high private, and in the years gone by, stood shoulder to shoulder in the body and in the spirit, with a great many of its supporters. How much we owe to these friends can never be said, and we shall not make an attempt. Encouraged by them in every way, material and spiritual aid and comfort, we have passed the roughest portion of our voyage and are in sight of land.

Perhaps it is a weakness to confess it, but we feel deeply in writing these words, for although the mere fact of sighting port is something, the agency by which it was accomplished is far more to us, Our vessel that we embarked in was seaworthy, but not very strong, to cope with all that it had to pass through; but those who had faith in us, threw us a rope occasionally, helped man the pumps when we sprung a leak, and by the efforts of all hands, have floated us through.

We are not unmindful of the chances of trade, or the exigencies that arise in even the most prosperous business, but we are warranted in our expressions from present aspects, and do not hesitate to inform our friends of the success of their efforts in our behalf. It acts upon us as a stimulant to constant effort, and we think that with the year 1884—if we should be spared—that we shall have a paper for working engineers and their comrades in all lines connected, that will be worthy of their continued approval.

THE AMERICAN STANDARD OF PRACTICAL WORK.

It is only within a very few years that much attention has been paid to what we may call mathematical exactness in practical work, that is, the every day work of the shop, but the advent of new firms with reputations to make, and the existence of new tools or instruments for measuring, has given an impetus in the direction named with the best results. Old mechanics remember the introduction of Whitworth gauges to this country, and the cynical comments of the elect upon them. They can also recall how slow they were in making progress. It involved too much overthrowing of old prejudices to succumb to them at once, and their adoption was confined to a very few establishments. Even these used them only occasionally.

The first popular movement toward closer measurements and finer work was the adoption of steel rules and scales. Prior to their advent few mechanics had ever seen any closer division of an inch than the thirty-second part of it, and these divisions of fiftieths and one hundredths seemed marvelous. But they did their perfect work—these tools—for they brought straight to the comprehension of every man the value of infinitesimal degrees. When this was recognized it was only a question of applying the knowledge so gained to the public good.

What is the public good in this matter? What have fine measurements to do with dollars and cents—the only material advantage the public feels? They have everything to do with it, for from the systems now in vogue have arisen a class of steam engines and machine tools that have no parallels anywhere in the world. We say that the general character of machines built in this country, by leading firms, are not approached by any similar elsewhere. We base our judgment upon specimens here of leading firms abroad, whose productions seem to be a quarter of a century behind as regards the workmanship demanded of American tool-makers. It is the same with steam engines. The actual hand workmanship upon them—the draw-filing, the finish in corners, the flat surfaces, and the curves turned in lathes, the fillets on connecting rods, for instance, and on valve stems where there are knuckle-joints or eyes in them; the finish of the bright work generally, in all these details the work does not compare favorably with American machines of a similar class. In making these remarks we are wholly unbiased as regards nationality. Such a consideration has no weight whatever with us. If the facts were on the other side we should call our countrymen to account, and tell them very plainly that their work was not so good as English work, for instance. In the Southwark Foundry and Machine company of Philadelphia there are a lot of English lathes and planers brought out by Charles T. Porter two years ago, because no American tools could be had. We were told by the men in the shop that these tools had to be overhauled in many respects before they would do what was required of them. In comparison with American machine tools in the shop, as regards convenience, ease of operating and noiselessness, they were not to be mentioned. The gears were uncut, and the result can be imagined.

Of course, our remarks will be charged in some quarters to the account of "boasting," etc., etc., but we notice in a recent English technical paper some in a similar strain in favor of their own. All we can say in the matter is, that one who is an impartial judge has only to see the work of both countries side by side to form an opinion.

The finish—not mere polish be it remembered—on American machines and tools is far better than it was a few years back, and it continues to improve. A friendly rivalry has sprung up, and the works of leading firms have raised the standard of all. What one firm have done in this matter of a standard gauge system—the Pratt & Whitney Company, of Hartford, Conn.—may be, in some degree, comprehended from the quotation appended, from a paper by Mr. George Bond, on the subject previously alluded to:

> "In the case of a four-inch hardened steel end measure gauge experimented upon, the coefficient of expansion being nearly one one-hundred thousandth of its length, one degree of change of temperature from that maintained in the reference bar, introduces an error of nearly one twenty-five thousandth of an inch in the total length, and hence, as a change or inequality of five or even ten degrees might be easily overlooked, the four-inch gauge would be found to be from one five-thousandth to one twenty-five hundredth of an inch too short when equality of temperature is restored; when it is asserted that an actual variation of so minute a quantity as *one thirty-thousandth* of an inch, and even less, can be readily detected by any tool-maker familiar with the use of an ordinary micrometer or a close gauge, the importance of keeping *within* this limit is apparent,—of course, this shortening effect is not so marked in smaller sizes, still the ratio is the same, and this error must be carefully avoided."

In a discussion which followed the paper alluded to, Prof. Eggleston said:

> "I do not know whether the members of this Society are familiar with the fact that in 1875 the Institute of Mining Engineers appointed a committee on standard gauges, and that committee came to just exactly the conclusion which is expressed here, that diameters or linear measures ranging in fractions of a millimeter or an inch were the only gauges which were standard or could be standard. It is a peculiar gratification, since a large part of the work fell to my hands, to see that idea so fully sustained. It is a matter of a great deal more importance than perhaps would appear just now. I have heard recently that the English engineers are again agitating the question of standards, and are going back to the old caliper idea. I think this is really a retrograde movement. Most of you may know the fact, but we discovered in the course of our investigations, that in a dozen standard gauges, so-called, of the fixed patterns out of any package, no two of them will be alike."

JOHN ERICCSON.

The veteran engineer, John Ericcson, is still engaged for twelve hours daily in the profession in which he has made a world-wide reputation.

John Ericcson is nearly eighty years of age, but hale, and so vigorous is he that he can accomplish more than men of half his years. His habits are most methodical. Upon rising in the morning he rubs his skin briskly with dry towels, following which he takes a cold bath, in summer using crushed ice. Then come gymnastic exercises of a vigorous description. When his system has recovered its normal temperature, Ericcson breakfasts upon eggs, tea and coarse brown bread. Then comes work, and it is to some purpose.

It is not so very long ago that we interviewed him in regard to a new propeller we had devised—a true screw—with a peculiar form of blade. He accorded us a patient hearing, though he said he had invariably refused to give an opinion on devices of any kind, for such demands were so numerous that he would have little else to do.

When our idea was explained he said, with great emphasis and animation, that the screw propeller could not be improved in any way. "What are you trying to do, sir? Do you know what you are trying to do? Here is an instrument with scarcely more surface than that door" (pointing out the large parlor door) "which drives an ocean steamer fifteen miles an hour—a true screw, sir. Do you think you can beat that? No, sir; you cannot beat that. You cannot get any more than a true screw will give, and that is all about it."

The wheel we showed Captain Ericcson was about four inches in diameter, driven by a small engine ¾ of an inch cylinder by 1″ stroke, and weighing one pound and a half complete. This drove a model hull 48″ long by 8″ beam by 5″ mean draught at the rate of nearly four miles an hour.

Captain Ericcson was much interested in the model, and asked how fast it had been driven; and when we told him, he was kind enough to say that it was a wonderful speed—that he had never been able to drive a model faster than three miles an hour.

These reminiscences of Captain Ericcson are brought about by the presence of the model-wheel in question, which lies before us on our desk. In outline—projected vertically—it is very similar to one made by Thorneycroft, and patented by him. Ours was made long before that, however.

ENGLISH LOCOMOTIVE ENGINES VS. AMERICAN.

A recent number of the *London Engineer* contains an article upon English and American locomotives, from which we quote a portion elsewhere.

So far as it goes, our contemporary makes out a case for itself, which is to prove that English locomotives are superior to American in point of economy in fuel. It proves this by erroneous statements as to the construction of American locomotives, and by wholly omitting in its estimate, any mention of the amount of work done. It says, loosely, that before a fast train in England goes out, the fire-box contains 995 to 1,120 lbs. of coal, and that in a run of fifty miles no more is put in. This is a consumption of only 22½ pounds per mile run, a rate it is needless to say, we have never yet heard claimed by even English engineers for English engines.

American locomotives do not admit all the air through the grate, as the *Engineer* might have seen by reading accounts of American engines. It has read superficially if it has not remarked the hollow staybolts in the fire-box walls over the grates, and as far as admitting air through the fire-box door, we are not aware that it it is an exclusive English custom, though our own engineers do not regard this as good practice, for the reason that it is very difficult to regulate the volume, and very injurious to the boiler.

It seems to us disingenuous to assert that English locomotives, as a rule evaporate 10 lbs. of water per pound of coal. Instances may be cited, possibly, where this has been done, but it would require more than a mere assertion to make us believe it to be general. Questions of relative economy of locomotives of different countries are not settled by stating in round terms what either is capable of. Efficiency is largely a measure of work done, and until this is settled in foot-pounds, it is idle to boast.

In another part of the same article the *Engineer* says:

> "He who gathers his knowledge of American opinion on technical matters from the columns of the United States press, will be certain to form a very inadequate and erroneous conception of its tendency. The United States press, as a whole, sometimes without justice, sometimes with sound information and sometimes without, systematically exalts all that is American, and persistently decries all that is not."

The first four lines of this quotation are so obscure that we cannot tell what the writer means. In no country that we are aware, is opinion on technical matters derived from the press. This institution does not manufacture opinion, it reflects it, and he who cannot form a judgment, or observe the current from what is written in the the technical papers, in this part of the world, must be deficient.

It also strikes us, on reading the *Engineer's* article, that where it speaks of American papers persistently decrying everything that is English, it furnishes a scourge for itself, for it seems impossible for an Englishman to comprehend that mechanical wisdom does not die with him.

PROFESSIONAL COURTESY.

The attitude of some men who make experiments with steam engines towards working engineers who assist them, is characterized by an offensive bearing and manner, as though they considered themselves quite superior beings. We have observed this, and heard remarks that have been passed upon the qualifications of working engineers by these would-be experimenters, which indicated that they held a very high opinion of their own merits. A well-known man of the so-called "professional" class made in our hearing some very sweeping remarks of the kind alluded to, and spoke of his assistant in a late experiment as "a very ignorant man," but later on in the conversation, having occasion to speak of the Czar of Russia, he designated that individual as the See-zar, which led us to feel that "ignorance" was, perhaps, only a comparative term after all, and that a man might know something of figures connected with the performance of steam engines, but so little about the machine itself and its management, that he would ruin it in a week if left alone with it.

Depreciation of the abilities of others, in any given line, is no advantage to any. It is only fair to give every one his due. While a man may be quite unlearned in abstract science or mathematics, he may be well versed in the practical management of a steam engine and boiler, and one is just as much education as the other.

Two men have studied in different branches, and in different directions; one with his head and a pencil in his hand, the other with his head and a hammer and chisel, or a starting-bar in his hand. Each has acquired certain information which can be made mutually beneficial, but, in too many cases, the man with the pencil seems to think engineering wisdom rises and sets with him.

NO EXCUSE FOR THEM.

An epidemic of boiler explosions seems to have broken out again, for the press dispatches are full of reports of such occurrences, all over the country.

There are still many persons extant in the world who persist in regarding boiler explosions as inevitable and unaccountable, and where such persons have charge of boilers there is some foundation for their belief. That is to say, though perhaps not inevitable, they are not unaccountable, for it is very easy to predict what will happen when a careless or indifferent man is placed in charge of a boiler. The recklessness is not all upon one side by any means, for a large part of it should attach to the steam user who hires an unqualified person simply because he can get him at a low rate. Boilers will not "blow up" of themselves. Properly cared for and inspected, a steam boiler is just as safe against explosion as a steam engine, and it is through the lack of these precautions that lives and property are destroyed.

Some day this matter will be better understood than it is now, through the constant labor of such papers as THE MECHANICAL ENGINEER and others, and the spread of public opinion upon the subject. There is no excuse or reason for a boiler explosion other than gross carelessness and recklessness, combined.

GRADUATES OF TECHNICAL SCHOOLS.

The substantial advantages accruing from a course of study in a technical college are thoroughly appreciated by manufacturers, who see in these young men assistants of great value. Graduates of technical colleges are in demand all over the country, for they have gone through a preliminary course of study in the colleges, which renders them of great service in actual manufacturing. We are cognizant of many young men who have graduated from technical schools, who are now occupying good positions, and are held in esteem. The number of these increases constantly, and no capable young graduate need have any apprehension as to finding a situation when he is fit for it.

In this, however, as in every other station in life, it is a question of fitness. There are graduates and graduates, and the mere fact of having been through the course is not in itself sufficient to establish a young man, but if he establishes a record as a student, he will find manufacturers very willing to give him an opportunity to show what is in him.

LITERARY MECHANICS.

It is with pleasure that we note the advent of another "practical man" in literary work. A mechanic who has written some excellent articles in a desultory way has turned his back on the shop, and taken up the pen instead of the hammer and chisel. We make a note of this, for it is only the forerunner of many such instances to come. Mechanics should write for mechanics. In that case, there is a chance that the number of humbugs in technical literature will gradually die out, and their places be filled by worthier men.

If, now, there could be a syndicate formed to suppress mechanical items—stock in trade—that have become desiccated by years of use, and attenuated by constant attrition through years of vagabond existence, another great good would be apparent. We never see that item about the Messrs. Serpollets' "invention" of the spray boiler without a shudder; it is perennial. It arose years ago, to our knowledge, but it still survives; not in our pages, however.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXV.

At one end of our premises is, by courtesy, a pattern store-room; for want of a better place, we have kept what few patterns we run, or need, in a small room off the main shop. I was in this place the next morning after the conversation narrated in the last letter, hunting for a pattern. Of course, we have a "system" and a book, wherein the shelf is numbered and the pattern ditto. This is simple, not complex, and works first-rate every time, except when the pattern is wanted at once, then it is *found* wanting. Reason: it is somewhere else, probably over in Slagtown, in a pattern store-room devoted to their system, marked with their marks, and stored in their store. That is the fate of all patterns which go out to be cast. They come back when they get home, which is seldom. It seems, too, while I am on this heat, as though the mischief possessed all moulders who work on jobbing patterns. About one moulding seems to ruin a good pattern for life. What they do to them, goodness knows; but they do something awful. Many of them, I judge, are rapped with a sledge and afterward soaked in a mill-race for a couple of days; in no other way can I account for their be-slivered, yawning condition. Joints that were perfectly sound come back laughing in one's face; draw-iron plates are torn out by the roots; core prints are knocked off, and either missing entirely or nailed on with spikes. Persons who have never had any experience with an average country foundry may think this is exaggerated, but I know what ours has been and doubt not others have had the same.

I say I was in this pattern store-room inwardly raging, because it always puts me out of temper to look for a thing, when I heard Miles and Lamb talking over their piece-work job. They didn't know I was near by, and I didn't tell them that I was. They were arranging how to rig up to do the work. Lamb was the youngest, and seemed to think that all rigs were a nuisance. He argued that it took more time to fix the work in place than it would to just hold it in the hand and go ahead, but Miles speedily convinced him that he was in error.

"That is no way to do jobs in the lump. We shall be left unless we count seconds, and we lose more time holding on to the work, to say nothing of adjusting it, than we would to drop it right into a fix bolted on to the drill press platen and feed away. The eye to be drilled should go chock up against a V in the end, and as the bosses are all the same size, the holes will come exactly the same distance from the end in every one."

"Yes," said Lamb, after a minute, "but it will cost like thunder to make such a thing. We'll be ten dollars out on the rig, and we won't lose ten dollars' worth of time without it."

"Ten dollars! ten grandmothers! What's the matter with you? Do you think we're going to make a fancy brass casting finished all over? It won't cost a dollar. I can make a pattern for it, noontime, in half an hour, that will do for one casting, and the casting itself will cost about eighty cents. That's all the ten dollars there is in it."

"Gosh!" said Lamb, "you're a man of business, Miles, ain't you? Go it for the casting; I am on it."

"Will we want twist drills or flat?" said Lamb.

"Who's going to buy twist drills for us? We have got to find our own tools. We can't afford them; besides, you will get to running the feed down jam on to the work with a whirl and fetch up all standing; that don't do with twist-drills; they don't come in here. No sir. We will get a lot of drills ground up ahead with a slight lip on them, and just rip those holes through that wrought iron like walking through a cheese."

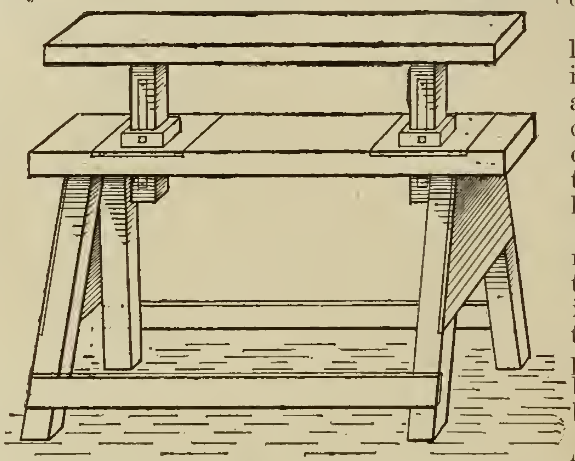
"I never took a walk through a cheese," said Lamb, "and don't know how fast that would be, but I see we can't use twist drills and pay for them ourselves; but let's go out and see if we can't find a casting in the scrap-heap that we can use without making a pattern for one."

"You can't do it," said Miles; "if we didn't want one we could find just the thing itself, but as it is we shall find everything else." But they both went out to rummage over the make-shifts in that machinists' waste-basket—the scrap-heap.

The pith and point of all this—the moral so to speak—lies right here: What is the reason so many firms and shops in the country utterly ignore the benefits to be derived from doing days' work on the same plan that these young men devised for doing piece work? that is, getting all ready first and then putting it through systematically and speedily, with no unnecessary handling or roundabout do-it-over-twice methods? Observation convinces me—and our own experience as well, that there is twice as much hand-work as head-work in the average machine shop, and that the way to make more money is to think more. The article entitled "Think," in the last issue of THE MECHANICAL ENGINEER, struck the bull's eye. Its sentiments or expressions are the same as mine, and I never go out around the country but that I see money kicking all around the premises in the shape of inefficient, make-shift devices, that are not only wasteful but positively exasperating. Last week I had occasion to go over to the parties who ordered this bolt drilling job of us, and there I saw a man drilling some bridge girders or straps, or something of that kind. The iron was 10′ long, $2\frac{1}{2}''$ wide, and $\frac{3}{4}''$ thick, and he was putting $\frac{3}{4}''$ holes in it three inches apart. I stood and watched that man. He had a common horse to carry one end of the long bar, and, as the horse was not of the right height, he had a lot of blocks to make it so. It needed about a foot to bring it up level, and this foot was made up of one three-inch block, about as square as a stick of cord-wood. On top of this was another that had been used to drill on, and was full of holes and true no way, the rest of the blocking was made up of old straight-edges and anything that came handy: the whole topped with a piece of sheet iron, to make the bar slide easy on the blocking! I waited till one hole was drilled and the work had to be shifted to see what our friend at the drill would do, and he did what might have been expected from a man who would invent such an edifice to work on. He pulled the bar towards him, and the blocks canted over a little but didn't fall; they were not quite ready for that yet. As soon as the drill got fairly started—of course it ran out about a sixteenth—down came the whole underpinning, the drill jammed and broke off, and the genius who devised it said: "D——m——n!"

After which he went to work and raised the same old crazy superstructure again, only the next time he shifted the work he had sense enough to go to the far end and hold on to the blocking with one hand while he shifted the bar. The man wasn't to blame; he probably didn't care. He was paid for ten hours a day, and it was all the same to him whether he put in that time piling up blocks or drilling holes, and breaking off drills in them. But what shall be said of the management where such a thing is possible? Nothing shall be said, but a good deal thought.

One result of my visit—and this incident—was a hint to provide for our own use a simple adjustable horse like this. It is the handiest thing in the world, for no horse is ever of the right height; it is always too high or too low; if there are only two out of use those are sure to be uneven in height. Six inches is the least possible difference in horses out of use; generally they vary about a foot. Then comes the skirmish for blocks, and wordy warfare as to whom they belong to, when violent hands are laid on them. This business cures all that, and though the cost is something, it is not as costly as blocks and botch-work, and curses. It is probably as old as the hills, but I never saw one before, and am sure it is worth all it costs in every shop.



The value of good tools and stable fixtures, as far as they can be provided, cannot be set down in dollars and cents, but they exercise the greatest influence on all concerned, and they mean money in the pocket also. Has the reader never seen that shop wherein things do themselves, so to speak? Wherein even the wheel of the wheelbarrow is always loose and wabbling on one side, kept in place possibly by ten-penny nails driven vertically into the axle? where the water in the men's pails is as thick as slush, and the towels stand up in one corner like sides of leather! In such shops the belts on the drill presses are made out of many pieces, and all those on the lathes have the pitches of the back gears printed off on them in many places; all the planer ways are deeply scored, its bolts are stripped, and a general air of lonesomeness and "we want to get out of this" pervades every one who works in them. I have been in them; the "Make-shift Works" abound all over but I never knew any of them to make money.

When the piece-work job is finished I will state how the boys came out on it.

Some persons are of opinion that castor oil makes a good lubricant. A mere ocular test would seem to disprove this, so heavy and viscous is it; but a better one than this is the testing machine, which shows it to create more friction than any other oil.

"IN THE ROUND HOUSE."—No. 3.

BY BERKELEY POWELL.

Observations in a round-house may appear to many people tame and unphilosophical, but the cause of many effects which have been deemed unknown or unassignable have been discovered there.

A certain engine driver I am acquainted with was found deeply absorbed one day, in the round-house, studying the guide-bars of his engine. He appeared much mystified. I questioned him and found he was in trouble over what he termed the strange action of the cross-head when the locomotive was running. He has an engine greatly in need of repair, and there is considerable play between the cross-head and the bars.

He noticed that when moving ahead the oil on the lower bars was not disturbed in the least, but, on the contrary, when backing the film of oil was removed, and the bars kept clean and bright. This was an enigma and I stopped, intending to throw light on subject. Levi, however, wished to work it out himself, and I left him and directed my attention elsewhere. I stepped up into a cab to study a new oil cup, with sight-feed, which admits oil into the dry pipe for lubricating the valves, etc. When working the oil feeds up through a glass tube filled with water and replaces a drop just admitted to the dry pipe.

It is a most excellent method for economical lubrication, and is very satisfactory in its working. The number of drops fed to the minute are entirely under the control of the engine driver, and valve-seats and cylinders, after a continued use with this method, show up beautifully upon examination. The chief feature, however, is its economy in the use of oil.

I have noticed that when working a certain number of drops, if the steam be shut off, sixteen or twenty drops will rise through the water in very rapid succession. I have not been able to account for this unless it be caused by the pressure of water contained in the condenser being greater after the steam equilibrium is broken by shutting off steam.

When these lubricating cups were first applied to locomotives great trouble was experienced, because, at times, they suddenly stopped feeding. I experimented in the round-house and found it to be due to the great length of the condensing pipe. Steam would condense too rapidly and fill everything with water. As soon as this water was drawn from the condenser, or well, by the drip-pipe, it would work oil again for a short time. Then it would again stop until the water was drawn off. The remedy for this was to shorten the condensing pipe. When this pipe is of the proper length water need never be drawn from the condenser.

It is frequently found that when a locomotive which has had tallow used on it for the valves and cylinders for some time, is changed to a lubricator with sight-feed (which cannot feed tallow); that there is a deal of groaning on the part of the engine. This need not cause the engine-driver any anxiety as it will not amount to anything, nor need he feed any more oil in consequence. I believe it to be caused by the oil attacking and cleaning off the tallow which always coats the valve-seat. The groaning entirely disappears in a few days.

A locomotive often groans upon leaving the round-house; this may be remedied by admitting oil to the valves just previous to entering the house on the return trip.

Levi has worked out the guide-bar mystery and is jubilant. He found me in the cab studying how to get the glass tubes out of the lubricator without breaking the machine—or the glass.

Railroad men will do well to note that this, I discovered, is done by drawing out the valve completely from above the glass. A chamber is left enabling a new glass to be slipped up and then into place. I understand, however, in future a change in form of machine will avoid this, and a broken glass will not require the combined brains of some half dozen men to put in a new one.

When an engine is moving ahead the cross-head works or bears only on the top guides, and when backing only on the bottom. Levi always had imagined, up to date, that it bore alternately on the top and bottom guides. The reason for this is obvious, because in moving ahead in the front stroke the steam forcing the piston ahead tends to draw the main rod and the piston rod in a straight line; the cross-head prevents this. In the back stroke the steam forcing the piston back tends to form an angle, the sides of which are the main rod and the piston rod; the apex is the cross-head, which must also bear on the upper guide. When backing the action is reversed.

When I worked as a fitter in a machine shop we used wrought iron guide bars planed, and ground with a special grinding machine. The bars were clamped on a planer table filled with water, and the emery wheel had a back and forth side motion.

Beginning at the right front end, as the bar traveled under the wheel, the latter would work over to the left back end. On the return stroke it would commence at the right back and travel to the left front, and repeat as before. When we received guide bars they were supposed to be true, and gang-bosses were determined they should be set up so that the lugs of the cross-head had an exact bearing on all four guides. How well I remember the amount of time spent in springing those bars so as to pass inspection! A slip of paper over this block, or a hair behind that bolt, to throw the bar down a trifle in the center! Then they paid attention in railroad shops to mechanical skill in workmanship. Now "the scene is changed," and cast iron guide bars have become the order of the day. Two cuts, with a coarse feed, seems amply sufficient; draw filng or grinding appear absolute and add to the expense of repair or new construction. Besides, tool marks need not be removed from guide-bars, as they form small channels for retaining oil. Right here let me say that a careful engine driver will never pour oil on his lower guide-bars when oiling the engine. It is wasted, being shoved off at one end on the first stroke of the piston. All that seems necessary is to have the oil-cups in good working trim, and in addition now and then shoot a little oil down between the upper guides and cross-head with a squirt can. It is impossible, now, in economical management to spend the time required to have a nice mechanical bearing all over all of the cross-head flanges on the guides. They soon wear to that, and seem to last (in addition) quite as long without attention as in years gone by, or more properly in the age of paper "shims."

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. IV.

By J. P. Mullin.

MOULDING LARGE SHEAVE-WHEELS AND FORMING THE RIM WITH SWEEPS.

Many pattern-makers and quite a number of moulders have worked for years at their trades, and have never seen a sheave-wheel made without a complete pattern, and would not know how to make one if called upon to do so. Now, although large sheaves are frequently used, we rarely require more than one or two alike, and as the rim of such a wheel is an expensive pattern to make, it very seldom pays to do so.

For this reason I have concluded to illustrate the following method by which wheels having any number of grooves can be made with but little expense for patterns, and scarcely any extra work while moulding.

Fig. 24 is the plan and elevation of a sheave-wheel with three grooves. For such a wheel make a complete pattern of hub and arms. The hub and ribs, *A*, on the side of pattern must be loose, and the ends of the ribs on both sides should be cut to the shape of the outside of the rim, as shown at *B*, Fig. 26.

Fig. 25 is a core-box for the center groove. It is a plain box, open on the top, and a strickle-piece, *C*, used for scraping off the same.

When moulding, bed the pattern in the floor deep enough to have sand for forming the top of the rim or bottom of copes, and then ram it up around the outside at *D*, Fig. 26, and level with the top edge of the arm. We now take the strickle-board *E* and bolt it to the arm of spindle, as shown at *F*, Fig. 26.

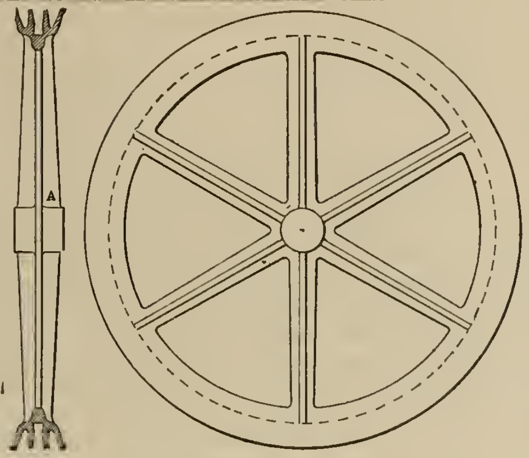


Fig. 24.

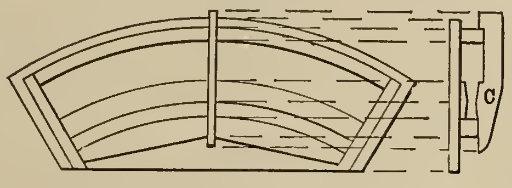


Fig. 25.

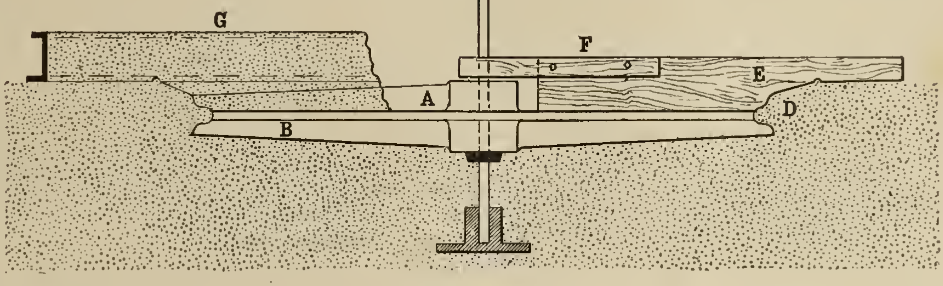
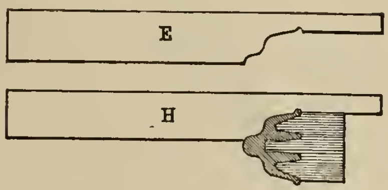


Fig. 26.

With this scrape off the sand level with the top edge of the arms, and also form the outside of the rim of the wheel. Having done this we put on the loose ribs and hub *A*. Set the cope-flask and ram it up, as shown at *G*, Fig. 26; lift it off again and draw the loose ribs, *A*.



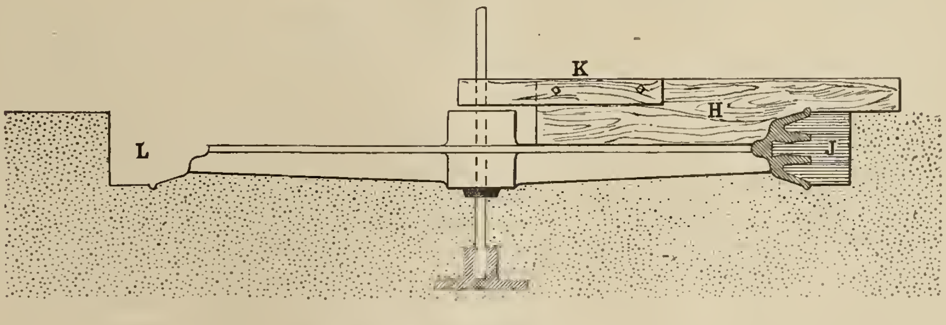


Fig. 27.

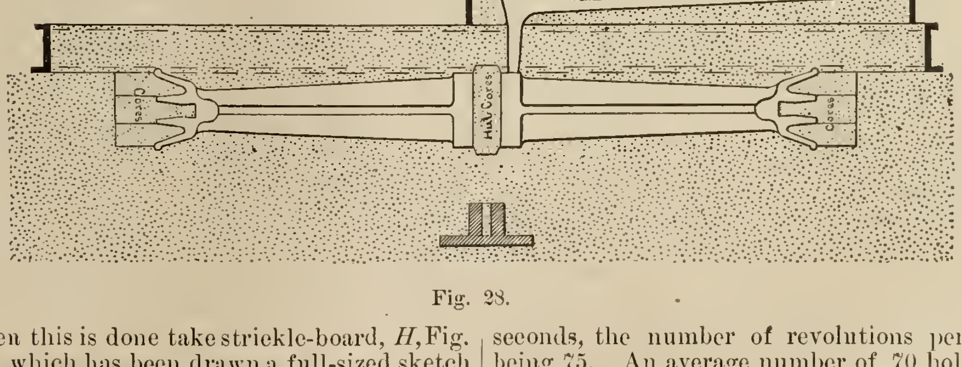


Fig. 28.

When this is done take strickle-board, *H*, Fig. 27 (on which has been drawn a full-sized sketch of the rim of the wheel and the core-print required, as shown at *J*), and bolt it to the arm of the spindle at *K*. With this we scrape away the sand, *D*, Fig. 26, and form the bottom of the mould for the rim of the wheel, and also the core-print, as shown at *L*, Fig. 27.

We are now ready to take off the strickle-board and spindle, draw from the sand the pattern of the arms, and finish the mould.

Having done this set the rim and hub-cores, close the mould, make runner-gate, *M*, set on the weights, and we are ready to cast the wheel, as shown at Fig. 28.

FAST DRILLING IN METAL.

Many thousands of holes ½in. diameter and 2¾in. deep have been drilled, by improved ½in. twist drills, at so high a rate of feed that the spindle of the drilling machine could be seen visibly descending and driving the drill before it. The time occupied from the starting of each hole, in a hammered scrap-iron bar, till the drill pierced through it varied from 1 minute 20 seconds to 1½ minute. The holes drilled were perfectly straight. The speed at which the drill was cutting was nearly 20ft. per minute in its periphery, and the feed was 100 revolutions per inch of depth drilled. The drill was lubricated with soap and water, and went clean through the 2¾in. without being withdrawn, and after it had drilled each hole it felt quite cool to the hand, its temperature being about 75°. It is found that 120 to 130 such holes can be drilled before it is advisable to resharpen the twist drill. This ought to be done immediately the drill exhibits the slightest sign of distress.

If carefully examined after this number of holes has been drilled the prominent cutting parts of the lips, which have removed the metal, will be found very slightly blunted or rounded to the extent of about $\frac{1}{100}$ of an inch, and on this length being carefully ground by the machine off the end of the twist drills the lips are brought up to perfectly sharp cutting edges again. The same sized holes, ½in. diameter and 2¾in. deep, have been drilled through the same hammered scrap-iron at the extraordinary speed of 2¾in. deep in one minute and five seconds, the number of revolutions per inch being 75. An average number of 70 holes can be drilled in this case before the drill requires resharpening. The writer considers this test to be rather too severe, and prefers the former speed. The drills in both cases were driven by a true-running drilling-machine spindle, having a round taper hole, which also was perfectly true, and the taper shank and body, or twisted part of the drills, also ran perfectly concentric when placed in the spindle, or in a reducer or socket having a taper end to fit the spindle. When the drills run without any eccentricity there is no pressure and next to no friction on the sides of the flute, the whole of the pressure and work being taken on the ends of the drills. Consequently they are not found to wear smaller in diameter at the lip end, and they retain their sizes, with careful usage, in a wonderful manner. The drills used were carefully sharpened in one of the twist-drill grinders mentioned above.

In London upwards of 3,000 holes were drilled $\frac{5}{8}$in. diameter and $\frac{3}{4}$in. deep, through steel bars, by one drill without regrinding it. The cutting speed was in this instance too great for cutting steel, being from 18ft. to 20ft. per minute, and the result is extraordinary. Many thousands of holes were drilled $\frac{1}{8}$in. diameter, through cast iron $\frac{7}{16}$in. deep, with straight-shank twist gripped by an eccentric chuck in the end of the spindle of a quick-speed drilling machine. The time occupied by each hole was from nine ten seconds only. Again, $\frac{1}{4}$in. holes have been drilled through wrought copper $1\frac{3}{8}$in. thick at the speed of one hole in ten seconds. With special twist-drills, made for piercing hard Bessemer steel rail holes $\frac{13}{16}$in. deep and $\frac{29}{32}$in. diameter have been drilled at the rate of one hole in one minute and twenty seconds in an ordinary drilling machine. Had the machine been stiffer and more powerful better results could have been obtained. A similar twist drill, $\frac{29}{32}$in. diameter, drilled a hard steel rail $\frac{13}{16}$in. deep in one minute, and another in one minute ten seconds. Another drill, $\frac{5}{8}$in. diameter, drilled $\frac{3}{4}$in. deep in thirty-eight seconds, the cutting speed being 22ft. per minute. This speed of cutting rather distressed the drill—a speed of 16ft. per minute would have been better. The steel rail was specially selected as being one of the hardest of the lot.—Ferd. Smith.

INTERESTING TO ENGINEERS AND BOILER-MAKERS.

A law suit of considerable interest to boiler makers and steam users generally has just been decided by the Vermont Supreme Court at the April session, just closed, at Rutland, and Hon. W. G. Veazey, Chief Judge, the particulars of which are as follows: In August, 1881, S. C. Forsaith & Co., of Manchester, N. H., manufacturers of and dealers in boilers, engines and general machinery, contracted with the Vermont Union Slate Co., of Fairhaven, Vt., to furnish a second-hand vertical boiler as advertised in Forsaith & Co.'s catalogue, the trade being made by correspondence.

The boiler was fully described in the catalogue, but was of peculiar construction, being similar to a steam fire engine boiler, standing seven and three-fourths feet high, three feet in diameter, containing 128 flues, each three and one-fourth feet long, these flues being made up of one central flue eleven and one-eighth inches in diameter, and surrounding this are 59 flues one and one-half inches in diameter in two rows, while outside of these were 68 two and one-fourth inch flues, also in two rows, while the fire-box was 33 inches in diameter, 24 inches high, having but one inch water space in the leg around the fire-box, and having also a combustion chamber at the top, thirty inches fourth of an inch thick, the plates being so stamped, while high, the shell made of Pottstown best C. H. No. 1 iron; one of the heads was three-eighths of an inch thick.

It appeared by the evidence that when Forsaith & Co. purchased the boiler they examined it, as is their custom, and found it had been burned or corroded in the lower part of the fire-box, and they therefore cut out one-half of the entire sheet; and as they were driven with work at the time they received it, they sent it to the boiler works of Scannell & Wholley, Lowell, Mass., with instructions to place therein a new sheet in first-class manner. This Scannell & Wholley did, testing the boiler, as the evidence showed, to 165 pounds cold water pressure, the boiler being then returned to Forsaith & Co., where a further test was given of 130 pounds cold water, this being their usual custom and as they advertised.

They then forwarded it to the Slate Co., at Fairhaven, there purchasers placing it in position in their quarry, three men, their engineer and two assistants, connecting it and firing up.

A few days after its receipt by the Vermont Slate Co., Forsaith & Co. were notified that the boiler was defective, that it leaked so around the new sheet and around the tubes that but thirty pounds steam could be made, the fire being put out by the leakage of water. Forsaith wrote them that the fault must be theirs, as the boiler was properly repaired and properly tested before shipment, quite a correspondence ensuing, Forsaith telling them that if they were not satisfied with the boiler to return it; but, instead of doing this, the Vermont Union Slate Co. brought suit in the Vermont Courts against Forsaith & Co., alleging fraud and deceit in sale of the boiler, alleging that it was old, defective and worn out, worthless, and not as named in the description, suing for all damages, costs, freights, loss of profits in their mills lying idle, etc.

Forsaith & Co. defended the suit, and the case was heard before the three judges on the court March 29, 30 and 31, the engineer of the Vermont Union Slate Co. testifying that he set the boiler up, and was from one and one-half to two hours in getting steam from cold water; that he did not remember whether he used his injector to feed the boiler or not, nor could he remember whether he performed any service with the boiler or not, and that he did not have steam on the boiler over two hours at the most, while his assistants testified that the boiler was run from two to three hours, the injector was used, and that the boiler was used in pumping water from the quarry.

The Vermont Union Slate Co. also brought numerous local experts to testify that in their judgment the defective flues were caused by deposit of sediment on the crown-sheet of the boiler, thus preventing the water having access to the iron, and in consequence burning it, while one of their experts testified that the boiler would not stand even 115 pounds cold water, he basing his testimony from outside examinations and measurements.

On the contrary, the practical boiler makers whom Forsaith & Co. summoned to examine the boiler and report thereon, testified that in their judgment steam could be made in from fifteen to twenty-five minutes, while they could see no reason why the boiler would not stand readily the test which Forsaith & Co. and Scannell & Wholley and their men had testified had been given it prior to shipment, while to show that the theory of deposit of sediment upon the crown-sheet was incorrect, Forsaith & Co. had one of the tubes taken out and an internal examination made of the crown-sheet, which showed it to be free from scales or deposit of sediment of any kind whatever.

Judge Veazey in announcing the decision of the Court decided fully and completely in favor of S. C. Forsaith & Co., remarking that he had rarely or never heard a case more fairly or more completely tried, by the knowledge and intelligent appearance of the witnesses, while the correspondence was conducted in the greatest fairness, and the Court was fully satisfied that all through the whole transaction Forsaith & Co. had acted in the utmost good faith, and without any suspicion of fraud; that they found no breach of warranty or contract, and that the injury to the boiler, which was evidently burned, had occurred at Fairhaven, in consequence of neglect of the purchasers or by their fault in some way.

Judgment was therefore ordered for the defendants, Forsaith & Co., with costs of suit assessed against the plaintiffs, the Vermont Slate Co.—*Boston Commercial Bulletin.*

WILLIAM MASON AND HIS WORK.

The death of William Mason, of Taunton, Mass., which occurred on May 21st, is a great loss to the profession. He was an old-fashioned mechanic who believed in doing his work as well as he possibly could. It lives after him, and his reputation stood very high.

An exceedingly interesting account of a personal interview with him is published in the *Railroad Gazette,* from which we extract a portion bearing upon his engineering work in part.

William Mason, the distinguished locomotive builder, died on the afternoon of May 21 at his home in Taunton, Mass., of pneumonia, at the age of 76. He was born in Mystic, Conn., and with nothing but his hands and genius made for himself a name and a fortune. No one in this country has done so much to develop and perfect the American locomotive as Mr. Mason. He was a wonderfully ingenious man, and combined with his ingenuity a high order of the artistic sense, so that his work was always most exquisitely designed. Just as architecture has been spoken of as "frozen music," so it might be said of Mr. Mason's locomotives that they are melodies cast and wrought in metal.

Of the work that he did during his life-time, no full account has ever been given, We are fortunate in having a verbatim report of a conversation had with him some months before his death, in which he related much of his experience and recounted what he had done during his professional and business career. Probably no better idea can be given of his life and of his work than to quote freely from this report.

In the conversation referred to he said:

"I learned my trade in Canterbury, Conn., but I came from Killingly. I went up into New York State one season and often was at Utica. Old Captain Baker was making cotton sheeting, etc., and he heard they were making cotton diapers in the vicinity were I was, and he wrote up to see if I couldn't learn how to make cotton diapers and put the machinery into his mill. I found there were none woven on looms, but they were done by hand. I studied the matter a little and made some looms for him to make such goods. I built them at Canterbury, where I was learning my trade. The machine shop was under the cotton factory—they were all under the cotton factories in the old days. After I got through with this job I was fooling about for some time, painting portraits, making fiddles and one thing and another. Finally they sent for me to come up to Killingly. They were trying there to make the ring frame. Somebody had got up a ring frame, but it was a miserably poor thing. It would not go at all. I looked it over while I was there, and watched it. Two or three men tried it. The man who invented it could not make it go, but they tried it there till they created such a prejudice against it that nobody would have it in the neighborhood. I made up my mind that there was something in it if it was only brought out right, and I took the shop and went into it, and I brought out the frame. I have since been called the father of it. I had hard work to introduce it, about as hard work as I had to introduce the double-truck locomotive. I was twenty-five years old then. There was great prejudice against the ring frame. The only way that I could introduce it was to go to a man who wanted some spinning done, and say to him, 'I will make you a frame to do so much more spinning. I will put it into your mill and start it up, and you can run it. If you do not like it I will take it away, and it shall not cost you anything.' I never had to take one back. I manufactured quite a number of them in the old shop, until it became known what it was. I then went down to Taunton and brought my machines down. I went there to run a shop of Crocker & Richmond. I was there a year when they failed, and I never got a cent of salary from them. They put the shop into the hands of Leach & Keith to run. I took charge of that, and I got up the self-acting mule there. Very soon they failed, and then I bought them out, or rather some one else bought them out for me. I remained there three years and then built the place I am at now.

"The first idea I had about improving the engine was to put the cylinders down level. The cylinders were all put up so as to be above the truck. Another thing on the old-fashioned engines was that if anything was the matter with the frame, at either end, you had to take the whole engine down. I was the first to make the front end of the frame separate from the back end, so that the one part could be removed without removing the other part. I made the driving-wheels with hollow spokes and hollow rim. I also got up a set of truck-wheels about that time. The plate wheels which were put under an ordinary engine truck looked like cheeses. I wanted my truck wheels to have some relation in appearance to the drivers. Therefore, I never put a plate wheel under any engine that I have built. I also put the counterbalance into the rim of the wheel by pouring lead into it. I have a rim that will hold enough lead to counterbalance the revolving and reciprocating parts. The lead is poured into the hollow rim.

"Rogers used the link motion in this country before I did; but he hung it from below. I hung my link above the center, and had the suspension link the same length as the rocker-arm, so that the link block would not slip at all. At that time I was trying to prevent the slipping of the block, but have found since that the slip is of very little consequence, because if it slides at all, it is just as well to slide six inches as two inches, so far as the wear is concerned. A little motion of that kind sometimes wears more than a long motion.

"In staying the crown-sheets I found that the bolts that go up through the crown-bars were riveted, and I found that they were so long they would leak. I thought the matter over and got up the plan which I am now using. Everybody adopted it. They are now put on with a cone at the bottom.

"I designed the arrangement of wedges in the jaws for locomotive driving boxes. I put a shoe next to the box and a wedge behind the shoe and between it and the frame, so that the wedge was out of sight. After a while I found that it was not a good way to have a wedge on both sides; that the men on the road were careless and would shove up one too much, so I made one side of the frame straight, and put the shoe on it also straight, and put a wedge on one side only. I now make both jaws straight. Then I put the wedge behind the shoe. Both the wedge and the shoe are tapered. The two together make a straight surface for the box.

"In the full-sized engines I have built I have generally given seven-eights lap, but on freight-engines which work slow, I make it three-quarters. I give a little lead at full stroke with the link. You do not want too much, for in time you get more than you need. Lap and lead in effect are all the same thing. The only thing that made locomotives run quick was the lap. The original slide valve had no lap, and, of of course, they could not get rid of the steam, because it would not exhaust. The lap was what gave the lead to the exhaust. The lead has precisely the same effect on the exhaust, as the original lap would have. That is the whole secret of the lead. They used to think that they must have a lead or else the engine would not run smart. It was not because it let the steam in quicker, but because it let it out quicker.

"Compression is a valuable thing in a locomotive. The steam you catch in the cylinder there is not lost. It enters as a cushion to stop your piston, whereas if you did not have that your engine would go to pieces very quick. It is all nonsense to say that the steam which fills the clearance spaces and the steam ports is lost. About the time that I commenced to build locomotives they were all trying to get rid of the compression. You see it answers as a cushion, and leaves the passages all full at high pressure, so that you do not need any lead. Sometimes you get more pressure there than you have in the steam chest, and on that account you do not need any lead. In slow running engines you do not need so much lap and lead, because you have more time to exhaust and you hold your steam longer. For that reason, of late years, when I come to reflect, I have given little if any lead on the link motion, because in starting a train they want to hold on to the steam as long as they can. As soon as they begin to go quicker, they begin to cut off, and then they begin to have lead.

"I built quite a number of engines with perforated supply pipes and without a dome, excepting a small one for the whistle and safety valve. The plan worked very well.

"I am now making the top of the outside shell of the fire-box of boilers for double-truck engines flat, and staying the crown-heads direct to the flattened portion with straight stay-bolts. It is better than the common way of staying the crown sheet.

"I am also overhauling the designs of my ordinary American locomotive. I began some time ago and made new patterns for wheels, etc., and am making the engines generally heavier and stronger, larger bearings, etc. I am going to make the bearings of the driving wheels 8 in. in diameter. I have been thinking of getting up a slab frame for the 18-in. cylinder engines. I have thought of making it a slab frame alongside the fire-box. I could then get 5 in. more width in the fire-box, but would have to put the springs below the frames.

"I do not believe that there will be as great an increase in the size of locomotives during the the next ten years as there has been during the past ten years. I think they are making a mistake in building those large engines and in making such big wheels. I saw some on the Pennsylvania road, which I think have 6½ or 7 ft. driving wheels.

"I commenced building double-truck locomotives twelve years ago. I have an application now to build some engines like those that I made ten years ago. The first one which I made was the "Janus," which had a double boiler and two sets of cylinders. It was the first one I built, and probably I will never make another like it. You cannot make a practical engine on that plan. It is not possible to carry a sufficient supply of fuel and water. Such an engine should at least carry 4,000 gallons of water, and besides, you would have the whole weight of the two boilers, the machinery and the fuel and the cab and the men all on twelve wheels. When the supply of water is exhausted, the weight on the wheels is of course very much diminished. Such an engine, if it carried a sufficient amount of water, would weigh ninety tons.

"The next double-truck engine that I built was a little 10 × 15 engine, the "Onward." She was a narrow-gauge engine. When I got through with that, I made up my mind I would never touch another, but after thinking it over I concluded there was something in that principle that could be worked out. The first steam-pipes which I used on these engines worked well, and I am told, are still working well, but I have made several changes since that time. A great feature of these engines is that you make the axle bearings for them just as large as you want, and the firebox just as wide and boiler just as big as you want them. You are not obliged to get out of the way of anything. I have a fire box now with 36 square feet of grate surface. You can make it any length you choose.

"My principal business has been cotton machinery. At the time I commenced there was a little slackness in cotton machinery, and for that reason I took hold of locomotives. My locomotive business now is the meanest part of it, and always was. I took an interest in it, and tell my friends that I got up locomotives for fun, but that it was the most expensive fun I ever had. I made just enough money from my cotton machinery to pay for my losses on locomotives. I am now doing a good deal of printing-press work, which is done by contract. I have nothing to do with the selling of them, and wish I could build locomotives in the same way.

"A great many men who start in the machine business fail. My own idea of the machine shop is that the money made out of it is always made because the mechanical manager of it is sharper than other people. If he is not he will not make much money. I never knew a machine shop to make money, the head of which was not a skillful mechanic. To manage a machine shop a mechanical man with business qualifications is needed. Generally, the successful shops are those that start in a small way under some man who has brains and takes a fancy to machinery and works it up. I can name several of this kind. There were Whiton & Hill, of Providence. There was a shop in Pawtucket managed by Brown. He was a machinist brought up to the vise. So was Hill, and so was Corliss. But Corliss' great success was largely due to Bancroft, who was a great mechanic. Bancroft was formerly a partner of William Sellers. Sellers was a very ingenious man. He was a clerk there in Providence at the same time, and he got to conjuring about a sewing machine in his leisure hours and finally got in there as a draftsman where Bancroft was. At last that shop was broken up and they went to Philadelphia. Bancroft came from Philadelphia and made some tools in Providence which were the first I ever saw that had any good workmanship in them. I have sold castings to William Sellers of tools that I got up. I could not get a planer worth a cent, and went to work and got some patterns and put some iron into them. Bancroft staid in business with William Sellers until he (Bancroft) died. He built the first planer ever built in this country, I think. They imported an English one and built one exactly like it. I have it now. It goes with a chain. It is not much use, but I keep it going."

SOME POINTS ABOUT TWIST DRILLS.

During the last thirty years many attempts have been made to introduce a better system of drilling and boring; and on this subject very much might be written if time permitted. Many engineers have used square bar-steel, which the blacksmith has twisted, and then flattened at one end to form a drill. The twisted square section revolving in the round hole had a tendency to crush or grind up the cuttings; and if they were once reduced to powder it was difficult for the drill to lift it out of the hole.

In most cases the lips of these drills were of such form that the cutting angle, or face of each lip, which ought to have been about 60°, was 90°, or even still more obtuse; this being an angle which would scrape only, but could hardly be expected to cut sweetly or rapidly.

Again, there were attempts to make the cutting angles of the two lips of much the same number of degrees as that given by the twist itself in a good twist drill. This was done by forging or filing a semicircular or curved groove on the lower face of each lip. For a short time lips thus formed cut fairly well, but a very small amount of re-grinding soon put them out of shape, and made them of such obtuse cutting angles that good results could no longer be expected from them; and to be constantly sending such drills to the toolsmith, and then to the fitter to file into form again before they were re-hardened, was found to be too expensive. Again, to arrive at the best results in drilling, each of the cutting lips should make the same angle with a central line taken through the body of the drill; in other words, the angles should each have exactly the same number of degrees, say 60°. The clearance angles also should be identical, and the leading point should form the exact center point of the drill. From practice it is found that if these proportions are not correct, the drill cannot pierce the metal it is drilling at more than about half the proper speed, and the hole produced will also be larger than the drill itself, as will be exemplified a little later on. To give an idea of the extensive accuracy which must be imparted to a twist-drill, we must bear in mind that even a good feed is only $\frac{1}{100}$ inch to each revolution; and as two lips are employed to remove this thickness of metal, each lip has only half that quantity to cut, or $\frac{1}{200}$ inch. This $\frac{1}{200}$ inch is as much as can be taken in practice by each lip in drills of ordinary sizes.

It will therefore be readily understood that if one lip of a drill stands before the other to the extent of $\frac{1}{100}$ inch only, the prominent lip, or portion of a lip, will have to remove the whole thickness of the metal from the hole at each turn. The lip of a drill will not stand such treatment; and it is therefore obvious that if this were attempted the prominent lip would either break or become too rapidly blunted. To get over these difficulties, the driller would no doubt reduce his feed by one-half, or to $\frac{1}{200}$ inch per turn, which would mean about one-half the number of holes drilled in a given time.

This nice accuracy, although absolutely required, cannot be produced by hand-grinding;

neither can a common drill, having a rough black stem more or less eccentric, be ground accurately, even by aid of a grinding machine with mechanism for holding it. To grind any twist drill accurately, it must be concentric and perfectly true throughout with the shank, as that part has to be held by the drill-grinding machine. If the drilling is to be done in the most rapid manner—in other words, at the smallest cost—and if the best class of work is also desired, it seems certain that a twist-drill, with all the accuracy which can possibly be imparted to it in its manufacture, and the greatest care employed in the re-sharpening, is the only instrument which can be employed.

About a quarter of a century ago both Sir Joseph Whitworth and the late Mr. Greenwood, of Leeds, made some twist-drills; but it is to be presumed that a large amount of success was not achieved with them, and for some reasons the system was not persevered with. After that period the Manhattan Firearms Company in America produced some beautifully-finished twist-drills. Though the workmanship in these was of a superior description, the drills would not endure hardship. It was found that the lips were too keen in their cutting angles, and that they were apt to drag into tne metal they were cutting, and to jam fast, and to twist themselves into fragments. Mr. S. A. Morse then took the matter up, and by diminishing by about 50 per cent. the keenness of the cutting lips of twist-drills, made a great success of them. He used the grinding line and an increasing twist.

If, however, the angle of twist is made to increase towards the lips, it will of course decrease towards the shank. The shorter the drill is worn, the more obtuse the cutting angle becomes, and the less freedom it will have; supposing, of course, that the angle, when the drill was new, was the most efficient. Suppose this decrease of twist were carried still further by lengthening the drill, a cutting angle of 90° would eventually be arrived at. The old common style of drill usually has a cutting edge which is so obtuse as not to cut the metal sweetly, but on the contrary to have more of a tearing action, and thus put so much torsional strain on the drill that friction is certain to take place, even if what the writer would now consider a moderate feed was put on by the drilling machine.

It is therefore obviously advantageous to adopt from the first the best cutting angle for all twist-drills, and to preserve this same angle through the whole length of the twisted part, so that, however short the drill may be worn, it always presents the same angle, and that the most efficient which can be obtained. This cutting angle is easy to fix, and becomes an unalterable standard which will give the best attainable results.

A common drill may "run," as it is usually termed, and produce a hole which is anything but straight. This means that the point of the drill will run away from the denser parts of the metal it is cutting, and penetrate into the opposite side, which is soft and spongy. This is especially the case in castings; where, for instance, a foss may be quite sound on the one side, while on the other a mass of metal may be full of blow-holes, or so drawn away by contraction in cooling as to be very soft and porous. In such cases it is perfectly impossible to prevent a common drill from running into the soft side. This sort of imperfect hole is most trying to the fitter or erector, and if it has to be tapped, to receive a screwed bolt or stud, is most destructive to steel taps. The taps are very liable to be broken, and an immense loss of time may also take place in attempting to tap the hole square with the planed face. A twist-drill, on the other hand, from its construction, is bound to penetrate truly, and produce holes which are as perfect as it is possible to make them.

The next important step in twist-drills has been to fix a standard shape and angle of clearance for both lips, which should also give the best attainable result. The angle might be tampered with if the re-grinding were done by hand, and too much or too little clearance might easily be imparted to the drill from want of sufficient knowledge on the part of the workman. If too little clearance, or in some cases none at all, is given to the drill, the cutting lips then cannot reach the metal, consequently they cannot cut. The self-acting feed of the drilling machine keeps crowding on the feed until either the machine or drill gives way. Usually it will be the latter.

Again, if too much clearance is given, the keen edges of the lips dig into the metal, and imbed themselves there, and of course break off.

The grinding line was introduced in the States, to assist the operator in keeping both lips of the drill identically the same. To arrive at this, however, is more than can be accomplished by hand-grinding as not less than three points have to be carefully watched, viz:

1st. That both lips are exactly the same length.

2d. That both have the same clearance angles.

3d. That both make the same angle with the center line on the body of the drill.

If these are not attended to, the drill lips may for instance be both ground so as to converge exactly to the grinding lines at the point or center of the drill, and may still be of such different lengths and angles as to produce very bad results in drilling.

Much ingenuity has been expended on machines for the grinding of the lips with mechanical accuracy.

The one which has been the most successful in the United States has three motions, ingeniously combined with each other. So many motions however entail complication; and this, added to a system of holding the drill which was not sufficiently reliable, failed to produce the extreme accuracy it is requisite to impart to the two angles.

The grinding line too is found to be more or less a source of weakness. It is therefore advisable to dispense with it if possible; and where a good twist-drill grinding machine is used, the grinding line is seldom or never looked at, and in that case is useless. If it is still desirable to have grinding lines (as in some cases where hand-grinding has to be relied upon) they should be made as faint as possible, and not cut deeply into the thin central part of the drill, so as to weaken it.

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LOCOMOTIVES AT THE NATIONAL EXPOSITION.

The Chicago Exposition of Railway Appliances is a great success and attracts crowds daily from all parts of the country. The locomotives shown are by all the principal builders. The *Railway Age* says:

The Brooks Locomotive Works of Dunkirk, New York, have seven fine locomotives on exhibition consisting of all classes of engines now in use both of the standard and narrow gauge patterns.

Their Mogul engine standard gauge has cylinders 18 × 24; six driving wheels, $55\frac{3}{4}$ inches diameter; boiler 52 inches diameter; tubes 2 inches diameter, 11 feet $1\frac{1}{2}$ inches long. Weight fully equipped 43 tons.

Their heaviest Mogul has cylinders 19 inches × 24 inches stroke; six driving wheels, $55\frac{3}{4}$ inches diameter; boiler 52 inches in diameter; tubes 2 inches diameter, and 11 feet 9 inches long. Weight fully equipped $47\frac{1}{4}$ tons.

The standard gauge switching engine has cylinders 17 inches × 24 inches stroke; six driving wheels, 48 inches diameter; boiler 48 inches diameter; flues 2 inches diameter, 10 feet 1 inch long. Weight fully equipped 33 tons.

Their passenger locomotive has cylinders 17 inches × 24 inch stroke, four driving wheels, 67 inchs diameter; boiler 48 inches diameter; tubes 2 inches diameter, 11 feet 6 inches long. Weight fully equipped 37 tons.

These engines are new, coming directly from the shops, and having the latest improvements. They make an imposing and creditable display, of which the manufacturers may well feel proud.

The Pittsburgh Locomotive works have a very fine standard gauge passenger locomotive on exhibition. It has cylinders 17 inches, × 24 inch stroke; 4 driving wheels 66 inches diameter; rigid wheel base 8 feet 8 inches, total wheel base 22 feet 9 inches. Weight equipped 42 tons.

This firm has also a fine Mogul engine built for the Pittsburgh, McKeeport & Youghiogheny railroad company. It has cylinders 18 inches × 24 inches stroke; six driving wheels, 56 inches diameter; a rigid wheel base of 12 feet 10 inches; total wheel base 24 feet 6 inches. Weight in working order 38·8 tons.

Their consolidation engine is another fine specimen of its class. It has cylinders 20 inches × 24 inches stroke; eight driving wheels, 44 inches in diameter; rigid wheel base 12 feet 4 inches. Total wheel base 20 feet 10 inches. Weight fully equipped $42\frac{1}{2}$ tons.

The Cooke Locomotive and Machine works, of Patterson, N. J., show one of their great "mastodons," the largest locomotions in the world, which is just completed. Its cylinders are 20 inches × 30 inches stroke; it has eight driving wheels 5 feet 5 inches in diameter, with a four-wheeled truck forward. The boiler is 60 inches in diameter; tubes $2\frac{1}{4}$ inches diameter and 12 feet long. The weight, in working order, of the engine is 123,000 pounds, and of the tender, 63,000 pounds. Total weight, 93 tons! The tank has a capacity of 3,000 gallons of water, and the tender carries 12,000 pounds of coal. The length over all is 64 feet. To give the reader some idea of the immense proportions of this engine the builders say that the outside connecting rods weigh each 675 pounds. The remainder of its working gear is in like proportion. Mr. A. J. Stevens, the master mechanic of the road, made the designs from which it was built.

The Rogers Locomotive works, of Patterson, N. J., show a handsome passenger locomotive of unusual size and power, which they have recently built for the New York, West Shore and Buffalo Railway. It has cylinders 18 inches × 24 inch stroke; four driving wheels, 5 feet 10 inches diameter, and weighs 50 tons.

As a novelty in locomotive construction the Shaw locomotive attracts no little attention from railway men of all classes. It has two cylinders on each side in place of one, as on all other engines, each being $10\frac{1}{2}$ inches diameter with a 24 inch stroke. These cylinders work in combinations. There are two crossheads, two piston rods, and two connecting and parallel rods on each side. There are four driving wheels, 5 feet 9 inches in diameter. The weight fully equipped is $60\frac{1}{2}$ tons. The best record of this engine, the "Henry F. Shaw," named for its inventor, is a mile in 47 seconds, or 76·6 miles per hour, drawing two cars. It is claimed that on jack screws, to test the principle of balance of wheels and their connections, which is the salient feature of the improvement, a speed of 100 miles per hour was shown. "Steam is the motor of balance as applied to the reciprocating parts," is the motto of the inventor, painted on the tender.

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In a description of the famous Westminster clock, it is stated that the movement is so accurate as not to vary more than two or three seconds per month.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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New York, July 7, 1883.

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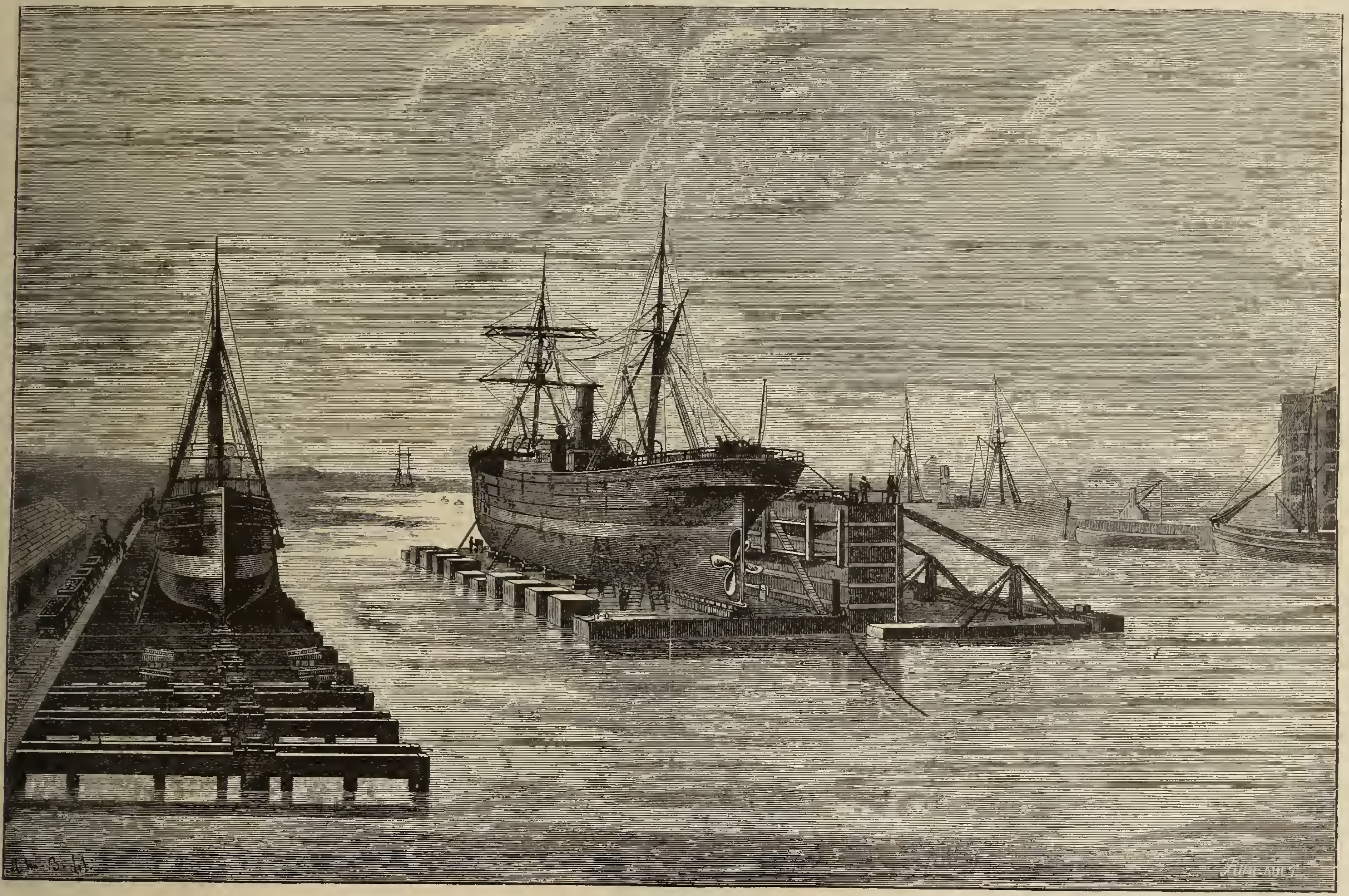
AN INGENIOUS METHOD OF REPAIRING VESSELS.

Our illustration represents what is to us a new and very ingenious method of handling vessels which require extensive repairs. Briefly, it is thus described in *Engineering*, from which paper we take the engraving:



"The dock consists of an upright side carrying the machinery, and having attached to it a series of parallel pontoons forming the bottom on which the vessel is lifted. On the other side of the dock is an out-rigger which always floats, and the function of which is to insure stability during the operations of raising and lowering vessels. The dock is lowered as required, and a vessel brought over the pontoons, and properly secured; pumping is then proceeded with till the vessel is raised well above water, as shown. The pontoons of the dock are now entered between the piers of the fixed staging, so that the vessel is brought over the latter, water is then admitted to the dock to lower it, and thus the vessel is quickly transferred from one to the other without any sliding or rolling motion. The reverse of this is done when a vessel is lifted off the staging into the water. The operation occupies only about twenty minutes, and the vessel can be left on the staging as long as may be desired. The illustration shows the s. s. 'Pensher' on the dock, and the s. s. 'Ardeer' deposited on the staging.

"This dock is the third of its kind, constructed by its inventors, Messrs. Latimer, Clark and John Standfield, of Westminster.

"The dock consists of two equal parts, each complete, and these are frequently used separately for docking and depositing vessels of 1,500 tons dead weight; the intended addition will be in the form of another independent section, suitable for vessels of 2,000 tons. When the three parts are connected together they will be able to lift vessels of 5,000 tons, as already stated. It is obvious that every additional length of staging gives the accommodation of another graving dock, and at a trifling cost, as the staging is constructed of ordinary piles driven in parallel rows, which are capped by horizontal timbers. This is clearly seen in the perspective view on the left. By this arrangement one dock serves for a large number of vessels, and can thus be very economically and profitably worked."

A MISTAKE.

THE *Philadelphia Record* notes that the St. Louis Manual Training School has been attended with such success that it can no longer be looked upon as an experiment. The first class of twenty-eight boys is about completing the three years course. These boys, of an average age of seventeen years, have nearly finished three steam engines, upon which they will have done all the work, from the drawings to the final touch. This education of the hands has not been accomplished at the sacrifice of the education of the head. With their manual training they have obtained the average high-school learning. Two hours of each day are devoted to manual labor. The course extends over three years, in which time they become skilled draughtsmen and gain a thorough knowledge of materials. They learn to mold, to cast and to plane, bore and drill castings by machine tools. Wrought iron and steel are worked by them at the forge, and tempering, brazing and soldering are thoroughly learned.

It is a mistake. Trades are not thoroughly learned in three years by two hours "study" daily. Too much is claimed; a boy cannot learn one trade in the time named, let alone two or three. Such boys are merely Jacks of all trades, of whom there are too many now.

"HOW TO MIX white lead" forms the staple topic of an article three inches long in a contemporary. We expect to read soon some instructions upon drinking a cup of tea.

THE PUPIL is the governor of the eye, regulating the amount of light admitted to it. It expands in a dark room and contracts in a bright light.

OCCASIONALLY SOME HEROIC person starts in to reform established customs and overthrow conventional rules, substituting therefor whims of their own. The customary spelling—orthography—of the day appears to have a great charm for these reformers, one of whom is endeavoring to make proselytes to his plans through the medium of a paper devoted to it. A sample of his style is here appended:

> "Mr. Lindsley relates that he was so much discurged with his poor sueces as a teacher of Fonografy, that he was impeld thereby to the invention of Takigrafy as a substitute. The truble, however. as has been wel proovd sinee, was not in Fonografy, but in our then cumbrus methods of teaehing it. It ean now be taut in a fraction of the time formerly required, and taut to better advantage, as I hope to point out by-and-bye. Stil, my beleef is that the best way of teaehing Fonografy has not yet bin hit upon."

This is, perhaps, not so good a sample as might be found, but it will suffice. As an editor, our opinion is that there are so many converts to this method already extant that it is superfluous to press it upon public attention. We never knew any one to be proud of it.

THE SHAW LOCOMOTIVE made a fine record in an experimental trip from Columbus to Urbana and back, *en route* to Chicago. The high speed of 73·6 an hour was reached, and for seven consecutive miles the speed made was respectively 64·3, 66·7, 73·5, 72·0, 73·5, 70·6 and 70·6 miles per hour. This is claimed to be the fastest railroading ever seen in Ohio.—*Trade Review.*

No locomotive extant can make steam for 73 miles an hour; it may reach that velocity down grade, if it is steep enough.

SUPPOSE WE WISH to know the largest square that can be cut from a circular sheet of given size. To ascertain without measuring, multiply the diameter by 0·7071, and we have the side of a square that will be contained in the circle. This is a useful rule for all trades. Machinists very often have occasion to use it; so do boiler-makers and lumbermen.

NEW PATTERN SHAPING MACHINE.

BY THE PRATT & WHITNEY COMPANY, HARTFORD, CONN.

The shaping machine here shown will commend itself to all practical workers by its adaptation to the work required of such tools. Necessarily, where the tool reciprocates over the work, and all parts of the machine itself are light, the job must be brought as close to the body of the machine as possible. By this means the work done is more accurate, for, in a great measure, the spring is obviated. As will be seen by the engraving, this is accomplished by making the front face of the shaper nearly flush, and keeping the angle-plates to which the work is bolted as close to the body, or main column, as possible, the result being a compact, rigid machine, capable of very exact work.

The horizontal traverse of the saddle is 15″, and the stroke from nothing to 10″; a quick return motion is applied to the ram.

This machine has circular, vertical, cross and angular feed, all self-acting, so that the tool can be made to work on jobs of any shape or description. Weight, as shown in the engraving, 2,400 pounds.

The drilling machine illustrated herewith is a most useful tool for contractors or others, where small holes are required to be bored quickly. As may be seen, it has lever-feed for the drill, which not only enables the operator to feel exactly the pressure he is putting on it, but also enables him to withdraw it with great rapidity. The design combines stiffness with grace, and the general appearance is satisfactory to the eye.

The range of the drill is 3″ for one movement of the lever, which can then be shifted for another motion, as shown by the ratchet worked by the rod on the lever.

The platen proper slides in a carriage fastened to the frame, and is raised or lowered by the lever, as stated, the drill itself remaining stationary. The carriage carrying the platen is capable of adjustment vertically by the screw seen beneath it, and is then bolted fast to the frame. The platen is 9″ square, and the end of the spindle at its greatest range is 12″ above it. The weight is 665 pounds. Circulars and price lists on application.

* * *

WHITE'S PULLEY BLOCK is an old device, but one that might be introduced with advantage in many places, as it is simple in construction, cheaply made, and efficient. It is merely two cones with grooves in them, like a cone pulley. Each cone has as many steps, or grooves, in it as desired, say six, and the greater the number the more weight one man can hoist with it. The rope is rove around it regularly, from the smallest to the largest step, and the cones are set so that the smallest diameters are opposite each other, not as in machine work. The efficiency of it is measured by the number of steps multiplied by two. That is to say, if there are six steps, or speeds, in the cones, the efficiency would be equal to twelve; a man pulling forty pounds on the rope could raise 480.

* * *

A DEALER IN the fruit business says that it is the custom every spring to clip a number of branches from peach trees in different orchards, and place one end in water that is kept continually heated. The dormant buds soon burst, the blossoms appear, and by examining these with a microscope an expert is enabled to approximate very accurately the condition and value of the coming crop in a short time.

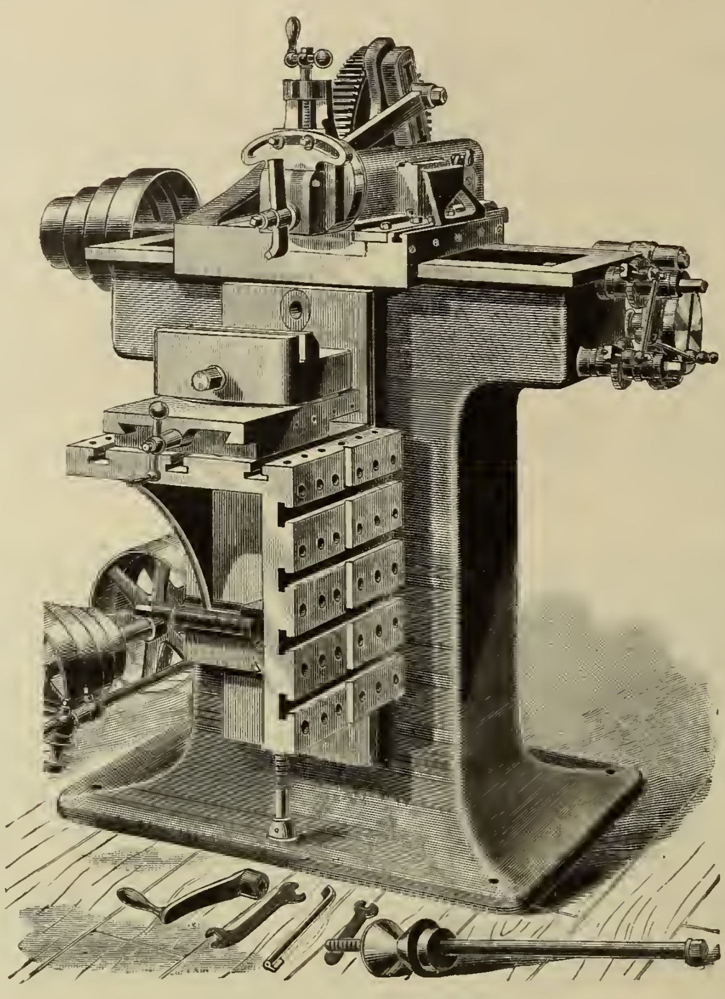
* * *

AN EASTERN contemporary says: "Will some of our readers please write an epitaph on our 'Engineer's Corner' for our next issue? It is evidently dead."

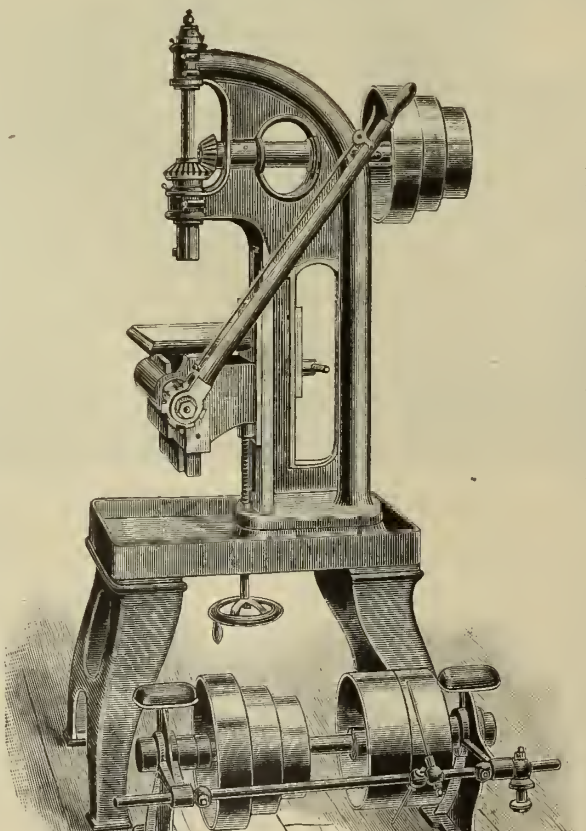
Yes, it is dead enough, and there is a very good reason for it.

STATIONARY ENGINEERS' ASSOCIATIONS have been chartered the past week in Rome, N. Y., Meriden, Conn., and Owasso, Mich. There will be more before there are less.

* * *



NEW SHAPING MACHINE.



NEW DRILL PRESS.

MINING FOR DIAMONDS in South Africa is a regular business and established systematically, with all the machinery and steam power necessary. The value of the industry is shown from the fact that in one year the value of the diamonds passed through the Post Office was $18,000,000, and it is thought that the main bed had not yet been reached.

CHEMISTRY HAS NOT been behind hand in its attempts to extract the natural odors of flowers. M. Millon, a French chemist, patented a process for extracting the aroma of flowers by placing them in a percolating apparatus and pouring over them ether or bisulphide of carbon, which is drawn off a few minutes after, and carries with it all the fragrant molecules. It is afterwards distilled to dryness, and the result obtained is a solid waxy mass, possessing the scent of the flower in its purest and most concentrated form. This process, although very ingenious, has not received any practical application as yet, owing to the expense attending it, some of these concrete essences costing as much as $200 an oz. It has, however, served to prove the total imponderability of fragrant molecules; for, although this substance, from its high state of concentration, appears at first to be the solidified principle of scent, if it be treated several times with alcohol it gradually loses all its perfume, and yet the residue is not found to have lost one atom of its weight.

THE *Industrial Review* says: "If the footprints of a man running be examined, they will be found to be all in one line, each thrust of the foot being straight toward his center of gravity, and, notwithstanding this and many other simple examples in animal mechanics, we go on placing the lower limbs of our locomotives (the cylinders) six feet, and sometimes even seven, apart." The cases are not analogous; there is a wide difference between the action of a man's legs and the drivers of a locomotive. "Prisoner at the bar," said a learned Judge, "You have had a good education and been well brought up, instead of which you go round the country stealing ducks."

* * *

BURSTING OF A TIRE IN THE LATHE.

A correspondent of the *London Engineer* writes to that paper, as follows:

"Not very long ago I saw a 5′ steel tire burst in the lathe. The wheels had not been long in the lathe, which was standing at the time. One-half of the tire flew a considerable distance, and would have killed had it struck anyone. The other half struck the slide rest, and sent it off the lathe, partly broken. No doubt the bursting of the tire was due to over-shrinking. In addition to the slide rest being struck, I was very much struck in another sense, at the whole idea, theory, and practice of tire shrinking. Had the tire stood until it was turned up and the wheels been finished and sent on the road, the result would probably have been death and destruction. Shrinking on tires in the usual way is not a safe method, however much may otherwise be said in its favor.

"I think, as a rule, locomotive wheels ought to be turned on their own journals; that is to say, instead of having them hung between centers, there ought to be a couple of plummer blocks to receive the journals, the same way as cylinders for paper mills are turned. The construction of wheel lathes could thereby be much simplified, and the wheels would be sure to be dead true with their journals. Of course in the case of the journals having to be turned up, that would have to be done in centers, but this is not often required."

* * *

SOME SINGULAR LETTERS get into papers. Here is an example: "I have been trying to run some brass boxes, but have met with no success so far. I was told to put borax with the brass and melt in a common coal stove. I did as directed. The brass after some time seemed to be in a melted condition; but when I poured it in the mould the borax seemed to run ahead of the brass and fill up the mould, thus spoiling it." And now he wants to know, presumably, what to do about it!

ON THE USE OF THE HYDROMETER AS APPLIED TO CLEANING BOILERS.

THIRD LECTURE.

By N. W. Williames, President Keystone Council Stationary Engineers, No. 1, Philadelphia, Pa.

In my last lecture I showed you the use of the hydrometer as applied to measuring the density of water, with considerable accuracy—the boiling point of water (by its density) being raised by foreign substances. This evening I will attempt to point out some of the dangers resulting from the increased density, viz: higher temperature in the water spaces, it being much higher than in the steam space. Many present witnessed the cleaning of a sectional boiler a few weeks ago, but I will explain to all how to clean boilers of organic, vegetable or animal matter; also to measure the substances taken from the water in the boiler by the use of the hydrometer. I will show you how to precipitate these vegetable and animal matters in the water, and how to ascertain to a certainty that the vegetable substances are lighter than water, and the animal matter heavier.

The boiler that I have just cleaned is of the sectional type, and known as the sectional boiler. It has been in use about fourteen years, and during five years of this time the condensation from the engine was pumped into the boiler. The remainder of the time the boiler was fed with Schuylkill water exclusively, through a coil heater.

The boiler is composed of 20 square slabs, 3 feet high, 3½ feet broad, and 4 inches thick, with 12 oblong openings in each slab. Each slab is connected with a 2-inch pipe, top and bottom, to an equalizing pipe on the outside wall of the furnace; 10 sections or slabs set in a nest. The 20 slabs have a capacity of 36·75 cubic feet when clean, or a capacity of 275·6 gallons when full. In a proper steaming condition it would have ⅔ of this quantity, which would equal 183·7 gallons, with 2 gauges of water. The boiler has 11 square feet of disengaging steam surface, 414½ feet of heating surface, and 169½ feet of steam heating, or superheating surface. It is made of cast iron, and rated at 30 horse power. In fourteen years use it had accumulated scale in such quantity as to fill up at least one-third of its capacity, and particularly at the steam and water lines of the sections, to such an extent in nine of the sections that the equalizing pipe had to be drilled to enable the 2-inch connecting-pipes to be drilled out, for they were completely stopped up with vegetable and animal matter. The boiler had become so foul that it must either be cleaned or condemned.

I will give you an idea as to how the boiler worked before cleaning. The engine delivered from 5 to 12 horse power from this boiler with two flush gauges of water, from 10 to 12 horse power was demanded from the engine suddenly. At such times the water would be lifted out of the boiler (it was in the cellar) into the engine. This was of the vertical type, and was in the first story, at least twelve feet from the water-line of the boiler to the top of the steam cylinder. It was only by carrying the water low in the boiler, and careful firing, that the engineer was able to get two-thirds of the power required. To throw this boiler out and get a new one would have been a great expense and a great deal of time lost. It presented the appearance of a first-class boiler, with the exception of being dirty; and believing that any boiler accumulating dirt, can be cleaned without disturbing it, I proposed this course, and, with the assistance of many present, I am pleased to say to-night that the proprietor and engineer consider the boiler as good as a new one. It is now impossible to lift the water with all the load that can be thrown on to the engine, or even make the water surge in the glass half an inch. We have tried to lift the water by building a heavy fire, letting the steam down to 50 lbs., and then putting a blast on and forcing the fire. The engine at this time was running with all its load on, a ½ inch pipe wide open to the sewer, and we raised steam from 50 lbs. to 75 lbs. in six minutes, without being able to oscillate the water in the glass one inch; while before cleaning, and the engine running without load, the water oscillated constantly, with only two gauges, from 2 to 4 inches. The pump, which is of the plunger pattern, 2½ inches diameter and 4 inches stroke, making 45 strokes per minute, was unable to supply the boiler through a ¾ inch suction pipe, from a tank 10 feet below the pump. Since cleaning, however, the engineer finds it difficult to keep the water down with the same pump. Half of the time his suction valve is not open ⅛ of a turn. I mention these things that you may be able to account for an excess of feed water used, without attributing it to leaky valves, pistons being out of order, blowing through, and spending time indicating; as this waste of water is not shown by the indicator.

The indicator tells a great deal, but inspection of a boiler will tell equally as much, and I believe that the study and use of a hydrometer is of the first importance. Dirty water, and the increased density which always accompanies that condition, necessitates a higher temperature in the water-spaces, in excess of that in the steam space, and I believe this to be one cause of weakening the shell of the boiler, and possibly producing explosions of boilers indirectly; for this constant, though imperceptible, movement of the shell from the variable temperatures, produces differential expansion in the parts of the boiler. To this cause I attribute breaking joints, cracking sheets, and opening seams. By the use of the hydrometer and thermometer we are able to detect these dangers, discover the condition of the shell as regards cleanliness, and find accurately the temperature required to make steam from any given water.

By keeping boilers clean, internally and externally, using comparatively pure water, and keeping the density at a minimum by blowing down in the morning, you prolong the life of the boiler, make steam freely, and reduce the chances of accidents materially. But I wish to caution you that this cannot be done by getting in the fire room at 6.45 A. M. and starting the engine at 7 o'clock. Many think it is smart to be able to bank fires with such nicety that they will have enough pressure to start with in the morning, and then blow up their fires and clean after they get started. This is a mistaken course. It is trying to do too much in too short a time, for the safety of any boiler, or those around them.

I stated in my first lecture the quantity of dirt collected in twelve months, without blowing out, in a 25 horse-power boiler, and in the second lecture I showed how to keep a boiler clean, how to operate the blow-off at the right time, and also its proper location.

I commenced to clean the boiler previously described at 5 o'clock P. M. on Saturday. The first time the steam was all blown off, but not the water. I had dissolved 50 lbs. of crude potash in one barrel of water, and applied it through an opening in the equalizing pipe to the boiler. Closing this opening I filled the boiler with water to the safety valve, having all openings shut on the boiler except a ½ inch pipe. I then started a fresh fire, got steam to 10 lbs. pressure, and purged the boiler until 9 o'clock P. M., at that pressure. I then carefully raised the pressure to 60 lbs. at 12 o'clock, and kept it at this pressure until 5 o'clock in the morning. At that time I drew five gallons from the boiler, by taking the top off the check valve, measured its density with the hydrometer, and found it was 70 ounces to the cubic foot, or 4·375 lbs. Making an allowance for part of the boiler being filled up with dirt, and taking 24·5 cubic feet, or ⅔ capacity of the boiler, we would have taken up, chemically and mechanically, 107·1875 lbs. At this point I ordered the boiler to be blown down to the bottom of the glass gauge. I then filled the boiler to the top of the gauge (it is 10 inches high) with fresh water, keeping the pressure at 60 lbs. I then filled it, and blew it down three times to the bottom of the glass gauge, and steamed the boiler for half an hour through a ½ inch pipe leading to the sewer. I then blew the boiler out completely, and left it to cool off. I examined it in the afternoon, internally, with a gas jet constructed for the purpose, and found that the lower parts of the sections and the lower equalizing pipes were as clean as when new. I then ordered the boiler to be run two weeks on its regular work; this was done, and the proprietor and engineer stated that it was working much better.

I made a second application of the purge on the boiler, with one hundred pounds of crude potash dissolved in two barrels of water, and applied it the same as before, under the same conditions. At 5 o'clock in the morning I drew two buckets of water from the boiler through the check valve, after blowing off a little, and found the water to measure 300 oz. to the cubic foot by the hydrometer, and so thick it was difficult to get the hydrometer to register accurately. Admitting the capacity of water space in the boiler, after purging the first time, to be larger by 27·42 cubic feet, it would equal 18·75 lbs. to the cubic foot, or 514·12 lbs. dirt taken out of the boiler with one hundred pounds of potash. The water was so thick in the boiler at this time that on blowing out the glass gauge it took some time for the column to equalize; and the engineer was in doubts whether we could blow the water out. It was almost as thick as mush.

I have precipitated some of the vegetable and animal matter. Part of it I have boiled down half of its volume. Seven and one-half quarts I have precipitated for your inspection. The brown substance is of a vegetable character, in a square cake, containing 37½ cubic inches, and weighing 17 oz. This divided into 1728 (number of cubic inches in a cubic foot), multiplied by 17 and divided by 16 for oz. would give us 48·8125 pounds; which again multiplied by 16 would give 781 ounces. This proves that it is much lighter than water, for a cubic foot of water weighs 1,000 oz. at 60°.

I will now invite you to try and sink some of it in a glass jar of water. I think you will find it is rather difficult to do; as much so as picking up mercury with the fingers. You will find this presents the same appearances on the water as mercury does on iron. The dust assumes a spheroidal shape, and rolls around like small particles of mercury on an iron plate. This is not all the vegetable matter got out of the 7½ quarts, for not having suitable apparatus to wash it after precipitating, considerable was lost; but it is enough to show that this inconceivably fine powder, now dried into a cake, combined with animal substance and a small portion of mineral, was sufficiently hard to turn the tempered edge of steel drills, in drilling the two inch pipe leading from the equalizing pipe to the sections in the boiler.

I have here 6½ oz. of animal matter, such as oil and other substances, which I estimate at a density of 68 lbs. or 1,088 oz. This, you see, is heavier than water by 88 oz. to the cubic foot. It presents the appearance of flint. The cleavage is very much the same as a flint used in gun locks. This is the substance in water that increases the cubic capacity rapidly, much more so than the vegetable matter. I find the boiling point of this water, at a density of 300 oz. to the cubic foot, to be 228° Fahr. in the open air, while of that in the jar, reduced to half of its volume, 0·37 pounds to the cubic foot, the boiling point is 237° Fahr. It is so thick that the hydrometer won't sink in it, and in a cold state it so coagulates that it will not break by turning the jar upside down. It is a jelly, in fact. I will explain how to precipitate the foreign substances, vegetable and animal, from the water.

After drawing the water from the boiler, by adding sulphate of zinc, or white vitriol, you will observe a brown coloring matter, until the bulk of the water assumes a milky, or a flaky appearance. You then add pure water again until the milky appearance passes off, and allow the brown coloring matter to settle. Now pour the clear water off, and by adding sulphate of zinc in excess, to the clear water, you will have a white, floculent substance, which should be allowed to settle. Again pour off the clear water, and fill both precipitations with fresh water and allow them to settle. Repeat this several times and you will wash out the sulphate of zinc, and leave the precipitate comparatively pure. The brown vegetable matter you can pour into a pan and dry out gradually; you can note its shrinkage, measure its cubic contents, and get its density. The animal matter you can evaporate to the consistency of soft-soap, turn it into a pan, and allow it to dry gradually on top of the boiler. It will assume a hard, flinty appearance, of a pale, brown color, due to a small portion of vegetable matter in it. All this you can do in several ways and with several substances. I consider the sulphate of zinc the cheapest, if not the best, to precipitate the vegetable and animal substances. I think after you have practiced awhile, you will be pleased with the operation and appreciate a clean boiler.

With these remarks I will close the lectures on this subject, hoping that I have conveyed at least one new idea; and in a few weeks I will renew the subject and explain how to clean a boiler of inorganic scale, which is much easier than with organic scale. Brothers! I thank you for your attention.

Of my lecture on the "Removal of Inorganic Scale," due notice will be given in The Mechanical Engineer.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

"READ, MARK, AND INWARDLY DIGEST."

Editors Mechanical Engineer:

Lately a correspondent expressed a wish to know the advantage of a condensing engine over a non-condensing; he was all in the dark about the value of the pressure of the atmosphere.

Unless an engineer possesses a knowledge of pneumatics he must necessarily remain in the dark concerning a great number of things which belong to his profession, for instance, draught of chimney, pumps and injectors, vacuum brakes, etc. Now, to properly understand the workings of the above, it is essential to know something about pneumatics, which simply means the science which treats of air.

Engineers should devote some time to mental culture; it is quite true that "much study is a weariness of the flesh," but I don't think it is right to neglect the intellect. No one knows what openings God may set before him in life, and should not one be prepared to take advantage of any that may offer in his line?

What a painful reflection it is for a man, when some rare opportunity presents itself, for bettering his condition, to say to himself: "Alas! I cannot avail myself of it; I am disqualified, 'tis my own fault, for I have made no preparation "

William Chambers, the great English publisher when speaking to a company of young men in Edinburgh, told how he devoted his evenings to study He said: "I did not read novels, but books on physical science. I look back to those times with great pleasure." He finished his address by saying: "I reaped more pleasure studying in a little attic in Edinburgh than I now find when sitting amid all the elegancies and comforts of a richly furnished house "

Our time in this world is too short to admit of learning many things well, but we have plenty of time to study some thoroughly, and obtain a slight knowledge of others, but "Whatever you take in hand, begin at the foundation of it, and whatever you know, know well."

Solomon said, "Get knowledge; but above all get understanding."

Walter Burdekin.

South Framingham, Mass.

A CORRESPONDENT COURTEOUSLY CORRECTED.

Editors Mechanical Engineer:

I was somewhat surprised at a letter I read in your last issue, in which a correspondent from this place states he "little thought the fly-wheel of that engine which he wrote about would burst, but such is the case."

He must have gained his knowledge at some distance from home. I am sure he has never been to me for any information in matters pertaining to this place. If he had, I could have put him on the track of what he desired. I have run engines where I had to use the starting-bar every day, when my engine was in such position that I could operate it; when it was not I had to use a little common sense with considerable elbow grease, so to speak. I think your answer to him on that question was to the point.

Now, in relation to the bursting of the fly-wheel No such thing has ever occurred. At the time of the last break down, which happened on the 17th of May, the gears were badly broken. A part of the gear on the crank-shaft fell into the wheel-pit; in so doing it came in contact with the arms of the wheel and three of them were broken, but they did not leave their places until they were taken from the wheel after the engine was stopped. The fly-wheel is put together in sections, and is a very strong, substantial affair, weighing over twenty-two tons, and in all the hard usage it got, the joints in the rim did not show the least sign of a crack. Had the pulley burst, as your correspondent said, I do not think I should have been alive to-day.

In reading the letter in question I notice that he refers to a former letter in relation to these works, in which he speaks of a previous break down, at which time the crank-shaft was *broken*. In this he is also mistaken. The gear on the crank-shaft was not even broken at this time. Does it look reasonable that a crank-shaft for an engine of this size could have been made and replaced in a week's time? I think the makers would hardly have got it from the forge in that time.

Your correspondent goes on to speak of the boilers. The number he gets all right, but in relation to the feed-pipes he is mistaken, for each boiler is provided with a check-valve between the stop-valve and the boiler.

The engine at these works was built by C. H. Brown, of Fitchburg, Mass., and is a first-class machine in every respect. The boilers were built by one of the best boiler-makers in New England, and the piping was done by one of our first-class concerns, and I know they would not neglect any detail to have things in proper shape. The safety-valve and other appliances connected with the boilers are in their proper places and in working order.

I have have no doubt your correspondent's intentions were all right, but would kindly recommend him to seek his information from reliable sources, and not accept as truth the reports circulated on the street.

George A. Henry,
Engineer Para Rubber Shoe Co.

South Framingham, Mass.

[Mr. Henry's closing advice is good In making any comments correspondents should be sure and get the absolute facts, otherwise great injustice may be done. We commend the tone of Mr. Henry's corrections. It is courteous, and commands respect.—Eds]

SUNDRY QUESTIONS FROM MICHIGAN.

Editors Mechanical Engineer:

Will you please give a rule for computing the centrifugal force of revolving parts of machines—also the tensile strength of iron and steel castings, and the weight per cubic inch of each?

Success to the *fortnightly* edition of The Mechanical Engineer.

Isaac Lehmer.

Sturgis, Mich.

[Centrifugal force increases as the square of the velocity. Where a number of bodies revolve around a common center, as on a locomotive driver, in the counter-weights and the connecting-rods, the common center of gravity must be found, and through this passes the centrifugal force, the same as if all were at one distance from the center. Every object has a center of gravity, and if that is supported the object is supported. To determine the center of gravity by computation is rather intricate to those not well versed in mathematics, but here it is:

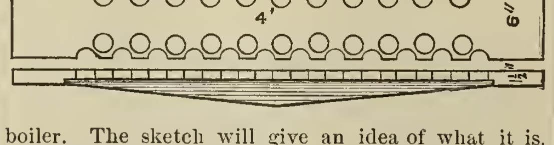
1. The center of gravity of a number of bodies not in the same plane may be found by assuming three planes, each cutting the other vertically. The distance of the forces from each plane, multiplied by the weight of each body, and all the momentums added, divided by the sum of the weights, will give the distance of the point of gravity from that plane. This, repeated with each body, will give the point of force for the whole system.

2. Tensile strength of iron and steel castings varies from 20,000 to 30,000 pounds for cast iron, and from 40,000 to 60,000 for best steel castings. Cast iron weighs 0.2607 of a pound per cubic inch—slightly over ¼ of a pound per cubic inch; steel castings about the same.—Eds.]

A GRATE BAR FOR BURNING SCREENINGS.

Editors Mechanical Engineer:

I have been interested in the question of burning coal screenings, or "slack," as it is termed here; and as I have had some three years' experience with soft coal screenings, what I have found out may be of interest to others. I use what we call a perforated grate bar set in a common furnace under a tubular boiler. The sketch will give an idea of what it is. The holes are ½″ diameter and 2″ apart. They have a well-defined taper from the bottom to the top, which allows anything that gets into them to fall through. When I lit my fire I first covered the grates with about two inches of slack, and then built on that. As it burned I added from time to time two or three shovelfuls of slack, until the fire was from 4″ to 5″ deep. Then I would begin to use my slice-bar by shoving the fire back on the grates, and lifting it up, thus letting down the ashes and breaking up the mass. Then, with two or three shovelfuls of slack, well spread, I have as hot a fire as I want. In three years I never broke or warped a grate bar, and at no time did I have any trouble about making steam. I would as soon burn slack as the coal that it is screened from. That is what I am using now, and on the same grate bars that I used for slack, with excellent results. I am using two boilers, turn about, and when I clean one out I pump the boiler nearly full of water and let it stand until cold; then I let the water out and turn or the cold water, pump full force (about 80 lbs. per square inch), and then watch the mud fly! The water I use forms no scale.



Thanks to L. P. Harvey for his ideas concerning flowers in the engine-room. I will try it and report results.

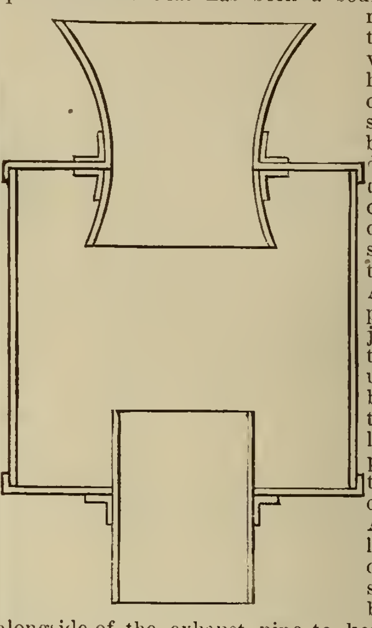
G. W. R.

Andrews, Ind.

EXHAUST PIPE NOZZLES.

Editors Mechanical Engineer:

"J. E. McC.," in the last issue, asks an interesting question—one that has been a source of trouble to many, viz.: ejection of condensed water from exhaust pipes. He cannot entirely stop the spray, but the largest drops of hot water that are forced up can be. Make a drum as shown in sketch, 20″ diameter and 3′ high. Allow the exhaust pipe, *B*, to project past the bottom about 6″. The upper pipe should be 1″ larger than the lower; this latter should only project a short distance above the drum inside pipe. A drain pipe, 1″, leads from bottom of drum to the sewer. It should be conducted alongside of the exhaust pipe to keep from freezing in winter.



Engineer.

Michigan.

FROM THE BROTHERHOOD No. 1, OF STATIONARY ENGINEERS, BALTIMORE, MD.

Editors Mechanical Engineer:

Our Brotherhood Number 1 of Baltimore, is making good progress. We are now working under the new rituals sent to us from the *National Association*, and electing new members at every meeting. I send by this mail a copy of our By-Laws, and to show you that we are being generally recognized as an institution, I send one of several telegrams received for Engineers. In answer to demands, I sent one to Philips & Co., Kent Island, Md.; one to N. C. Railroad Co., at Newport, News, Va., and one to Partner's Brewery, Va. Day after day we see the benefit of this good work, as President Cozens told us in our hall last Thursday night—Brother Hall has laid the foundation stone of the order in Maryland, which will be an honor not to be forgotten even long after he has returned to "that bourne from whence no traveler returns."

Last Wednesday I received a telegram from the President of the National Association, H. D. Cozens, to meet him at the depot. It took me quite unawares, but I was on time at the Union depot with carriage, and had the pleasure of seeing him. We proceeded to my residence where my family were in waiting for us, and took tea. After tea we went to the regular meeting of Brotherhood No. 1, Stationary Engineers Association.

When we arrived at the hall we found twenty-nine brothers present. I opened the meeting at once according to the new rituals, and after it was duly opened, I had the pleasure of introducing President Cozens to the Brotherhood. He responded with some appropriate remarks, gave us a glowing account of the organization, and, I must say, flattered us not a little, in my opinion, for in his remarks he said that No. 1 of Baltimore was far superior in their working to some associations that he had visited, that were much older than we were. He also said that he found No. 1 of Baltimore beyond his expectations; he congratulated us upon having such a fine organization. I responded, thanking him for his presence and the high compliments paid our Brotherhood. Treasurer R. H. Schultz, also made some remarks as did Brother Belcher. After the meeting adjourned President Cozens, myself and other brothers proceeded to Brother Schultz's residence, where we were handsomely entertained with music by Brother Pool's daughter and lady friends. On Friday I showed President Cozens around the city, to various places of interest, and on Friday night, by special request, President Cozens and myself took tea with Brother Pool's family, and spent a pleasant evening. I will here state that Brother Pool is not a member of the Brotherhood as yet, but is a member of 32 Marine Engineer's Association, and is chief engineer of the ship *Wm. Crane*, of the Boston line. Saturday morning President Cozens left for Philadelphia, no doubt highly pleased with his visit.

David E. Hall, President.

Baltimore, Md.

Draughtsmen generally may not be aware that a heavy, transparent "parchment paper," so-called, is in market, which can be used equally well for tracing or drawing, as it stands erasures and rubbing.

PAPER, SO-CALLED.

If persons are inclined to think that car-wheels are really made of paper, commonly known, or that this material when put into a wheel is exposed to any wear or abrasion, such as could be compared with the wear to which the rail is subjected, they would be led to change their views upon examining a so-called paper wheel. They would find a block of uniformly dense vegetable fiber, so thoroughly compressed in its manufacture as to resemble the best seasoned oak, with a steel tire, and so fitted, by turning and boring, that the pressure shall be transmitted to the rail by a uniform bearing upon each point of the whole surface of this so-called paper block. This block has passed through the paper-pulp stage, it is true, and is made up of many sheets of a true paper, but by the later details of the process through which it passes, it is as completely transformed from the paper state, as a brick is transformed from clay to the hard form in which it is used for building.

The endurance of the wheel is due to the steel tire. People would laugh if the proposition were made to take off the steel tires from the "paper" wheels, and to permit the wear to fall upon the fibrous material itself. This is in effect the precise thing which is proposed to be done in the use of a paper rail.

This remarkable pulp material, from whatever source it may be derived, is sought for in so many new and legitimate uses that it is a real wrong toward those who are seeking to extend its use to suggest it for such things as railroad rails.—*The Paper World.*

A MACHINIST IN SEARCH OF AN EDUCATION.

The subjoined letter from Boston, Mass., though not intended for publication, is of interest, as showing the popular feeling on the subject mentioned. We say popular because we have had many such inquiries propounded to us in years past, from all parts of the country, though none from persons as old as this writer. His aims are most laudable, and we are certain that, with his determination, he will yet make his mark in the world. We certainly advise our friend to carry out his plans; there may be some departments in the Massachusetts Institute of Technology where he can enter—with his acquirements, but if not there are other colleges which will receive him. We heartily commend his courage and convictions:

> "I have read your paper since it first came out, and like it very much. You must excuse me for trespassing on your time, but I would like to ask your advice
>
> I have worked about twelve years at the machine business, setting up and running, and in the shop. I really begin to think I don't know much about it yet. When I first commenced I thought I knew it all, after working two or three months, but have got bravely over that. I am thirty years old now, and am thinking of taking a four years course in some technical college; which one is the best? Is not the Massachusetts Institute about as good as any? Would you advise me to do it, at my age? I feel as though there was a higher niche in the world for me than spending my days at the vise, or in running tools and engines. I have not much cash to go on, owing to having a family and young children looking to me for support, but they are earning their own living now, so I can do what I want to—go to school—and I am going, *you bet!*
>
> I have only a grammar school education, with what I could pick up since. I don't know, but I think I can enter this fall. I shall have to work my way through I hardly know how I am going to do it, but "where there is a will there is a way."

Our readers will perceive a notice at the head of our editorial page, to which we desire to draw their special attention, and for that reason make mention of the matter again. "In time of peace prepare for war," and we are now planning our line of action for the year 1884. We have made our offer general, for in addition to our old and valued contributors we want some new ones. There are plenty of mechanics who can write, as we have found. Many new names have been added to technical literature through The Mechanical Engineer, and we hope for many more. The serial articles already published in the past volume have been very popular. We receive constant calls for the issues containing them from the beginning, and our correspondents (in all sections) allude to them as of the greatest value in their daily avocations.

INACCESSIBLE BEARINGS.

A correspondent of *The Builder and Woodworker* makes some good points on this subject, as follows:

"No man having charge of mill machinery should *ever* have any bearing so hemmed in or blocked up that oil cannot be got into the box at any time, even if the engine must be stopped for a moment to be *sure* the doubtful bearing is all right; for he knows as well as I do (and perhaps better) that it is safer, and very much cheaper to stop an engine five minutes than an hour, and may be a much longer time for hot boxes. I once had a box that I had to feed through a long tube, but I knew every day, and sometimes two or three times in a day, how my concealed protegé was getting along; and I tell you, 'Engineer,' that constant care and watchfulness is one of the very necessary things that a man *must* have to run machinery successfully, and therefore cheaply.

"It seems to be unavoidable sometimes to have lines of shafting that are hard to get at, and this should make us always careful to look out for just such out-of-the-way places. When we once get in the habit of looking after things it is not really a burden. It does not tax a man's mind that has the habit of smoking to light a pipe or cigar at any time. He never has to make a memorandum that at a certain time he must smoke. Quite the contrary. It often bothers him if he cannot have his *good smoke.* And it is just so about having the care of machinery of any kind. If you make it a *point* to see to it at regular intervals it grows into your life, and requires no effort to think of it."

A FEW FACTS ABOUT THE NEW YORK AND BROOKLYN BRIDGE.

The bridge has been thirteen years in building, and has cost about $15,000,000.

The two towers are each 274 ft. high and 1,595½ ft. apart. The length of the bridge between the anchorages of the cables is 3,500 ft., and between the termini 5,989 ft.

There are four cables, each having a solid section of nearly 145 square inches, and containing 1,732,086 lbs. of wire, with an estimated strength of 75 tons to the square inch.

It is 88 ft. wide, and 135 ft. clear above the water in the center of the span.

Construction was commenced January 2d, 1870.

Length of river span, 1,595 ft. 6 in.

Length of each land span, 930 ft.; total 1,860 ft.

Diameter of each cable, 15¾ in.

First wire was run out May 29th, 1877.

Cable making commenced June 11th, 1877.

Length of each single wire in cables, 3,578 ft. 6 in.

Ultimate strength of each cable, 12,200 tons.

Weight of wire, 12 ft. per lb.

Each cable contains 5,282 parallel galvanized steel, oil-coated wires, closely wrapped to a solid cylinder 15¾ in. in diameter.

Depth of tower foundation below high water, Brooklyn, 45 ft.

Depth of tower foundation below high water, New York, 78 ft.

Size of towers at high water line, 140 ft. by 59 ft.

The total height of towers above high water, 278 ft.

Clear height of bridge in center of river span above high water, at 90 deg. Fah., 135 ft.

Height of the floor at towers above high water, 119 ft. 3 in.

INSPECTION SERVICE IMPERFECT.

There is complaint among the licensed engineers as to the imperfection of the inspection service. Mr. James H. Reid, President of the Marine Engineers' Association, in a recent letter to the *Marine Journal*, treats this subject in an intelligent manner and makes some wise suggestions for remedying the evils complained of.

He says he is in receipt of letters from several licensed officers, complaining of the way in which some local inspectors examine some engineers and pilots, and to whom they give licenses. The reports are true, as some of the men that are going around with licenses, looking for positions, verify them.

One of these men came aboard of my boat a few days ago, and asked me for a second engineer's position, and showed me a license of a chief engineer, empowering him to act as such on a steamboat of 700 tons. I asked him if he had ever sailed on a steamboat, and he said no, but that he had worked in the shop a year, and that he thought he would like to sail, and that a friend of his was acquainted with the inspector, and told him that he could get him a license, and as it only cost fifty cents, he told his friend he would like to have one if he could get it for him, and if he could get on a boat he would stop working in the shop. His friend went with him to the inspector's and he got his license without any trouble, as the inspector did not ask him any questions at all. I thought that a strange way of granting a license to any man.

I led him to think that I was in need of a second engineer, and asked him a few simple questions, and I found that he was very deficient in the first principles of taking care of a set of boilers. I asked him what he would do if he was ordered to get steam as soon as possible? He answered: "Start a good fire underneath the boilers." I told him I had no use for him.

He asked me for a recommendation, and as it was the first time I had ever seen him, I could not do it, and told him that it was a good deal to ask.

I find that there are several of this kind looking for boats, and are on boats. One of these days, when boilers in charge of men of this kind blow up, and several are killed, the public will say it was a mysterious occurrence, and there was no one to blame; the engineer was a careful man and held a United States license, and the inspector states that he examined him carefully and found him well qualified, when, at the same time, he had never asked him one question.

This is not an imaginary case, for I know of two firemen that have got licenses through the owners of boats asking the inspectors for them. One of these same men had fired for me, and I did not consider him capable of attending to the water, and would not have trusted him to do so.

The law is good, and no doubt has been the means of saving property and lives, as inspectors are not all alike, and some try to enforce its provisions; but they are not supported in their efforts by some owners of boats as they should, for the "almighty" dollar is in their way, and that is all they care about.

Now, would it not be a good amendment to the law to require the Secretary of the Treasury or the Inspector General to appoint, in each district, say three good engineers, and three pilots to meet with the inspector and examine engineers and pilots, say twice a month, for, the way it is now, it is one man who is the judge of the applicant's qualifications, and he can grant a license, or refuse one, at his pleasure.

There is a Civil Service Board appointed to meet and examine clerks for positions in Government service. Ought not engineers and pilots to be as carefully examined? Are not their duties as responsible as clerks in the custom and other departments?

There can be found men in every district that would devote their time to such examinations without pay or reward, if necessary. This is the rule that exists in Great Britain in regard to granting licenses to engineers and pilots, and when a man obtains a license from this board he is well qualified to perform the duties of an engineer or pilot.

The Government of England claim that their officers are better qualified to perform the duties allotted to them than ours.

Had not this subject better be talked over before the next Congress by the licensed officers? And if it meets their views, then let them ask Congress to make an amendment to the law in regard to a board of this kind.

Jay Gould's new Yacht, the *Atalanta*, is credited with a speed of 17 knots on her trial trip, but trial trip speeds are sometimes much higher than any attained subsequently. Champagne makes a boat go very fast.

THE
Mechanical Engineer.
FORTNIGHTLY.
EGBERT P. WATSON & SON,
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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

FOUL WATER FOR STEAM BOILERS.

In many parts of this country the greatest difficulty is experienced from the nature of the waters indigenous to them. So impregnated are they with lime that boilers are seriously affected. Last week a milling firm in this State addressed us an inquiry concerning their difficulties with bad water, and asked for some directions upon the best way of avoiding the trouble. We would like very much to give them and others some specific information which would be available in all cases, but it is unfortunately impossible. Water is as variable in its constituents as the direction in which the wind blows daily, and the only way to cure any special case is to have a careful analysis of the water made, and apply a special remedy to suit it. This is not expensive, and we recommend it in all cases of the kind mentioned.

Aside from the nature of the water, the care which a boiler receives in its management has very much to do with its condition as to scale, and very bad water may be used without great injury if the engineer is experienced in preventing it. As to what should be done in such cases individuals can learn much from the lectures published in THE MECHANICAL ENGINEER on this subject, numbers X and XI, and current issue, by N. W. Williames.

Our correspondent asks if he should employ certain agents to settle the water in one tank before using it to feed from. This is done by some parties where large quantities are not used, but it obviously requires large tanks and time to be very effective. When the special cause of trouble is known, whether it be carbonate, or sulphate of lime, or of magnesia which is in excess, no difficulty is experienced in finding an antidote for them: but to neutralize them effectually the actual or average quantity of solid matter held in suspension must be known, and this, as before stated, requires a special analysis. We could not advise any one to proceed by haphazard methods. Where carbonates of lime and magnesia abound, which is probably the case in our correspondent's locality, for a limestone formation extends all through it, *carbonate* of soda is a useful antidote. This precipitates the scale-forming elements—carbonate of lime and magnesia—by absorbing the free carbonic acid in the water, and it will also decompose the sulphate of lime which is deposited, leaving harmless sulphate of soda in solution in the water. Carbonate of soda if used in excess, however, will make a boiler foam, and there is danger of corrosion above the water line.

There is scarcely an end to the substances which have been used in steam boilers to prevent scale, but we dislike very much to name them in this connection, for the reason that, in the special case mentioned, we do not know that they would apply. A locomotive superintendent in Missouri, very well known, once told us that, being greatly troubled by the water in that section, he had tried everything recommended, but had never found anything so effectual as a pint of linseed, weekly, in connection with thorough washing with hose. He said that, to whatever cause it was due, the linseed softened the scale so much that it came away like sludge. *Linseed*, not linseed oil.

We have ourselves used slippery elm bark, ground fine or in pieces, with good success in many cases, and this in limestone countries, where the water was very hard. A small vertical boiler, 20 H. P., that was so dirty with scale that it would not make steam, was treated with a pound of ground slippery elm bark, when, a week after, the old scale came away in great patches. Many persons put fine brush into open heaters with the object of forming a surface to which the carbonates will adhere, and those who have used it state that within a week's time they become thickly coated.

Obviously, the remedy in every case is to analyze the water and see what the principal element to be removed is, and apply the remedy indicated. Such an analysis could be had, doubtless, for $25, and it would be money well expended, so far as a steam boiler is concerned, for it requires very little scale to eat up $25 worth of extra fuel in a short time, to say nothing of the permanent injury to the boiler.

LABOR ON TOOLS IN DIFFERENT MACHINES.

It appears from a series of experiments made by the United States Government some time since upon eighteen different varieties of tool-steel, that the amount of work a cutting tool will do varies greatly with the machine it works in.

For example: A lathe tool will take off much more iron in pounds before it requires grinding than the planer tool, and so on in retrogression, through the various processes of slotting, drilling and chipping. Why some of these should give such widely different results is not clear. Turning is the same, apparently, as planing, with this difference: That the turning is constant and the planing is intermittent; the tool in the latter case has a period of rest and, it would seem, is better fitted to do more work, not in pounds removed in a given period of time, be it remembered, but in work done before the tool needed grinding; but as will be seen later in this article, the turning tool does more than twice the work of the planing tool, while the slotting-machine tool shows a remarkable depreciation. The drill, singularly enough, stands better than the slotting-machine tool; the amounts being as follows for the several tools just mentioned:

Lathe tools, in eighteen tests, made with eighteen different kinds of steel, under the same conditions, averaged twenty pounds of metal removed before they lost their cuts.

The planer-tools removed only nine pounds of metal before losing their cuts. The slotting-machine tools removed only two pounds before losing their cuts, while the drills removed about three pounds before losing their cuts. The continuous working tools, therefore, showed a higher average efficiency than those acting intermittently.

It is well known to machinists that planer tools will not last so long without grinding as lathe tools, but that the ratio of performance, one with the other, is so great few will credit, the planer tools requiring to be ground twice as often as the lathe tools, while the slotting machine tools have to be ground ten times as often. We do not think that this is correct as regards ordinary daily shop practice, and we shall be glad to hear from our friends on this subject who have opportunities for verifying the above under identical conditions.

It must be borne in mind that these experiments, which we find quoted in Thurston's "Materials of Engineering," were carefully made, and were not hap-hazard deductions. The steel was of the best, and many minor precautions, such as weighing the tools to see how much they lost by grinding and dressing, were made. These have no direct bearing on the matter of efficiency, but relate wholly to commercial values of certain steels.

In summing up the experimenters draw some "conclusions from practical tests," but they go aside from the issue, because they do not inquire into the discrepancies noted by us in relative performance, in special machines, under similar conditions of cut, feed, etc., etc. That there should be, and is some, we know of our own knowledge, but we do not think that the average planer tool requires grinding twice as often as a turning tool, when removing the same amount of metal in a given time.

TENACITY OF OPINION AMONG ENGINEERS.

Engineers have the reputation of being a most opinionated set of men, and perhaps justly. We know very little about other professions, but if they are divided into as many classes and schools as our own, with as many ways of looking at the same thing, it would not be surprising if differences arose. Mere tenacity of opinion in practical details is one thing, and the correct interpretation of theoretical principles is another. In the latter, there would not seem to be any opening for heresies, or grounds of opposition. Yet it is precisely in this direction that the widest differences appear.

It is not very many years ago that a well-known member of the profession advanced the proposition that weight in the reciprocating parts, the crosshead, the piston and the connecting rod, was an advantage, inasmuch as power was stored up or absorbed by them, and given out again when the steam exerted no impulse, as at the ends of the stroke for instance. The connecting rods, accordingly, of these engines were, to speak mildly, somewhat cumbrous ; the crossheads were mere lumps of iron, and the curious appearance resulting from this plan caused much comment. The theory alluded to gained some adherents, and a few indorsed this new gospel of engineering. Many engines were built in the manner described, and the father of the "anvil" theory was hailed as a new light. Somewhat later in his practice, the exaggerated features of the reciprocating parts were toned down, and were less obtrusive, until at this day they have entirely disappeared, and are, if anything, a little lighter than the usual practice.

A total abandonment of a radical theory like this is not unusual, and it serves as a mark for our article, in that it illustrates how far individuals may go, and how set they can be upon a hobby or an idea, not in the line of practical construction, but in the application of a theory, or, if we may say so, the invention of one.

It also illustrates another phase of the engineers' profession which accounts for their tenacity of opinion, and this is, that no matter what others may say as to the value of certain practices each one has to prove it to his own satisfaction before he adopts it. What seems good in the eyes of one is bad in the eyes of another.

Machinists are in the same category. They "prove all things and hold fast to that which is good—in their own opinion. One man uses a tool post with a beveled washer, and never has any trouble with it in a life-time. Another finds it an insufferable nuisance, and straightway invents something far worse. This accounts for the multiplicity of devices to attain a very simple end.

Paradoxically, this tenacity of opinion leads to the happiest results; for, without it, progress would be impossible. If all men were of one mind, and servile imitators of each other, errors would be perpetuated, and fallacies would be immortal. They die, because some man, tenacious of his own opinion and way of thinking, departs from the beaten path and discovers a shorter road.

* * *

SELF-FEEDING DRILLING MACHINES.

Self-feeding drilling machines are made, doubtless, which are entirely successful; but we have yet to see one that is adjustable for drills of all sizes and all speeds in all metals. It is a difficult problem to work out, for the rate at which drills cut is entirely conditional. Very many minor matters affect them. In certain kinds of cast iron a drill, properly ground, penetrates very rapidly, while other metals—wrought iron especially—are very intractable. When a drill becomes dull the pressure required on it is greater to keep it up to its work than when it is sharp, and an automatic feed that works well with a good tool is inefficient with a poor one. This is apparent to the man who drills; and, seeing that the feed does not work well, he throws it out and uses the hand-gear. Gears that feed by friction devices have this defect at times, for the friction adequate for a sharp drill is not for a dull one. Of course, there should not be any dull drills; but it is a long way to the grindstone sometimes, if it is only ten feet off, and sooner than take the drill out and grind it the average man forces it through.

Positive motion devices have the defect of doing too much. They feed at the same rate at all times, when the drill is going through or when it is just commencing the hole, and are very apt to break the drill off in it. A positive motion feed we once saw on a French machine was a very good one, in that it could be varied quickly to any degree. A vertical shaft by the side of the spindle had a small eccentric on it, which worked a rocker arm and ratchet on the main spindle, the same as a planer-feed. This could be set at once for any size of drill and any speed, and is efficient, reliable, and cheaply made. We have not seen all the self-feeding devices for drilling machines that are extant, and it is possible that we have unwittingly been unjust to some. If any of our friends make such tools, we will publish an engraving of them with pleasure.

* * *

INSPECTING ENGINES.

In another column we publish a most interesting communication on this subject from James H. Reid, President of the Marine Engineer's Association, wherein he gives an instance from his own experience which illustrates in a startling manner the necessity of reform in the matter of granting licenses to engineers—marine in this case. We refer the reader to the letter in question for the particulars.

An inspector's position is a serious one, and should only be given to persons thoroughly alive to the responsibilities they assume. All inspectors are not recreant, by any means; but, so long as politics have any influence in their appointment, there is danger. Mr. Reid suggests as a remedy that there should be a board of engineers and pilots, six in all, who should meet twice a month and examine candidates. This is a good idea, but it has the objection of being impracticable, we fear. We cannot see how such a board can be appointed, and we do not think the Inspector General has power to institute such a proceeding. Unless we are greatly in error, Congress alone can make any changes in the inspection service involving so radical a departure as is set forth.

The Inspector-General might issue a form, or series of questions, to be propounded to all candidates, and the inspector who examines them should be required to make an affidavit on the certificate granted that the candidate had personally appeared and answered the questions correctly. If this was done the inspector would have to ask questions, or palpably evade his duty and commit perjury.

Reform is needed in this matter unquestionably, and it is a subject demanding earnest thought and discussion as to the best way to reach the evil and destroy it. The great obstacle will be found in political influence, but engineers are a part of the community, and have as much voice in what affects the public welfare as other citizens, and they know how to make themselves heard when occasion demands. The leading men in various places should come together and discuss this question, and the good to all will be apparent.

* * *

SHORT-SIGHTED POLICY.

Every machine shop in this country should take every strictly technical paper in it; and the number of these is so small that the expense would be very slight, if that were of any moment. The amount of information contained in these papers in every number is astonishing, considering the rapidity with which they are issued. They are "guide, counselor and friend" in one, and if manufacturers were fully alive to their interests, technical papers would be as much of a necessity as the daily papers. It is rare that more than one is taken, and even that is not always read. From purely business reasons every shop should have all the technical papers in its line on file. Likes and dislikes have nothing to do with the matter, it is simply a question of business. The best mechanics in the country are giving their experience in all kinds of work, and some of the letters from them contain descriptions and hints that have taken years to acquire. It is poor policy to go without technical papers. Every shop should subscribe for all.

* * *

CONCERNING LOSS OF PRESSURE BY CARRYING STEAM LONG DISTANCES.

Various opinions are held regarding the loss of pressure and of temperature in carrying steam long distances, and quite recently a series of tables upon the subject have been published, which showed very great losses.

These, however, were calculated from Clark's tables of the friction of air in pipes, which perhaps are not wholly applicable to steam.

We publish on another page an account of some experiments bearing on this subject which, although made many years ago, are as valid as ever.

They seem to have been made by a careful man, thoroughly alive to the chances of error, and in fact endeavoring to disprove the evidence of his eyes. There may be other experiments, but if there are we have not heard of them, and shall be glad if persons will say where they can be found.

* * *

LIGHT DIMINISHES as the square of the distance from the body which produces it.

BOOK NOTICES.

THE MATERIALS OF ENGINEERING, Part II, Iron and Steel. By ROBERT H. THURSTON, Prof. Engineering Stevens' Institute Technology, New York: John Wiley & Sons.

This work is the second part of a series of three volumes upon the subject, and it is replete with information. So full, indeed, that a mere repetition of the titles of chapters affords but little insight to its value. All persons engaged in the manufacture of machinery, or the superintendence of it in process of construction, as also the student and seeker after information, should possess it. The fullest data in all points is concisely given, and (the author being an engineer himself) in such a way as to be assimilated by professional men. From the ore to the inspection of the finished product, the writer reviews the processes and gives facts which are necessary every day in the shop or counting room. We regard it as indispensable in every engineer's library.

PRACTICAL CARPENTRY, being a guide to the correct working and laying out of all kinds of carpenters and joiners work, etc., etc., to which is prefixed a thorough treatise on "Carpenters' Geometry." By FRED. T. HODGSON. New York: The Industrial Publication Company.

As may be supposed, from the brief summary above, this work is of great value to woodworkers, especially the class addressed, as it treats in simple and direct language of the best methods of doing certain kinds of work. Arches, roofs, sashes and skylights, joints and straps, hinging and swing joints, have chapters specially devoted to them, to which is appended a series of tables upon timber, forms of specifications and estimates, which are of great value. Carpenters, builders and millwrights will find this work a great assistance to them every day.

* * *

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXVI.

As promised in the last issue, I will state how the piece work job came out. There were 4,000 pieces to be drilled with a $\frac{3}{4}$ hole through $\frac{3}{4}$ iron, and a thread 6″ long cut on each piece. The drilling was done in eight working days of ten hours, and the threading in five working days of ten hours, and I call it pretty good work for two young men not out of their time. Average of the whole time on the job 13 days, and net profit to the boys over their regular wages $18; with which they were very well satisfied, and would be glad of more on the same terms. There was no more of this sort on hand, and Jacob dampened their ardor for piece work by saying, slyly, that it was always customary for bosses to cut down the rate on piece work as soon as they found out what a man could do on it; if they didn't, the bosses would not make enough, and the men would get rich too quick and cease to associate with common day workmen!

I have no doubt that with better tools, that is with a more powerful drill press than we have, the rate above mentioned could have been materially improved upon, for I read in the last issue of this paper an article on "Fast Drilling in Metal," which is far ahead of it; it speaks of drilling $2\frac{3}{4}$″ deep in wrought iron in ninety seconds, about half a minute to the inch, which is certainly rapid enough to suit anyone. But this was done by a twist-drill; whereas our young men used common lip-drills. The bolt cutting was also slow as compared with some modern machines in use, for we have had proffers of tools guaranteed to thread, for an average day's work of ten hours, 1,500 $\frac{3}{4}$ bolts cut $2\frac{1}{2}$″ up. I call this pretty fast work for regular business.

So far as regards the pernicious effect of piece work, as a spectacle to incite the other men to demand the same in their line, this job fell harmless. Not one of the men looked upon it in any other light than that of an incident in our daily routine. Jacob's apprehensions of insurrection and general dissatisfaction were not realized. I knew they would not be. We should not hesitate to put any job on piece work if it was of such a character that we could.

Nothing has puzzled me more than a crude experiment I made recently upon friction, and the generally accepted laws in regard to it. I yield to no man in due respect for authorities, and established data as regards mechanical practice, but I won't disbelieve the evidence of my senses for all that, and there is something about this friction business that needs overhauling, as regards the rules laid down for it. Briefly we are told that it is independent of the surfaces in contact—that is the area of them, but is directly as the pressure. Reading this one day for the thousandth time possibly, I went out into the shop and said to Jake: "Just center that shaft there for me, will you, and put it in the lathe. I want to try an experiment. Run a cut over it and make it straight, so it will be evenly balanced, and then turn the centers down, just as small as you can. Take a side tool and run as close as you can; center-drill the centers, and then cut the countersinks out."

Jake did this in about an hour, and said: "What do you want to do with it now?"

"I want you to tie a line to it, and wind it around three or four times, and then put it in the lathe again."

Jake did this, too, and then we put it between the centers so that it had just the least mite of end play; enough to say there was no end pressure on it. Then we weighted the line until the shaft turned around on its own centers. We then took it out and countersunk the ends, so that they were about ½″ diameter, across the countersink, and tried it again with the same amount of end play as far as we could observe with the naked eye, and the shaft would not budge with the same weight that it moved easily with before being countersunk.

"What's all that about?" said Jake.

"Why, I wanted to see if friction was independent of the surfaces in contact, as it is said to be. I find it isn't. If it was that shaft would run as easy on centers countersunk 4″ across, as it would on an infinitesimal point. If friction was directly as the pressure, and independent of the surfaces in contact, a platform scale might as well be hung on 3″ journals, as knife edges, for these latter are only put in, as I understand the matter, to reduce the amount of surface in contact, and consequently the friction; otherwise the scale would not indicate anything less than tons weight."

I said purposely that our experiment was a crude one, for I do not wish to appear superficial, or as one who draws hasty conclusions from very small grounds, but as far as the test went it showed that there was an element of doubt introduced as regards this particular form of friction, that is rolling.

Again: it is stated that velocity of surfaces in contact has no effect on the friction; it remains the same whether a body is running fast or slow. Is this quite correct?

If it is, how can we account for heating at high speeds when the same bearings run perfectly cool at less velocity? In one way we can account for it, for at high speeds more foot-pounds of work are done and the surfaces in contact are driven or pressed together with more force, but does the friction increase or decrease in the same ratio as the work done?

All these questions are of great interest to mechanics and engineers who wish to work rationally and arrive at conclusions by methods instead of guess-work. A man can figure very nearly the amount of work an engine will do at certain pressures, and points of cut-off, but he cannot figure the friction.

Since General Morin's experiments many years ago on this subject, none have been made that I know off; and it seems to me that with the increase of appliances for testing, and the delicate modern measures, to say nothing of the higher education of observers since Morin's time, there is an opportunity for investigation and experiments on the subject of friction. Practical experiments and experience does not agree with the dictum of Morin, and some machines, watches for instance, are made directly in opposition to it.

* * *

An oil cup could be made with a "brass wick" which would feed as well as a cotton wick, provided the brass wick was drilled full of small holes. The only trouble would be in keeping them perfectly clean and open.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. V.

By J. P. Mullin.

MOULDING HEAVY, WIDE-FACED BAND-WHEELS WITH SWEEPS AND DRY SAND CORES.

Among the many heavy castings required in the construction of general machinery, perhaps none are more frequently called for than band or balance wheels. There are, of course, several good ways of making such wheels without a pattern, and the plan shown herewith (although not perhaps new) I think is yet one of the best.

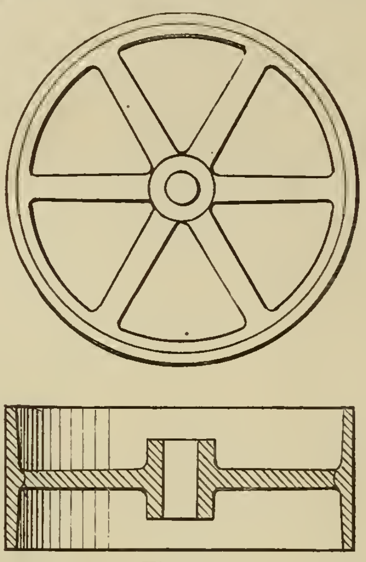


Fig. 29.

Suppose we need a wheel 8′ in diameter, 2′ face, with 6 arms, as in Fig. 29, we first make a segment of the rim, as shown in Fig. 30.

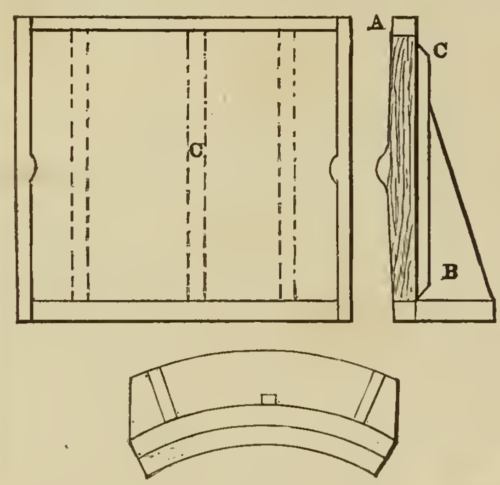


Fig. 30.

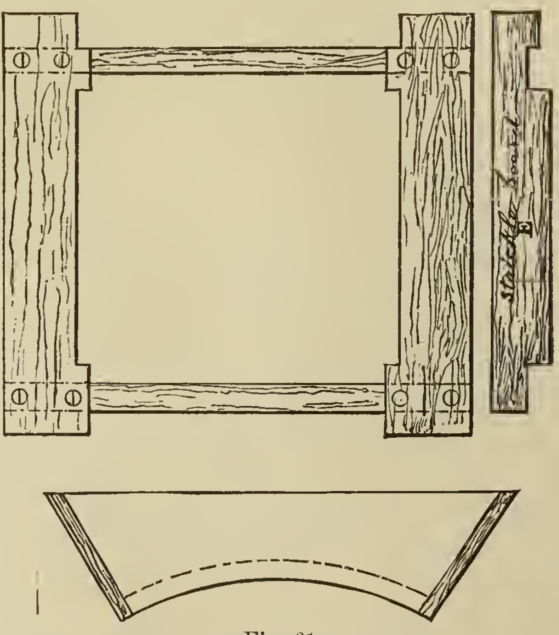


Fig. 31.

This segment may be made any convenient length—say from 2′ to 2′ 6″ long. On each edge of this segment we put a print, the full length and width, and about 2″ thick, as shown at *A A*. Also a bottom or steady-piece, and two braces, as shown at *B*. If the face of the wheel is rounding, we screw parallel piece, *C*, on the center. This is to be used for plumbing the face of the segment when moulding the wheel; Fig. 33.

Fig. 31 shows the box for making sectional cores for the face and edges of the rim of the wheel, as shown at *D*, Fig. 34. It is a plain box, open both top and bottom, and a strickle-board, *E*, used for scraping off the face of the core.

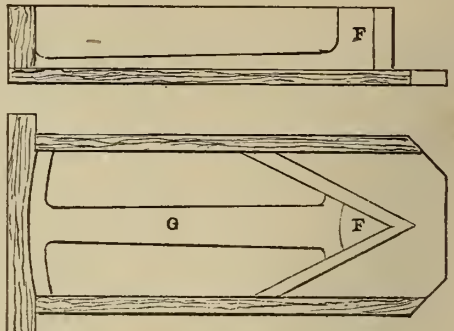


Fig. 32.

Fig. 32 is the plan and section of the arm core-box. It should be made half the depth of the full length of the hub of the wheel. For instance, if the hub of the wheel is 13″ long, the box should be 6½″ deep. A section of the hub and half the arm is set in the "hub end" and bottom of the box, as shown at *F* and *G*.

MOULDING.

Having made the proper excavation in the floor, bed for the mould and set the spindle and hub-core print, *H*, Fig. 33, we then take the sweep-board, *I*, Fig. 35, and bolt it to the arm of the spindle, as shown at *J*, Fig. 33.

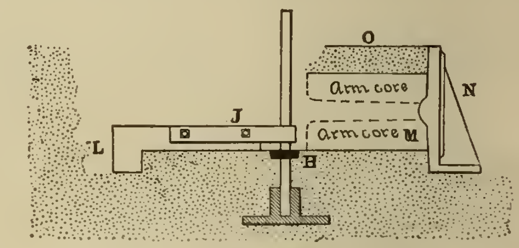


Fig. 33.

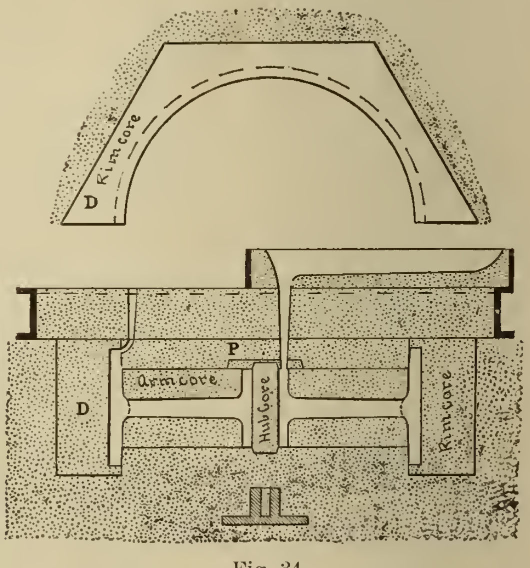


Fig. 34.

The projection, *K*, on the sweepboard must be the length of half the width of the face of the wheel, and the print, *A*, or bottom-board included, less the depth of the arm core-box.

Example: Half the width of the face of the wheel, 12″, thickness of print, 2″, 12″+2″=14″, depth of arm core-box, 6½″, 14″—6½″=7½″, as shown at *K*, Fig. 35.

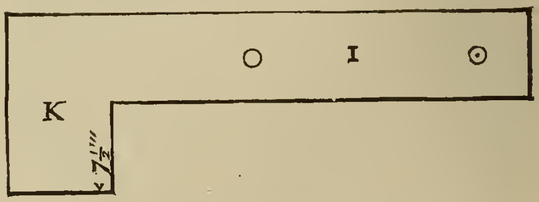


Fig. 35.

Having bolted the sweep to the spindle-arm, as stated above, we sweep out the same, as shown at *L*, Fig. 33, and form the bottom for segment of rim, and rim-core, *D*, Fig. 34.

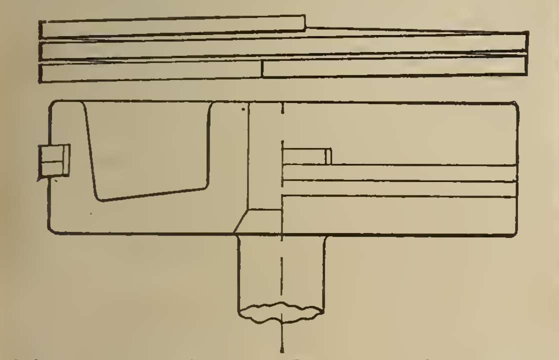
We now take off the sweep and set all the arm-cores, as shown above When this is done, take the segment of rim, set it in position as shown at *N*, and mould up level with the top of the print, as shown at *O*, moving it around from place to place until the circle is completed. We now set the rim-cores, *D*, fill in the sand, and ram up the outside, set the hub-core and cover it with cake-core, as shown at *P*. Set on cope-flask, ram it up, making feed-gates, risers, etc., as shown at Fig. 34.

* * *

"IN THE ROUND HOUSE."—No. 4.

BY BERKELEY POWELL.

There are three methods in vogue on locomotives for diminishing the leakage between the piston head and the sides of the cylinder in which it slides. One is to use packing-rings held out by several small springs. This, however, is rapidly being abandoned. It necessitates the removal of the front head every now and then to set out the packing. This often occurs when it seems impossible to spare time for the operation. The second is to admit steam pressure from the cylinder to the back of the packing rings. In principle, this is a good arrangement; but, in practice, it does not succeed very well. Its most serious drawback is that it does not wear the cylinder evenly, the pressure forcing out the packing not remaining constant. The third, and by far the most popular and successful, is to use simple cast iron or steel rings. These rings may be separate, or continuous spiral, and may have underneath, if necessary, one continuous plate spring, 1/8 in. by 5/8 in., or thereabouts. Mr. Joy, of England, has invented a packing which comes under the latter head, though I have never seen it tried; he does not use a riding ring. The head is made 1-16 in. in diameter less than the bore of the cylinder. A recess is cut with a tool set to 1/2 in. pitch, and making three inches more than two revolutions. The cast iron ring from which the packing is made is turned and bored 5/8 in. thick, and 3/4 in. larger in diameter than the cylinder. It is then placed on a mandrel and a spiral groove cut with a 1/4 tool set at 5/8 in. pitch, so as to form a spiral spring of 5/8 in. by 1/2 in. in section. The spiral spring gives probably a more uniform pressure on the cylinder than a simple ring, and its axial elasticity prevents its knocking in the groove. Continuous spiral packing is not generally known in this country. Nor when the simple ring is used does the thickness vary; it is always uniform throughout.



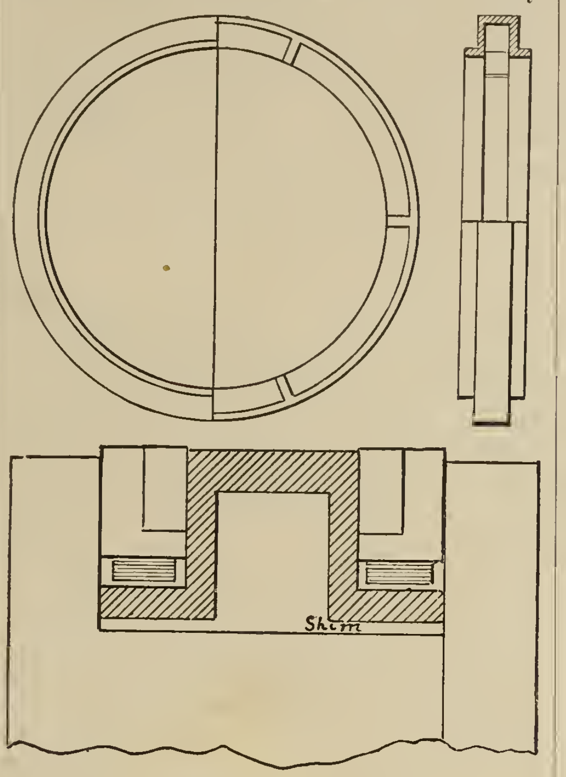
In England, on pistons for locomotives where rings are of uniform section, they are about 1 1/2 in. wide by 1/2 in. thick, two rings being used, and the split made with a half lap to prevent leakage. In this country, when no riding ring is used and rings have but one break-joint, they are turned 3/4 in. by 1/2 in.

There are so many different kinds of packing coming under the third head that it will be impossible to describe more than one with a drawing. It is about as successful as any, and is what is known as Dunbar's packing.

In this, one long plate spring is used, 1/8 by 5/8, under each ring. The riding ring is cored very light, as shown, and is turned 1-32 smaller than the bore of the cylinder. The cast iron rings are turned the same size as the cylinder, while the head and follower-plate are 1-16 inch less. The rings are four in number; the two larger rings have one side turned off to admit the 3/4 in. by 3/8 in. rings. They are each cut in three pieces and the small rings moved ahead one half length to break joint, and held in place by two small copper rivets.

Balanced valves upon locomotives are not generally long-lived. They are complicated and continually on the repair lists. Coal-cinders are the greatest enemy to the balanced valve, though the nature of the lubricant, or the unequal travel of the valve are also detrimental to its successful working.

Occasionally a furore about them spreads all over the country, and the primitive valve assumes all styles of neatly balanced architecture. This pyrotechnic outburst usually has a skyrocket existence, then out comes all the finery.



PACKING IN PLACE.

This excitement can be expected with as much regularity as the fashion plates for spring bonnets. We are just recovering from one of these balanced-valve panics, and our locomotives will soon subside into the plain, every-day, "only reliable." The evils of the plain slide valve, as used upon locomotives are greatly over-estimated, and its advantages seldom appreciated. I am willing to admit that there are good points to the balanced valve, and that in its unbalanced form it is laborious for the engine driver to operate it, but I simply won't listen when a man comes into the office to convert me to upholster my valves upon erroneous suppositions.

The man referred to always has a grip-sack containing a neat model of *his* "latest improved," and he usually opens the conversation by inquiring what length of port I favor in a sixteen-inch cylinder. I intimate that, were it possible, I would like them a yard long, but I find (16) sixteen inches is all that can be conveniently used. Then he attempts to show me the immense pressure that must come on the valve covering so large a port; he theorizes and multiplies the pressure on the valve by its area, which may be all right and proper. Practice, however, here, as in many other instances about the locomotive, conflicts with theory, and asserts that the steam pressure multiplied by the valve-area does *not* represent the actual pressure which forces the valve to the seat. The figures are altogether too much. I expostulate. I attempt to show the man that the motion pins and valve gear, by their life, prove to the contrary. I tell him that when the valve works particles of the steam find their way under it, and every microscopic hole in the seat is filled by the steam. This tends to lessen the pressure he has named very materially. He remains unconvinced, however, and wishes to be paid $50 per engine for his patent right. I tell him, further, that I have experimented practically with a testing machine, and find that I am right about the pressure, and he leaves, vowing that I am wasting large quantities of fuel by my obstinacy. From his standpoint I am insane. Every inventor looks at his particular hobby from a prejudiced position, and it is only natural.

If I ever get so that I can use a port longer than 16 inches on a 16 or 17-inch cylinder, and the engine driver expostulates, I believe a steam reverse gear to be much less expensive, on a locomotive burning coal, than a balanced valve. I will give him one.

* * *

ENGLISH LOCOMOTIVES.

The truth is, that it is in the performance of the boiler and furnace that the American engine shows the greatest defects. English engines burning the best coal and heating the feed-water by returning a portion of the exhaust steam to the tender, evaporate without trouble 10 lb. of water per pound of coal consumed, and an average result of 8 lb. with second-rate coal is by no means unusual. But we venture to say that the duty of the American locomotive, burning soft or bituminous coal, seldom approaches this figure. Careful experiments, indeed, have demonstrated that an evaporation of 6 lb. of water per pound of coal is good rather than bad work. Thus we have particulars before us of American engines with 17 by 24in. cylinders. The boilers had each 160 tubes, 2in. diameter and 11ft. 6in. long, the total heating surface being 1,254 square feet, the grates having an area of 15·6 square feet. These engines burned, when hauling a goods train of ten cars, weighing each, with its load, under 25 tons, 66 lb. of coal per mile. The passenger engines on the same line burn 50 lb. to the mile, with six cars, representing probably about 140 tons. The road is not heavy, and this is for both ways traffic. Such figures as these cannot be explained by anything but the bad performance of the boiler, and we may confine our attention here entirely to the difference between the American and the English system of making steam—for in this lies the true explanation of much of the contrast between the performances of the two types of engine.

The American engineer is troubled with sparks, and he attempts to get rid of the nuisance by going to the wrong end of the boiler. He burns his coal by admitting all the air required through the grate, and he has smoke as a result. Consequently the tubes become foul very quickly, and this entails a high smoke-box temperature and waste of fuel. In this country we employ a totally different and very refined system. Each fire-box is provided with a fire-brick arch almost covering the grate. In the fire-door is fitted a scoop or deflector, and below the fire-grate is an airtight ashpan. Some two or three hours before a fast train is taken out, the fire is made up and permitted to cake together. By the time it is wanted we have in the fire-box 8 to 10 cwt. of coal all, or nearly all, red hot. When the train starts a dart is driven into the mass of coal. The whole is broken up, and, stimulated by the blast, a vast body of hot gas is produced. The ashpan dampers are nearly or wholly shut and the fire-door is opened. Almost all the air necessary for combustion is then forced down on the top of the fire, and meeting the gas rising up under the brick arch perfect combustion ensues, and the fire-box does its maximum amount of work. When the run is of moderate length, say, from London to Brighton, a distance of fifty miles, no more coal is put into the fire-box on the run, a single fire sufficing to complete the trip. On longer runs, a somewhat different system is pursued, the furnace being supplied pretty frequently with a coal put with great care exactly in the right place on the grate, and the ashpan dampers and the fire-door are worked together, so to admit the proper proportion of air at each, which varies with the condition of the fire. To a large extent the fire-box of the English locomotive is a gas furnace; but this is certainly not true of the American locomotive, in which there is no brick arch. The American fireman, too, thinks that he does all that can be required of him if he keeps steam, while the English fireman is not content with this, but endeavors to get all the steam wanted with the smallest consumption of coal. In a word, we hold that one of the most important differences which exist between the two types of engines lies in the way in which the furnace is worked.

While Americans are advocating the importation of an English engine for the sake of experiment, we are better off. At a station not many miles from London lies the American engine imported from the States by Mr. Eames a few months ago to teach Englishmen how to build locomotives. This engine does not appear just now to belong to any one in particular. It might be worth while to find out its owner and hire it for a few months. It might be worked on both the English and American methods, and no doubt valuable information would be obtained. Meanwhile it is satisfactory to know that even Americans begin to admit that English engines are possibly better than theirs. If this be the case, they will also concede that they are the best engines in the world—a fact which many of our colonists would have done well to learn long since. However, better late than never; and unless we are misinformed, the purchase of American locomotives for British colonies has dwindled down to merely nothing. —*London Engineer.*

CONDENSATION OF STEAM IN LONG PIPES.

Some information interesting to engineers is an account of a subterranean engine erected in the celebrated "Gould and Curry" mine, California. The engine is 50 horse-power, and is 201 feet below the surface of the ground. The experiments were made in 1865 by Mr. R. G. Carlyle, Chief Engineer.

He says: "The mine was worked through three tunnels—upper, middle and lower—with a respective difference in their levels of about 225′ each. In consequence of a very heavy winter and the softening of the hanging wall of the mine, it became evident that the mine would cave or fall in; therefore it became necessary to project some other works which would secure the yield of the mine at a lower depth, outside or below the 'cave.' There was no shaft from the surface, so that there had to be put up temporary works in some secure part of the mine until a shaft could be put down from the surface. I then carefully considered the troubles arising from putting a boiler in the mine; and, on the other hand, the ease with which a steam pipe could be carried there from a boiler on the surface. In fact I had no other recourse, as, if I put a boiler in the mine, I would have to use part of the old workings for a smoke stack, but as that was going to 'cave,' I would then have had no smoke stack at all, so I resolved to carry the steam 1,300′, which was the shortest available distance to the surface. I had no data to work on other than the knowledge that, in some coal mines in the north of England, they have carried steam six or seven hundred feet for accessory work, from lower levels than the main pumping level. It was 'Hobson's choice' with me, but I was fully aware that I staked my reputation in the experiment.

"The boiler was of the common Mississippi style—two flues of 42″ diameter, 26′ long, and two flues 14″ diameter, having also steam and mud drums. The steam was taken from the steam drum and passed through a super-heater under the boiler—the same firing answering for both—and thence through a 4″ gas pipe down an air shaft to the lower tunnel, where I had fixed an expansion joint and also an accumulator; this was a small boiler, 30″ diameter and 5′ long—its object being to catch water in case the boiler should foam, or to drain the pipe beyond. As the pipe raised gradually from this accumulator to the engine, with the grade of the tunnel, it was in just the right place. The length of the steam pipe in the air shaft was 201′. From the accumulator the pipe ran alongside of the tunnel, to a branch tunnel, to the engine room—600′ long—in the branch tunnel—500′ long—and up a slight incline to engine room, 40′ more—making, in all, a steam pipe of 1,341′ in length. In the engine room was placed another accumulator, the same as the one at the bottom of the air shaft, but set on its end—the steam going in at its middle and out to the engine at the top. The object of this one was to catch whatever water might be carried with the steam, also scale from the iron pipes, and to form a kind of reservoir for steam; as the engine had a variable cut-off on, it acted as such to a considerable extent. On each of the accumulators was placed one of Furman's steam and water traps, also a gauge to note pressure.

"The engine was made at the Vulcan Iron Works in San Francisco, and was a horizontal cylinder of 14″ bore, 30″ stroke, and was used cutting off a half stroke. It hoisted a bucket for sinking purposes, holding one ton of rock, in one shaft 200′ deep; in another shaft a cage, with car and load weighing 3,000 pounds. The speed of hoist was 400′ per minute; it also worked a pump of 8″ bore, 4′ stroke, with its machinery in the third shaft. This amount of water was not much—about half the capacity of pump, as the pump was going sucking about half the time. The trips of hoisting were made about every ten minutes, respectively—sometimes both were hoisting together. The hoisting apparatus was of the friction variety—the same as generally used in these mines; in all I think the engine had to do about 35 horse-power of work.

"The steam pipe was 4″ gas pipe screwed together with flanges at intervals of 100′. For convenience of repairs, in every 400′ there was an expansion joint. The pipe was anchored to the side of the tunnel in the middle of that distance, so that it expanded both ways from that point. The casing of the pipe was of wood, made of two by 12″ plank—making a box of 8″ square inside, in the center of which rested the pipe on saddle pieces, the balance of space being filled with common wood ashes. The expansion of the pipe was very nearly 2″ per 100′, from 60° to temperature of the steam at 80 pounds pressure (325°). The difference in pressure at the boiler, from that at the engine, could not be detected; I changed the gauges (Ashcroft's) from the boiler to the engine, but no difference could be found. I even made two gauges of gas pipe, ½″, of common siphon shape, and filled them with mercury. I made them long enough to suit our working pressure, and still no difference in pressure between boiler and engine. I also made experiments without the super-heater, and found no difference in pressures. The only loss was an increase in the amount of water trapped off from the pipes. The loss would then be one cubic foot per hour trapped off; with the super-heater the loss was one-third of a cubic foot per hour. The amounts trapped off were accurately kept; these figures are the average, and not the result of any one hour, although it never varied much from what is given. When the flow of steam through the pipe was rapid it was less; when slow, greater.

"The fuel was common pine wood, using from three and a half to four cords per twenty-four hours—which will compare with any engine having short steam pipe and doing the same amount of work with the same kind of fuel. The engine ran in the mine over one year, during which time I made numerous experiments with it. It is now out of the mine, as they have no use for it in there. It was a complete success, as it did more than was ever expected of it, and enabled the company to declare dividends during the 'caved' condition of their mine.

"In conclusion, I would state that, as far as my experiments went, I see no end to the distance to which steam can be carried—it being merely regulated, more by the amount of condensation than by difference of pressure. I would not hesitate to carry it one mile, if I could cover the pipe well—that being the great point to be looked after."

MODERN MACHINE TOOLS.

By J. Richards in Engineering.

It is strange that several ages of experience have not served to determine the matter of material for the bearings of machinery. Something must of course be allowed for the discovery of new alloys and new uses that arise, also for new mechanical arrangements of bearings; yet, after all, one may find a great variety of opinions among engineers and mechanics respecting the value of different kinds of material. In this country this is still more confused by the extensive use of soft lining for bearings, poured in a melted state around shafts to secure alignment without boring; a common opinion being that the use of such alloys is to provide a suitable or better material than iron for shafts to run upon.

The determination of this problem of material for bearings would be exceedingly difficult if attempted. Time, high speed, pressure, the quality of fitting, added to the great variety of material to be experimented upon, make an appalling array of "factors," which no single firm can be expected to deal with in an experimental way; so we must, for a time to come at least, look to empirical sources for information. In respect to machine tools the problem of bearings is less difficult than in the case of many other kinds of machinery, in so far as avoiding heat or abrasion, but more important in regard to maintenance, alignment or wear upon the surfaces. We think it may be assumed as a general rule, that the harder the material for bearings the better. This is proved by the large proportion of cast-iron bearings employed and the good results such bearings give in working. In planing, shaping and slotting machines, the sliding bearings are nearly always of cast-iron. and run at a speed equal to the tool movement. These bearings are more exposed than in the case of spindles, yet they, as a rule, give no trouble and are expected to last for long service.

Why there should be one rule for flat and another for cylindrical bearings is not clear. The stress upon cylindrical bearings of lathe-spindles, for example, is greater than upon the slides of planing and other reciprocating machines, but the speed is. slower in most cases, the diameter of the work exceeding that of the spindles; yet it seems in modern practice that a different kind of material is required for flat and round bearings. It will seem a strange proposition that a cast-iron spindle on a cast-iron bearing is one of the best next to hardened steel, yet the experience of any one who has had opportunities of observation must admit this to be the case. Cast iron has much to recommend it. It is the cheapest material for bearings, as hardened steel is the most expensive; it is easily worked and fitted, and may be varied as to texture and hardness, the same as brass or other alloys.

The commercial cost of hardened steel bearings must always limit them to a restricted use in common machine tools; of their excellence there can be no doubt; long experience has proved that a lathe spindle mounted in such bearings will maintain its alignment for a lifetime. After iron, hard brass or phosphor-bronze is the most suitable material for bearings. The last, if properly compounded, gives good results. The difference of material between a spindle and its bearing is one of those opinions that may be safely disregarded; at least, it does not, so far as we have been able to discover, have much to do with the performance of running surfaces. The difference of granular construction and the "interlocking" of such surfaces, because of their uniformity, will not apply when a film of oil is interposed, as there must be and is in all cases, unless a bearing is hot or "grinding."

For slow speeds, such as are required in machine tool action, the abrasion of spindles and slides is not so much to be considered as in the case of high speeds, wood working machines for example, when there are good reasons for having the bushes of material softer than the spindles, so the former will be cut and the latter preserved in case of accident. The quality of fitting has most to do with the performance of bearings where they are subjected to great strain. The surfaces, especially for spindle bearings, are made as small as possible, there being no requirement of area for stability, as in the case of slides, and the pressure is apt to exceed the endurance of the surfaces unless all parts bear. This has been the principal obstacle to the employment of cast iron, because bearings of that material must be carefully fitted to begin with and kept in line afterwards. Soft brass or other alloys may be pressed into shape, or soon worn to a fit, but iron is more obdurate.

The mechanical construction of cylindrical bearings although rarely considered as a matter of importance, is nevertheless one of principal difficulty to contend with in any case where journals require to fit their seats. If no wear takes place and a perfect fit is secured at the beginning, there is no difficulty to contend with; but if compensation is necessary as is almost always the case, there is only a choice between plans, none of which are perfect, and some of which are wholly unsuited. Among the latter we must venture to include the split or half bushes, or "boxes." These close as two semi-circles, and are compensating in one direction only. The least wear destroys the fit, and the wonder is that lathes with their spindles so mounted will perform accurate work, a matter which must be assumed, because a very large share are made in that way.

It is not always considered that there should be as much strength provided to hold a lathe spindle "down" as there is to hold the tools "up," but such are the requirements in working. One advantage, and a very considerable one, in favor of split or half boxes is that a spindle can be put in place or removed after its driving wheels or other gearing are in place. It is true work well fitted may be put on or taken off a number of times without injuring a fit, yet a part subjected to such strains as the main wheel on a lathe spindle is as well to remain after being pressed on.

There are some obscure conditions attending on the action of rubbing surfaces in machinery. "Metalline" bearings are a case in point. These operate without lubrication, the surfaces becoming glazed, and in some cases performing very well. An example of this method is seen in sharpening tools on oil stones. If used dry the surfaces become glazed and abrasion stops; if oil is applied the stone becomes clean and abrasion begins. The writer some years ago was astonished to see in Sweden waterwheel shafts supported on bearings of granite stone, and was informed that the iron gudgeons stepped in that manner wore very well. There is undoubtedly much yet to be learned in the matter.

PREPARATION OF CARBON FOR ELECTRIC LIGHTS.

The chief difficulty inventors have had to contend with in producing an arc light sufficiently steady and reliable for general use have been, first, the necessity for adjusting the approach of the carbons so as to exactly compensate for the loss by combustion and mechanical transference of particles; and second, the impurities present in such forms of commercial carbon as were sufficiently hard and incombustible, and the loose texture and easy combustibility of other forms, such as wood charcoal, which are more free from impurities. The difficulties connected with the adjustment of the carbons have been very successfully grappled with by several systems of arc-lighting, but pure, hard, nearly incombustible carbon is still a desideratum in order to put an end to the capricious changes in intensity of color of the light which still distinguishes arc lamps from incandescent lamps.

Some interesting experiments on this important subject are published by M. Jacquelain, in a paper recently read before the French Academy of Sciences. Many will no doubt value the following summary of M. Jacquelain's theories and experiments. After citing the observations of Hare, Silliman, W. West, and Chevreuse on the passage of the electric current between different forms of carbon, and noting the introduction of gas-carbon electrodes, M. Jacquelain goes on to say: "As far as conductibility is concerned, the use of this hard carbon was preferable, and similar effects could be produced from wood charcoal only after it had been plunged red hot into mercury; but wood charcoal thus prepared gives off, when heated by the electric current, a notable quantity of mercury vapor, which, becoming condensed on the interior of the glass globe, injures its transparency. With gas carbon a deposit of alkaline-earthy silicates is formed, which also clouds the glass. These drawbacks were at first thought to be of little importance, but as soon as electric lighting came to be put in extensive practice it was seen that the presence of earthy matter in the gas carbon became a source of intermittence and irregularity in the intensity and color of the light. The numerous applications of electric lighting are thus beset with two difficulties inherent in the carbon employed—strongly-heated wood charcoal furnishing electrodes of small conductivity and too combustible, while electrodes of gas carbon are much harder, less combustible, and better conductors, but contain an amount of earthy silicates which interfere with the indispensable quality of steadiness in the light. The problem reduces itself to the preparation of carbon having better conducting power than wood charcoal, and if not quite free from hydrogen, at any rate containing no mineral matter. To attain this end three means may be employed: First, the action of dry chlorine on carbon at a bright red heat; secondly, the action of melted potash or soda; thirdly, the action of liquid hydrofluoric acid on the prepared pencils a greater or less time, according to the hardness of the gas carbon.

"The use of chlorine answers perfectly with finely-divided carbon. I have employed it with great success in preparing the pure carbon of the kind used by Dumas in his well-known determination of the atomic weight of that element. By the double influence of chlorine and a high temperature on carbon, the silica, alumina, magnesia, alkalis, and other metallic oxides are reduced and transformed into volatile chlorides, and all the hydrogen in the carbon employed is transformed into hydrochloric acid, and carried away by the current of chlorine. However, this processs, very efficient when small quantities are operated upon, becomes very long and troublesome when it is used to purify large, compact masses of gas carbon. The mode by which I propose to simplify the operation is to pass a current of dry chlorine for about thirty hours over several pounds of gas carbon, previously cut into pencils, and maintained at a reddish-white heat. This first operation, in consequence of the disappearance of silica and metallic oxides, hydrogen, and even a little carbon, as chlorides, leaves vacant spaces, which render the pencils more or less porous. In order to restore their original hardness and conductivity, they are now submitted for six hours to the carbonizing action of a slow current of hydrocarbon vapors at a high temperature. The hydrocarbon employed is a heavy coal-tar naptha, the vaporization of which must be regulated so as to yield only a slight deposit of carbon, otherwise the pencils may become completely coated and soldered together.

Caustic soda, mixed with three equivalents of water and melted in iron vessels, rapidly acts on the impurities in gas carbon, converting the silica and alumina into soluble silicates and aluminates of soda, which can be removed by washing with distilled water. A subsequent washing with hot dilute hydrochloric acid then removes oxide of iron and other metallic oxides, and a final washing with water removes all traces of the hydrochloric acid. The action of melted soda is completed in a time which varies with the hardness of the carbon and the amount of impurity. Three hours are generally sufficient, but to make certain it is best to incinerate a weighed portion of the carbon before and after purification. Purified carbon containing a few thousandths of ash furnishes a light of great beauty and steadiness. It is indispensable, before submitting a batch of carbons to purification, to ascertain by a preliminary experiment with half a carbon the degree of hydration of the caustic soda which gives the best results. If the soda is too strong, or the action too prolonged, the carbon may be corroded and rendered porous. The washed and dried carbons are finally submitted to the carbonising process mentioned above. The temperature at which a mixture of caustic soda with three molecules of water attacks the silicates should not be pushed so high as to volatilize two equivalents of water, for then the carbon is rapidly corroded, carbonic oxide, hydrogen and sodium vapor being produced.

"The third process of purifying gas carbon is by hydrofluoric acid. This operation is very simple, viz., immersion of the prepared carbons in hydrofluoric acid, diluted with twice its weight of water, for twenty-four or forty-eight hours, at a temperature of 15° C. or 25° C., in a rectangular leaden box furnished with a cover. The carbons are then washed with fresh water, then with distilled water, dried, and finally carbonized as in the above processes. Some samples of gas carbon are very refractory under this treatment; therefore the percentage of ash must be determined before and after immersion. Samples containing 3·602, 5·185, and 8·674 per cent. before immersion, gave after immersion 3·100, 0·900 and 0·767 per cent. respectively. The treatment of gas carbon by hydrofluoric acid is attractive from its simplicity and economy, but it must be borne in mind that the use of this acid, even when diluted with twice its weight of water, requires great care in order to avoid its contact with the skin, which is followed with virulent ulcers, with sharp pains and much inflammation. Above all, the acid fumes should be kept away from the eyes.

J. M. H. Munro, D.Sc.,
In *The Mechanical World.*

AMERICAN PRACTICE IN HEATING BY STEAM.

Steam mains and branches are apt to be noisy whenever any dipping bend or pocket in the pipes, or any recess in the fittings, allows water to accumulate, and become cooled below the temperature of the steam supply. In such cases a rapid condensation occurs there, and the steam rushing in carries the water along with it; or sometimes two opposite currents of steam, rushing into the vacuum, meet each other, and characteristic noises of rattling and hammering are produced.

Where separate supply and return pipes are used, whether the system of circulation be open or closed, they should everywhere slope downwards in the direction of the current of steam or of water. A fall of ½ an inch in 10 feet (1 in 240) has been found ample to provide against all sag of the pipes or other mechanical defects in the work, and to insure silent working. When the levels at which the radiators have to be placed do not admit of this slope being continued in the so-called horizontal supply main, vertical breaks are made in the line by the insertion of pipes of larger diameter, which are trapped by check-valves or siphons into the return main. In any extended distribution by separate supply and return mains, the supply main should be connected to the return at the remote ends by the method of open circulation; and between any parallel or not very distant supply and return pipes, occasional drips should be provided, at intervals of say 600 to 1200 times the pipe diameter, siphoned off to prevent any short circuit. Branches upon the horizontal mains, whether supply or return, should be connected upon the top of the main, not at the sides or bottom. Freedom for expansion should be allowed by horse-shoe or S bends, or when practicable by elbows judiciously arranged. Expansion joints are an established fitting for warming apparatus; but their use is not to be approved except in emergency. Repairs are facilitated by substituting at frequent intervals along the mains, in place of some of the screw couplings, cast-iron flange joints, the flanges being screwed upon the tube ends. Main pipes should in all cases be either carried on rollers or suspended, to allow freedom for expansion without straining the joints. The author does not attempt to describe completely all the minutiæ of detail in the construction of the mains for warming by steam; but simply notices some of the appliances commonly employed in America, which have been devised and worked out practically, and are regularly manufactured for general use

To prevent loss of heat, steam mains are protected by clothing. Felt is bound to perish when applied direct to a surface as hot as 200° Fahrenheit; and Rumford's air-space, formed by inclosing the main within a rather larger casing of thin cast iron, or of sheet iron either plain or tinned or zinced, is sufficient for enabling the felt to be employed as the clothing outside the casing. A covering of wire-netting has also been devised. Coats of porous terra-cotta or of porous plaster answer, by their low conductivity, to save the felting put outside them. Outside the felt again is applied some suitable sheath or protecting covering that will stand the exposure. When thus clad, the loss incurred in carrying a steam main to any distance—either out of doors, or inside rooms, in passages, in cellars, or in culverts or flues either underground or above—is found to be less than 1 unit of heat for each 100 square feet of external surface of the main itself.

In warming a room by direct radiation, the proper situation of the radiating surface for the attainment of an equable temperature is, in some respects, a moot question. As long ago as 1846 Dr. Morrell Wyman called attention to the way in which heat was distributed in any room, when the source of heat was situated as usual at the back of the room, against an inner wall, with windows and exposed outside wall at the front or side of the room; and he showed that a layer of highly heated air collected next the ceiling, whence descended a sheet of air along the cooler wall and window surfaces, becoming itself cooled in its descent, until at about the height of a man a uniform temperature of comfortable warmth was established throughout the room.

In warming by steam with direct radiating surfaces, the practice for many years was to arrange the steam pipes in lines or groups, called coils, along the bottom of the outside walls or under the windows. But present usage seems to indicate that better results can be obtained by placing the radiating surface where it will apparently be warming what is already the hottest part of the room; in reality, it then promotes the natural circulation, whereby the proper diffusion of the warmth is aided, instead of being retarded. For warming rooms in mills, the most recent practice is to place the direct radiating pipes in rows overhead, suspended a foot or two from the ceiling, and two or three feet from the outside walls. Although by this arrangement the heat would apparently be expended in the top of the room, yet very satisfactory results are thereby obtained, in regard both to equability of warming and to efficiency of radiating surface.

In rooms warmed by direct radiation, the attempt has repeatedly been made to effect the ventilation by admitting air direct upon the radiating surfaces; which are then placed under the windows, so as to intercept any descending currents of cooled air. Not much success has attended this plan, inasmuch as through some of the inlet apertures outward currents of warm air are then apt to escape from the room, producing no perceptible warming of the external air; while through others a flood of cold air enters from the outside, and, passing only some one coil or radiator, gets hardly warmed at all, the effect being far from comfortable.—*Robert Briggs.*

◆

According to the census returns the amount of "culm," or coal-dust, on mining anthracite coal alone, is 34 per cent.; this waste amounts to millions of tons a year. Many attempts hitherto made to utilize it by mixing with bituminous substances failed, but it is said that W. H. Carey, of England, has succeeded in making it of use. He mixes the coal-dust with a small quantity of dry fire-clay, and a small percentage of silicate of soda. The three materials are mixed and submitted to a pressure of one ton to the square inch of the block surface. The blocks are kept under cover for 24 hours, and become without any heating as hard as ordinary lump coal. Sir Frederick A. Abl, Consulting Chemist to the British Government, has made a very favorable report of this process, and its general adoption in Great Britain has been decided on.

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Where a policy of insurance requires that the insured shall truly state all incumbrances existing on the property at the time of the insurance, and also contains a condition that concealment or misrepresentation shall make such insurance void, a failure to disclose all the incumbrances on the property is such a concealment as invalidates the policy. Indiana Insurance Company *vs.* Brehon, decided by the Supreme Court of Indiana on May 29.

◆

The article on "Some Points about Twist Drills," in in our last issue, should have been credited to W. Ford Smith.

A MANIAC STATISTICIAN.

Some one in Kansas has been figuring up the actual cost of transportation, and comparing it with the prices charged by the railroads. The writer arrives at conclusions thus: "Let us look at the actual expense of bringing a train of thirty cars loaded with wheat from Chicago to New York—a distance of 912 miles. We will make a liberal allowance: For engieeer, $4 per day; fireman, $2; conductor, $4; four brakemen at $2 each, $8; $18 per day for a five-day trip, $90. The consumption of coal, $8; oil and waste, $4; use of cars at $4 each, $120; locomotive, $20. Total, $152; for five days, $760. Add to this $43.80 for interest at 10 per cent., and $43.80 for wear and tear, and we have $937.60. To find the cost per ton, at twenty tons per car, divided by 600 tons, we have the actual cost of $1.56 and a fraction per ton, or $31.20 per car. At the schedule rate of twenty cents per 100 pounds, we have $4 per ton, or $80 per car, thus leaving a profit to the railroad companies of $48.80 per car, after deducting the actual transporation expense. On a train of thirty cars, the railroad kings thus receive a clear gain of $1,464 net profit."

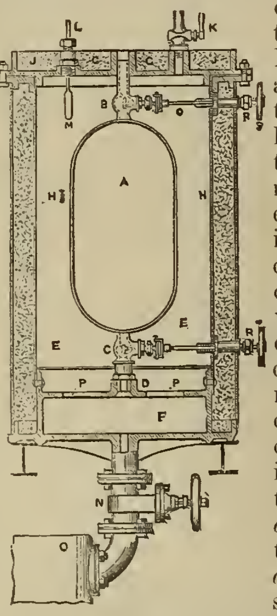
Friend, thou lackest! Who pays for the cars that go back empty, for the trains that carry nothing, and whence comes the profit of running a railroad in the dull season, when there is no traffic and the mourners go about the streets seeking freights? For some profitable trains there are many unprofitable.

◆

APPARATUS FOR MEASURING WATER MECHANICALLY SUSPENDED IN STEAM.

BY PALAMEDE GUZZI, C. E.

The greatest difficulty which is encountered in determining the coefficient of evaporation of a steam generator, or the weight of vapor produced in a given time, is in measuring the water which it carries over from the boiler by mechanical action. This problem, which has acquired a greater importance since Hirn, Lelontre and Hallauer, by their overthrow of the old theories of the steam engine, have opened the way to the true theory, is not yet completely solved. The only solution of real importance among the many which have been hitherto attempted, is the one suggested by Hirn, and followed by the distinguished experimenters of the Industrial Society of Mulhouse, and others. Even this leaves some uncertainty, so that the Mechanical Committee of that society has recently renewed its offer of a reward for a better method. Hirn's plan consists in measuring the total heat of a given weight of steam, and comparing it with that which would be found in dry saturated steam, as given by Regnault's formula. His apparatus consists simply of a coiled tube, surrounded by water. But there is some indeterminate portion of the energy of the steam, which is so transformed as to be incapable of measurement. The vibrations generated by the flow of steam, in the coil, and in the surrounding water and air, as well as in the boiler itself, represent a transformation of heat into mechanical energy. A part is manifested in the form of sound, and is lost; only a small fraction of the remaining portion can reappear in a greater elevation of the temperature of the water. Moreover, during the flow of steam and its condensation in the coil, recent experiments have shown that there is a conversion of thermal into electric energy. It is true that Regnault's experiments were made under similar conditions; but for that very reason there is a greater need of other means of experimenting for purposes of comparison or confirmation. I have devised an apparatus, consisting mainly of a vessel which is filled with the steam of which it is desired to measure the humidity, and which is protected, as much as possible, against radiation and consequent internal condensation. Its capacity, and the weight of the vapor contained in it being known, it is easy to ascertain the amount of dissolved or suspended water. This recipient, marked, *a*, in the accompanying diagram, is made of copper, in the form of a cylinder with hemispherical ends. It has an upper valve, *b*, and a lower valve, *c*, which is fastened by the screw, *d*, to the bottom of the chamber, *e*. This chamber, which serves as the envelope of the recipient, *a*, is formed of the double bottom, *f*, and the cover, *g*, which are both of cast iron, and the cylindrical sheet iron wall, *h*. The sides and top are protected by non-conducting materials enclosed in the external envelopes, *i*, *j*, which are made of polished brass. The covering receives the pipe leading to the valve, *b*, and contains the stop-cock, *k*, as well as the stuffing-box, *l*, through which passes the stem of the thermometer, *m*. The double bottom, *f*, is put in communication, by means of the receiving valve, *n*, with the steam-dome, *o*; by means of the openings, *p*, with the chamber, *e*; and, when desired, with the interior of the recipient, *a*. The valves, *b*, and, *c*, are worked by means of the hand wheels, *s*, and the spindles, *q*, which traverse the stuffing-boxes, *r*. In order to diminish as much as possible the transmission of heat from *b* and *c* to *s*, the spindles are made hollow and pierced with holes, so as to increase the surface of contact with the steam of the envelope, *e*, while the heat-conducting sections are diminished. In experimenting, the air is driven from *e* by opening *k* and *m*; *k*, is then closed, and after some time *b* and *c* are opened. After the air is driven from *a*, *b* is closed. After some seconds, when the equilibrium of pressure is established, *c* and *n*, are closed; the cover, *g*, is lifted, and the spindles, *q*, being withdrawn, the recipient, *a*, is removed to be weighed. The total weight, less the weight of the receptacle, gives the weight of the mixture of water and steam; deducting the weight of an equal volume of dry saturated steam at the same temperature, we obtain the quantity of water dissolved in the steam. Care is needed in determining the tare of the vessel, *a*. To take account of the vapor which is condensed upon the inner walls of the vessel and adheres to them, it will be well to experiment with a generator from which no other vapor has been withdrawn, and which has not been heated for some time. Subtracting from the weight of *a* thus filled with vapor, that of an equal volume of dry saturated vapor at the same temperature, we get the weight of the empty vessel, but internally bathed; this is the tare. The apparatus could also be applied to the determination of the density of dry saturated vapors, under high pressures, for comparison with the results of Fairbairn and Tait, and to find the values of r in the formula of Clausius, $A\,P\,u = \dfrac{r\,P}{T\,\dfrac{d\,P}{d\,T}}$, for comparison with those obtained by Regnault.—*London Engineer.*



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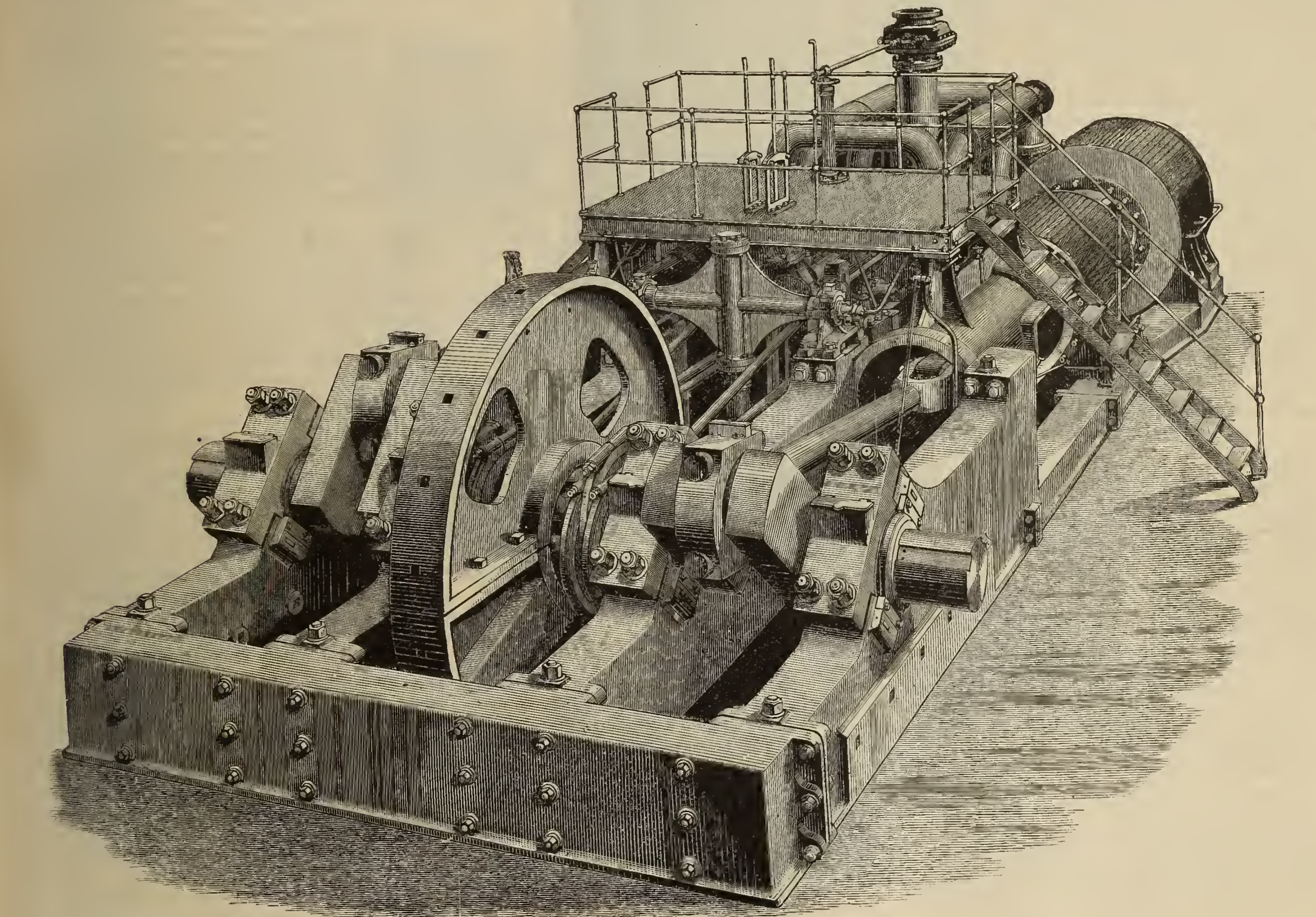
ENGLISH RAIL-MILL ENGINES.

Our engraving, for which we are indebted to *Engineering*, illustrates another English rail-mill engine somewhat different from others which have preceded it. This is a compound engine, made by Messrs. Tannett, Walker and Co., of Leeds, for the works of MM. de Wendel et Cie., France.

The engines have two high-pressure cylinders, each 34 in. in diameter, and two low-pressure cylinders, each 60 in. in diameter, all having 5 ft. stroke. The cylinders are steam-jacketed, and provided with piston-valves and link-motions, the latter being worked by a hydraulic cylinder for reversing. The crankshaft, which is of the marine type, is made in two pieces bolted together, and weighs about 13 tons. The pins are 18 in. in diameter and 15 in. long, and there are four bearings, each 18 in. in diameter and 22 in. long. The connecting rods are 13 ft. 6 in. centers. The engines are constructed to work at a pressure of 90 lbs. to 100 lbs. per square inch, and deliver their exhaust steam to a surface condenser, fitted with brass tubes $\frac{3}{4}$ in. internal diameter.

Messrs. Tannett, Walker and Co. have recently made seven pairs of engines of similar construction to the foregoing, which, with their condensers, weigh about 225 tons.



Multiply the length of a sheet of boiler iron by ·31831, and we have the diameter it will roll up to. This is convenient for boiler-makers who, having a sheet of given length, wish to know what size cylinder it will make. No allowance is made in the above for lap. Observe the decimal point; that is, point off five figures on the right, the remainder is the diameter of the circle.

It is stated that in order to pay 4 per cent. interest on the cost of construction of the New York and Brooklyn bridge, the sum of $1,600 per day will have to be taken in tolls. As these are only one cent for foot passengers, and twenty cents for teams, it will require a large "attendance" to realize the above sum. We do not feel it extra hazardous to predict that the interest in question will not be received. As a spectacle the bridge attracts only the wandering ruralist, at this season. Torrid heats blaze on its central span, and "the ascent is steep, and difficult to climb." It will be a brief nine day's wonder, and then the majority will cross over the ferry.

The mind becomes habituated to certain channels and trains of thought, and a man whose attention is always given to material processes, such as the work of tools, sometimes finds great difficulty in bringing his mind to bear on matters foreign to them. This is why many hesitate over simple things, and appear, to the casual observer, to be stupid, when in reality they are far from that.

Machinists and engineers express themselves tersely and to the point, the request appended being an example from Keeseville, N. Y.:

> "Please send me another copy, June 9th; mice chawed the other one, blast 'em."

The steamer *Bristol*, of the Old Colony Line, has an engine of 110 inches cylinder by 12 feet stroke, and the clearance between the piston and the cylinder-head is only $\frac{3}{16}$ of an inch Close work for so large a cylinder.

The Smoke-box Extensions of locomotives, now so popular as spark catchers, have been in use on the New York and New Haven R. R. for at least 16 years, the invention, we think, of E. J. Reed, when he was the master mechanic of the road; he is now vice-president. It has taken a good many years to get the extension into general use.

The number of individuals who expend valuable time in devising complicated fish-bait buckets, and similar articles, is not small, judging from the postal cards received by us. These cards contain printed offers showing that we can obtain these buckets, or other articles, by advertising the same to the extent of about $35, and trust to luck, possibly, to get the bucket, if we do. We are not in this line of business. We sell our advertising space for money, to regular parties in our trade.

An exchange says that recently there applied three hundred candidates in answer to a call for six clerks, and adds that "there is no such rush when capable mechanics are wanted." No, for the capable mechanic has no occasion to rush after a job.

Glass-houses begin work at 1 A.M. Monday and run continuously until 12 o'clock the following Saturday. Some branches of the trade begin work on Sunday at 12 M., says the *Crockery and Glass Journal*, but it gives no explanation of the why or wherefore of these unearthly hours.

Heavy machine tools in England are frequently driven by hydraulic power direct, particularly slotting and shearing machines, and it is said that the principle is extending.

STANDARD VERTICAL ENGINE.

BY THE NEW YORK SAFETY STEAM POWER CO.

The engraving represents a standard vertical engine which has been in the market for many years, and of which thousands have been sold. It is without doubt the most popular engine of its class, its general appearance and style having been imitated far and wide. The idea of its designers was to furnish a light and compact machine for small manufactures and generally in small powers, but the demand for it soon ran it up in size until many of them were made of 100 horse power. The catalogued sizes now run from 2 to 12 horse power. Aside from the symmetrical design, one reason for the general introduction of this engine is found in the excellence of the work and material employed. Both are of the highest quality, and, as a consequence, when once set at work, they continue to give good satisfaction for years. They occupy but very little floor space, and are easily got at for adjustment all over.

They are furnished complete in all parts ready for immediate use, with pump and heater combined, and with, or without, boilers, as may be desired. They are also fitted with link motions when desired, and many of them are used in small yachts, a position for which their lightness and high speed especially fits them. Improvements have recently been made in the valve gearing, which very much enhances its value. Circulars and price lists will be sent by addressing the New York Safety Steam Power Co., 30 Courtlandt street, N. Y.

THE SPLENDORS OF A MILLIONAIRE'S YACHT.

The *Atalanta*, Jay Gould's steam yacht, has been visited by the New York *Sun*, which gives the appended account of the fittings. The cost of this vessel was only $250,000, a mere trifle to the owner, whose wealth is counted by millions:

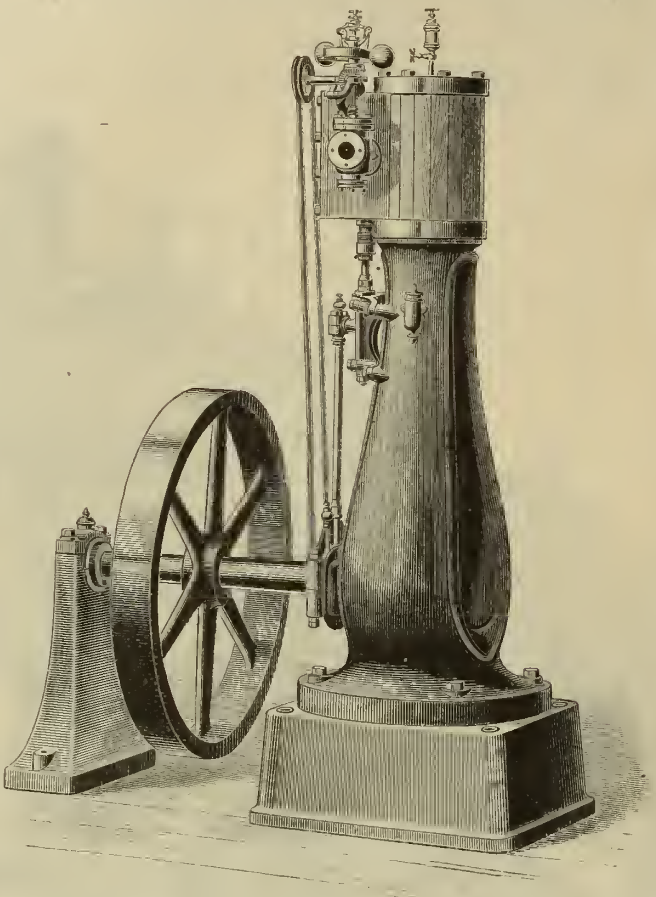
"In the *Atalanta* everything has been subordinated to speed. The result is that the accommodations are all limited. Mr. Gould's room is 13½ feet long by 9½ feet wide. It is the largest room in the yacht, with the exception of the main saloon. Mr. Gould can get at least seventeen knots out of the *Atalanta*, but he gets this remarkable speed at the expense of comfort.

"But if the rooms are small, the design is elegant. Mr. Gould's room is finished in mahogany. The ceiling is of the same, and the floor is inlaid with oak, with a handsome border. An Indian rug covers the center. The room is lighted by two port-holes. Between them stands an elaborately carved bureau, with a beveled plate-glass mirror. Many days have been spent in carving fantastic designs upon a desk filled with panels and secret drawers. A center table is a marvel of workmanship. At one side stands a wardrobe with plate-glass doors. One of these doors opens into a bathroom, fitted up in pure white maple. The bed, door, and window curtains, and the upholstering of the furniture are of rich tapestry.

"But it is upon the main saloon that the greatest amount of labor has been expended. This room extends from side to side, and runs forward 21½ feet. It is lighted from the deck by skylights, and from the sides by port-holes hung with rich curtains. There is not a square inch that has not been touched by the carver. The floor is inlaid with oak, mahogany and sycamore. The ceiling is of paneled oak. The sides are covered with panels of the most intricate pattern. At one end is an upright piano, carved in the same elaborate manner. Just above it is the monogram of the owner. It represents a jay-bird perched upon the tail of the letter G. There are fruits and flowers, and trailing vines and animals, and all sorts of curious and quaint designs.

"A passage-way leading forward from the saloon terminates in the collision bulkhead. Four state-rooms open into this passage-way from either side. They are arranged so as to be thrown into suites of two. These rooms are fitted up in the same lavish manner that characterizes everything else aboard the *Atalanta*. The woodwork is of cherry, ash, California laurel, butternut, sycamore, mahogany, and white maple. Each room has a bedstead, a bureau, a sofa, a washstand, and a desk. The curtains and the appoints are princely. The toilet sets are of triple-plated silver.

The engine has an indicated H. P. of 1,600. On the trial trip the other day, under adverse circumstances, it sent the yacht through the water at the average rate of sixteen knots an hour. Nothing has been overlooked. There is a machine which can produce 1,000 pounds of ice a day. There is another which can convert 500 gallons of salt water into fresh water in twenty-four hours. Electric lights in every part of the yacht—150 of them in all—illuminate the beautiful vessel from steam to stern. She will carry, besides Captain Shackford, whose salary is $5,000 a year, two mates, four quartermasters, two boatswains, a chief engineer and two assistants, three oilers, six firemen, the coal passers, a steward, three cooks, six servants, and eighteen seamen. The *Atalanta* is rigged as a three-masted schooner, and her delicate-looking masts can spread a good bit of canvas.



STANDARD VERTICAL ENGINE, NEW YORK SAFETY STEAM POWER CO.

* * *

In a recent *Chronique Industrielle* an account is given of the examination of a large cylinder in a Woolf engine employed in the mines of Sarrebruck. On opening the cylinder there was found upon the piston a brown, wax-like mass, weighing more than 150 kilogrammes. It contained 60 per cent. oxide of iron, 26·77 per cent. of organic matters soluble in alcohol, 5·7 per cent. of insoluble organic matter, the residue being composed of water with a little silicic acid. The cylinder had been in use about a year, during which time 192 kilogrammes of suet had been employed for lubrication. The decomposition of the suet by steam into glycerine and fatty acids led to the formation of a soap of protoxide of iron. The oxidation of the iron, which is limited chiefly to the interior surface of the cylinder, gradually produces an enlargement of the diameter. The evil may be obviated by using as a lubricant mineral oil of good quality, which boils only at a very high temperature.

* * *

Alloys of metals are often difficult to make and very small changes greatly affect them. The presence of $\frac{1}{30000}$ of a pound of antimony in a pound of melted lead increases the rapidity with which the lead oxidises and burns. Lead which contains more than $\frac{1}{14000}$ of its weight of copper is unfit for the manufacture of white lead. *Der Techniker* says gold with an alloy of $\frac{1}{2000}$ of lead is extremely brittle. Copper with ½ per cent. of iron has only 40 per cent. of the electric conductivity of pure copper. Nickel was regarded as a metal which could be neither rolled, hammered, nor welded, until it was found that the addition of $\frac{1}{1000}$ of magnesium, or of $\frac{3}{1000}$ of phosphorus, makes it malleable. Some varieties of cast steel are exceedingly brittle, but the addition of $\frac{1}{12}$ of 1 per cent. of magnesium makes them malleable. At the Paris Exposition of 1878 a great difference was found in the toughness of sheets which were made of Swedish puddled iron. The only difference which chemical analysis showed was that the good plates contained $\frac{20}{100000}$, and the bad $\frac{21}{100000}$, of phosphorus.

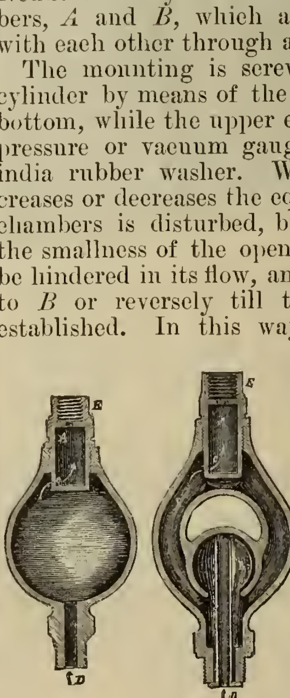
The Secretary of the Treasury states that no special acts of Congress regulate the conditions for opening draw-bridges on navigable waters, but that if a private citizen be aggrieved by the closing of a draw, he has his action at common law for damages; and possibly, under State statutes, a draw-bridge which was not seasonably opened might be indicted as a nuisance.

The receipts for the first month over the New York and Brooklyn Bridge were in round numbers some $27,000. This is a poor showing considering how many were attracted to it simply as a spectacle who will never visit it again. The amount for 30 days is only equal to $900 per day, when $1,600 is needed to pay interest at 4 per cent. on the bonds.

GAUGE MOUNTINGS.

Pressure and vacuum gauges are usually connected directly to the cylinders or vessels, the pressure in which they are to indicate. The changes occurring in the pressure are thus immediately communicated to the gauges, whereby the mechanism of the latter receives sudden vibrations which tend to impair their accuracy in course of time and shorten the life of the instruments. To mollify these sudden transitions, the mountings represented by our illustrations have been designed by Mr. F. Zur Nedden. They consist simply of two chambers, *A* and *B*, which are in communication with each other through a very small orifice, *C*.

The mounting is screwed upon the pipe or cylinder by means of the external screw at the bottom, while the upper end is tapped for the pressure or vacuum gauge with an interposed india rubber washer. When the pressure increases or decreases the equilibrium in the two chambers is disturbed, but in consequence of the smallness of the opening, *C*, the fluid will be hindered in its flow, and pass slowly from *A* to *B* or reversely till the equilibrium is re-established. In this way sudden changes of pressure in the pipes or cylinders are transmitted gradually, and the instruments preserve their accuracy longer and require fewer repairs.



According to the temperature of the fluids, the arrangement shown in Figs. 1 or 2 is used, the former filling itself in the lower part round the tube, *S*, with water, and thus protecting the gauge against the detrimental effect of the heat in a similar way as the usual siphon pipe. For vacuum gauges the simpler form can be used, as in that case no high temperature has to be feared.—*The Mechanical World.*

* * *

We shall publish in an early issue an account of some experiments with cut-off governors of different makes.

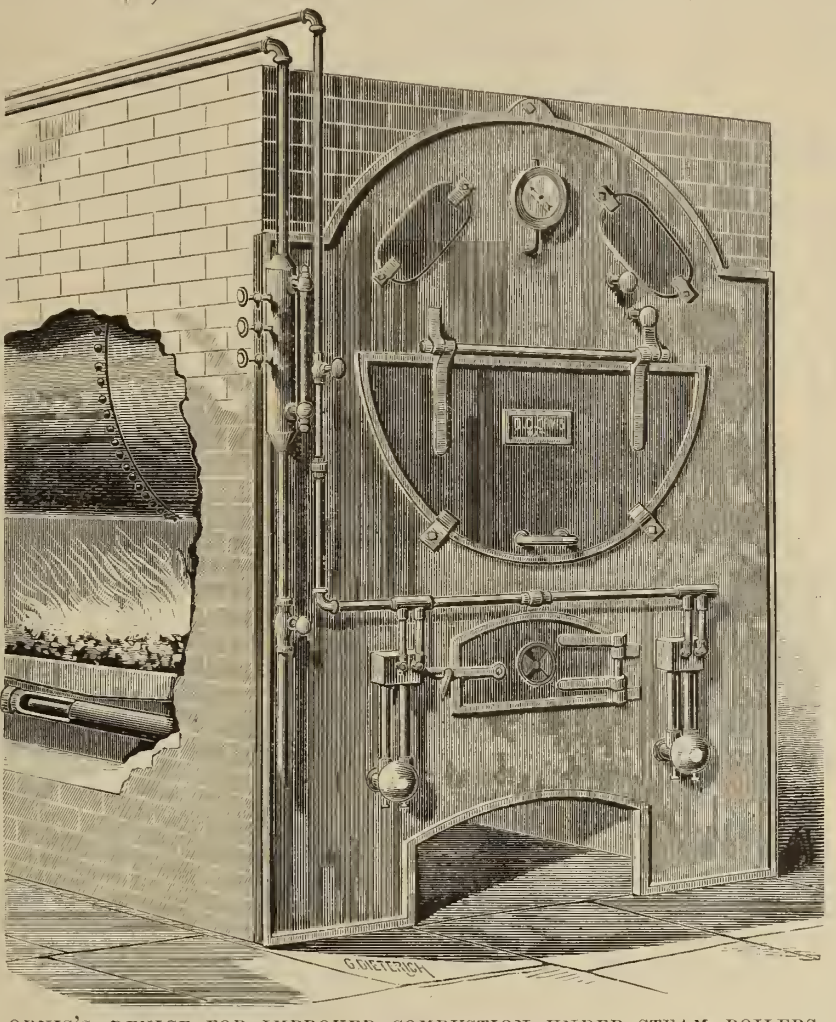
ORVIS'S DEVICE FOR IMPROVED COMBUSTION UNDER STEAM BOILERS.

With the attention now being given to better combustion under steam boilers, every device intended to attain this desirable end is of interest. One of the latest in this line is here illustrated, and is very clearly shown, as to its operation and attachments. These latter are very few and simple in arrangement, and the management of them is easily understood by any one.

Under normal conditions the ordinary steam boiler furnace is a crude affair, merely a chamber, so to speak, wherein fuel can be consumed in any quantity, and without economy; for, depending upon the amount of draft, natural or artificial, the products of combustion are driven through the flues at high velocity and in such combination that often the highest temperature is just where it is useless; that is at the top of the smoke-stack. This apparatus is intended to obtain the highest temperature where it will make steam, and to that end it supplies hot air, and steam as an agent, directly over the fire. In this way, by thoroughly commingling the products of combustion at a high temperature, and supplying oxygen at the time and place where it is needed, the best results are obtained.

The air is heated by a reservoir back of the bridge-wall, from whence it is taken by a pipe, shown where the wall is cut away on the left, and injected into the furnace by the apparatus shown in Fig. 2.

It is claimed for this arrangement that a greatly increased economy is apparent at once, not only in the evaporation per pound of coal, but in the condition of the fire surfaces directly exposed. Voluminous testimonials as to its efficiency are shown, which can be obtained by addressing the New York Combustion Attachment Company, 261 Broadway, N. Y.



ORVIS'S DEVICE FOR IMPROVED COMBUSTION UNDER STEAM BOILERS.

Some experiments on the comparative economy and advantages of firing boilers by gas over hand firing have been made at an English colliery. The boilers were set side by side, and were of the Lancashire pattern, 27 feet long, 7 feet diameter, with seven Galloway tubes in each flue. Three trials were made of each boiler, one trial extending over eleven hours, the result tending to show that the gas-fired boiler made 32 per cent. more steam than the hand-fired boilers in a given time.

Machinery for glass-blowing has now been introduced into France, at the works of M. M. Appert, at Clichy; and, from its great success, it may safely be predicted that it will become universally adopted. The glass in fusion it kept compressed in some reservoirs, whence is is allowed to run out to each workshop. The glass-blower then operates by means of an air tube provided with a regulator, which distributes the exact quantity of air required, together with the necessary pressure.

The *Scientific American* says: "Many a practical invention has been dropped before completion because of the inventor's discouragement and lack of push and determination. Twelve years ago a certain inventor filed in the Patent Office at Washington an application for a patent for the invention of a certain article. On some technical grounds the patent was disallowed. The inventor, in the meantime, had been discouraged by his friends, and so ceased pressing his claims. What, then, must be his surprise to find his invention now in quite general use, years after he had surrendered it to the public? The experience of this man is but a sample of the experience of thousands of others." Well, if this is surprising—where a man invents something and does not patent it, but some one else does—what name shall we give the sensation a man feels when he finds an article he *has* patented invented over again by some one else, and also patented? This is an insoluble conundrum, which we wish our contemporary would explain. "Interference cases" form a large portion of its business, so it ought to know the answer to the above.

One year's subscription for a copy of No. 1, Vol. V.

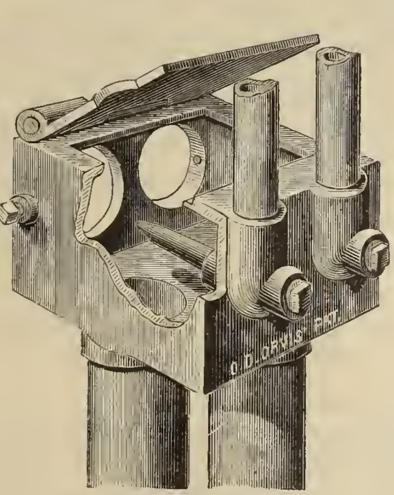


FIG. 2.

A man asked a paper for some advice as to buying a feed pump for his boiler, and this is what he received in return:

> "Whatever device may be selected for feeding boilers, it should be arranged so as to permit a constant feed into the boiler which shall exactly equal the evaporation; but this should not be the limit to its capacity. In selecting a pump, allow one cubic foot of water per hour for each horse-power of the boiler; the smallest size for the pump should be not less than twice that capacity when running at ordinary speed, and four times this capacity may often be found to be a useful reserve in case of leaky valves, pipes, etc., which are not only liable to occur, but at a time when it may not be convenient to take the pump apart for repairs. The above advice is safe to follow."

It is, if one can find any in it. Why not get a pump as big as a house and be done with it?

Chilled cast iron would seem to be one of the worst materials for armored vessels. Yet it has been experimented with in Europe, and pronounced very satisfactory.

Rumor asserts that another technical paper is to be established shortly in this city, with the venerable Dr. Grimshaw as editor, director, etc., etc. We shall be glad to learn this is fact, and wish Dr. Grimshaw much joy in his undertaking in advance. Advertisements, it is said, have been secured for many years ahead.

The director of the mint reports that the total production of the gold and silver mines of the United States in 1882 was $79,300,000.

A Baldwin passenger engine, 17" × 22", weighing about 36 tons, regularly takes a train of eight passenger cars, every seat full, from Elizabeth to Jersey City in 18 minutes, including slowing up for one mile and a half over the Bay Bridge. This is a fine performance, as for a good portion of the distance, $12\frac{1}{5}$ miles, the grade and curves are heavy. The rate is $35\frac{1}{4}$ miles per hour average time.

Concerning foundations for engines, it was stated at the last meeting of the *American Society of Mechanical Engineers*, by a Mr. Scott, that he had built a foundation on soft ground, driving piles and laying stone, forming what appeared to be a good solid base. When, however, the engine was run considerable vibration was experienced. He had found relief by trenching out lengthways in both directions, fore and aft of the engines, for some 30 or 40 feet, and had filled this in with heavy material. This proved successful, and the engine ran steadily.

PROPORTIONS OF COMPOUND ENGINE CYLINDERS.

A correspondent of the *Mechanical World*, who claims to have had extensive practice, gives the following rules:

The following will be found a rule for ratio of cylinders: Multiply the absolute initial pressure on piston by $4\frac{1}{2}$ and divide by 105. For instance, suppose best ratio is required for 80 lb. pressure, that is, 95 lb. absolute. Then we get by above rule

$$\frac{95 \text{ lb.} \times 4\frac{1}{2}}{105} = 4{\cdot}07$$

or a ratio of about 4 to 1. For 60 lb. we have

$$\frac{75 \times 4\frac{1}{2}}{105} = 3{\cdot}2$$

or a cylinder ratio of say $3\frac{1}{4}$ to 1, and so on. The best ratio of expansion (R) will be found by dividing the initial pressure (absolute) by 9. Thus, for 80 lb.

$$R = \frac{95}{9} = 10{\cdot}5$$

In view of the great loss, however, which takes place in practice in compound engines from condensation, etc., I have found it best, in making preliminary calculations, to assume a final pressure of $10\frac{1}{2}$ lb. and divide by this. Thus, for 80 lb. R would become

$$\frac{95}{10{\cdot}5} = 9$$

The ratio of expansion may be obtained from the cut-off by the following: Let

n = number of tenths of stroke during which steam is admitted to high-pressure cylinder.
r = ratio of cylinders.
R = ratio of expansion. Then

$$R = \frac{10r}{n}$$

If, therefore, cylinders were in the ratio of 4 to 1, and steam was cut-off at half-stroke in high-pressure cylinder, we should have $r = 4$ and $n = 5$, and thus R becomes

$$\frac{10 \times 4}{5} = 8 \text{ dimensions.}$$

I have generally found it best in an extensive practice to cut-off in the high-pressure cylinder at a little less than half-stroke, or say about $4\frac{1}{2}$ tenths, irrespective of pressure. This is, of course, where I have been free to adopt my own ratio of cylinders. Where the cylinders already exist, or are badly proportioned, the cut-off in small cylinder must, of course, be arranged to obtain the requisite number of expansions for the pressure available, or for getting out the power required. The rule given above for obtaining cylinder ratio is based upon a cut-off of $4\frac{1}{2}$ tenths in high pressure cylinder, and a theoretical terminal pressure of $10\frac{1}{2}$ lb. in low-pressure cylinder, which, in practice, generally comes out from 8 lb. to 9 lb.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

AN INCIDENT CONNECTED WITH STEAM LEAD SHOWING ITS ADVANTAGES.

Editors Mechanical Engineer:

I do not propose to do a vast amount of figuring to illustrate this subject, but simply to give an incident in which I was an actor recently, which speaks for itself.

I was called to examine an engine which was using 100 lbs of coal per hour more than it formerly did under similar conditions, and on arriving at the Works found an engine of 76 H. P. working finely, and with everything in and about the place in excellent order, externally. I applied the indicator and obtained a card which showed that the lead was so late that the boiler pressure was not reached until about the middle of the stroke. I moved the eccentric ahead on the shaft until I had a compression of the exhaust equal to about three-fourths of the boiler pressure, and there was an immediate change in the consumption of coal; it fell back to its original amount.

I noticed when changing the wheel that it had not slipped but had been set where it was, and I made some inquiries. I found that the engineer in charge had intentionally set the wheel in that place, for the reason, as he said, that he always ran engines in that way, the steam having then full force (at mid-stroke) on the crank when it was at its best point! Seeing that this person had very little knowledge of the subject I did not argue the question, but merely requested the superintendent to see that the wheel remained where I put it and left.

I think there may be some others who have similar ideas, who may, possibly, see this letter, but if they have such views I think the points here advanced may serve to dispel them.

Steam should be admitted at the beginning of the stroke, or a little before, to get the reciprocating parts in motion, so that when the crank is on the quarter center it can be acted on to the best advantage. Steam should be admitted at the beginning of the stroke to relieve the shock caused by the change of direction of motion on the bearings, thereby making the engine run easier. Steam should be admitted at the beginning of the stroke until the point of cut off is reached, so as to obtain full expansion and a low terminal pressure, for a high initial, and a low terminal, combined with the point of cut-off suited to the work, are essentials of economy.

To put this in a few words, as high an average pressure with as low a terminal (above the atmosphere) as possible is desirable. Where steam is admitted late the piston is traveling faster than at the beginning of the stroke, and the space to be filled by it is constantly enlarging; it expands continually in following up the piston, and does not reach the initial pressure possibly at any time.

Now, as to compression: Why is not high compression economical? If we wish high compression we have to confine the exhaust earlier, and the cylinder is, therefore, not exposed so long to the lower temperature of the exhaust, and there is not so much condensation when live steam is readmitted to the cylinder. This would seem to be in favor of the link-motion, for with that, on high cut-offs, compression is enforced. Or does compression mean a loss of power and demand a larger cylinder for a given amount of work? I would like to have the views of others on these subjects.

Allow me to thank "Caution," of Troy, N. Y., for his communication through your paper, I will communicate with him shortly.

Brooklyn, N. Y. A. M. Z.

LEARNING BY EXPERIENCE.

Editors Mechanical Engineer:

I send you a clipping from one of our evening papers, by which you will see that the owners of the factory where a boiler recently exploded, killing the engineer and destroying the building, have now learned by experience that a boiler should be made of good material, in place of the poorest, as the one that exploded is said to have been. A great many boilers are injured by improper setting, causing unequal expansion, rendering the boiler liable to give out without warning.

The boiler that exploded was connected to the other two by a mud drum underneath, feeding into this drum from the force pump.

There was nothing to prevent the water leaving the boiler that had the heaviest fire under it for the one that had the lightest. I think that the engineer was not to blame for low water, but the man that designed this arrangement was. I have seen water leave boilers connected in this way, and the engineer had to draw the fire to save them.

You will also see that the boiler-maker and owners have seen their error by the change in the plan of the new boilers Experience is good if it does not cost too much, as it did in this case, for the total destruction of the factory and the lives of two men was the price paid.

The item I alluded to is this:

"At the time of the boiler explosion at the Wolverine paper mills there was some talk as to defective construction of the boilers. Neither the torn one nor the whole one shows a single rivet opening or leaking, and Mr. ——· says that either of them would have stood a fair pressure of 350 pounds to the square inch before 'letting go.' But before bursting with any such pressure they would have been leaking at every seam and rivet, which was not the case. F. A. Blackman, superintendent of the Wolverine Company, yesterday gave an order for two new boilers of about the same size, but made of steel. The old boilers were set so that the heat from the furnace went all around them, but as a matter of extra precaution these will have a wall separating the furnace from the top of the boilers.

Detroit, Mich. James H. Reid.

EXPERIENCE MAKES AN ENGINEER.

Editors Mechanical Engineer:

I have tried several mechanical papers, but, my mind being filled with engine-work, have never found what I wanted till I saw yours about one year ago, and have bought it ever since; and I can but wish it success, as many have done before me, and as many others will in future.

If I may be favored, will you answer the following questions:

1. How best can I (a young man, 23 years of age), having some knowledge of steam, run a small stationary engine, and worked $2\frac{1}{2}$ years at the machinists' trade, become a thorough marine engineer?

2. Do you know what the demand in that line is at present?

3. As the system is to-day, does the shop (engine-shop) have any advantage over the school of technology, or *vice versa; i. e.*, can a man learn engineering in a shop where the engines are built and given out, to each a certain part, as well as he could be taught in the Boston Institute? Or is it best to work one's way by promotion on board a vessel? J. H. N.

Waltham, Mass.

[We are never tired of answering these letters, for it is within the province of our paper to give information on the points in question. We trust that all others who have the same calling in view will take this as addressed to them also.

The only way to become a thorough marine engineer is to begin at the bottom and work up to the top; then a man is sure of having had experience in all details of it. The most successful men are those who began when young in an humble capacity, and obtained promotion through merit alone. A man cannot learn to be a marine engineer, or any other kind for that matter, by working in a shop, and least of all can he learn to manage an engine in a technical school. That institution teaches him theory and the elements of practice, but no more. In a word, experience makes the engineer; there is no short cut.—Eds.]

FROM PRESIDENT FOSTER, STATIONARY ENGINEERS' ASSOCIATION NO. 2, NEW HAVEN, CONN.

Editors Mechanical Engineer :

Perhaps a few words from the *Stationary Engineers' Association No.* 2, of this city, would interest other organizations throughout the land. I would say that we were fully organized June 20th, with 47 names on the application for a charter, of which 25 came in on the eve of the institution; and as we hold our next meeting to-morrow night, a goodly number of the rest will ride the *goat!*

Our list of members comprises all the leading engineers of the city, and they are very enthusiastic about the organization. Manufacturers are taking an interest in us, and think, as we do, that it supplies a want long needed, and that if the engineers hang together it must be a success.

Below I send you a list of the officers:
President—Frank A. Foster.
Vice-President—A. G. Worden.
Recording Secretary—Hopkins A. Sanford.
Financial Secretary—Saul Sanford.
Treasurer—Dwight C. Beach.
Conductor—Wallace Holt.
Doorkeeper—E. E. Gillette.

Frank A. Foster.

[Our friends will be glad to hear from President Foster, and we hope all other associations will make it their business to let us know what they are doing. We want to hear from Meriden, Conn., just organized, and hope the Association there will let their comrades know that they are on deck. Also from Owasso, Mich. Write, and we will publish with pleasure. There will be an interesting session at the National Convention next fall in Chicago.—Eds.]

ATTENTION, STATIONARY ENGINEERS' ASSOCIATION!

Editors Mechanical Engineer:

The secretaries of the different associations will please send list of officers with their July report. This will show a decided increase, both in organizations and members, over the last report. Yet there is room for many more, especially in the West. Judging from the societies already organized, Eastern engineers are inclined to improve more than Western, as two-thirds of the societies are in the East.

All communications regarding the organization of societies should be addressed to the Secretary of the National Association, and they will receive prompt attention. A. M. Davy, Secretary.

175 Elmwood Ave., Detroit.

WATER COLORS IN MECHANICAL DRAWING.

Editors Mechanical Engineer :

I am a constant reader and admirer of your valuable paper. I should like to ask a question in regard to the use of "water colors" in mechanical drawing. How are they used so that they will not warp drawing paper or tracing cloth? If you will answer this I should be much obliged. L. T. K.

Alpena, Mich.

[This correspondent writes a hand like copper-plate, and if he can draw as well as he writes, we should like to see some of his work.

Coloring drawings is not difficult, if one does not use too much color. When it is washed in it is apt to stretch the paper from an excess of moisture. Sometimes on tracing paper, the color is only sketched in along the margins of the area, indicated by successive strokes, as in sections. Use color as dry as possible, and there will be no trouble.—Eds.]

LATEST FROM CHICO, CAL.—EXHAUST-PIPE HEADS.

Editors Mechanical Engineer:

I wish to give you an account of an accident which happened recently in this place. It occurred in a mill that I ran last year. On starting up this spring the contractors said that the mill must cut fifty thousand feet per day. I did not think it could be done safely, so he employed another engineer who would take more risks than I would. Not to say too much of myself, I knew that the boiler would not stand over 90 pounds of steam, but the mill was repaired and started, everyone thinking everything was safe. When they got to work the boiler pressure had to be increased from 90 to 110 pounds. The engine was started, but in a short time the belt running the saw broke. The engine was quickly stopped, and at that moment the dome head blew off. As it happened, no one was hurt, but all the water was blown out of the boiler. I was not present, but I judge that somebody's eyes were opened about that time. It taught a good lesson.

If the correspondent who had trouble with the spray from his exhaust will make a cone-head, tapering both ways, like a locomotive smoke stack, to his pipe and put across the center of it, and at the top, a wire cloth half inch mesh he will have no more trouble.

Chico, Cal. W. B. L.

It seems to us that twist drill grinding machines are unnecessarily cumbrous and costly, where a very simple appliance would answer the purpose. Suppose we have an emery wheel grinder, such as is used for grinding small tools; upon any convenient portion of the frame we attach an arm having a T head with a hole through it at the right angle; this being governed by its place on the machine and the relation of it to the lip angle of the drill. Various bushes fit this hole so as to allow drills from $\frac{1}{4}$th to say $\frac{3}{4}$ths of an inch, to be inserted without play, all that is necessary is to push the drill in up to the face of the wheel and give it a slight rotation with the hand on its own axis; a drill needs only a slight touching up to keep it sharp. The center line marked on the drill will answer to grind by, so as to keep both lips of the same length.

The salaries of the New York and Brooklyn Bridge employes are as follows: Frederick D. Hart, chief mechanical engineer, $2,000; Thomas Hampshire, first assistant mechanical engineer, $1,300 ; James V. Martin, second assistant mechanical engineer, $1,200 ; J. S. Hoagland, superintendent of the railroad passenger department, $1,500 ; Henry R. Vankeuren, superintendent of tolls, $1,200; Police Captain James Ward, $1,200; toll collectors, $2.50 per day; railroad conductors and policemen, $2 per day.

The Scientific American says: "If a boat makes five miles per hour in still water she could not hold her position against a five-mile current, or if the boat made seven miles per hour in still water, she could not make two miles per hour against a five-mile current."

Why not give the reason with the assertion? It is because the velocity of the current represents only the motion of the water and not its live force. A boat struggling against a current fights the live force (*vis viva*) of a body of water in motion equal to its displacement.

◆

Natural oil, though possessing several advantages as a lubricant over vegetable or mineral oils, has the disadvantage of wanting the necessary viscosity and solidity to resist great pressures. M. Boulfroy has remedied this defect by concentrating natural oil in a special apparatus until it acquires a density of from 0.91 to 0.912. On continuing the process of concentration, a mineral tallow is obtained, which takes the place of animal tallow.

"Mineral tallow" is simply paraffine, and does not in any way take the place of animal tallow.—Ed. M. E.

At the National Exposition of Railway Appliances, in Chicago, Robert Kent, of Brooklyn, N. Y., exhibited one of his patent punching and shearing machines, with Jenkins' combined punch and reamer attached. This makes a hole as smooth as though it were reamed out. The peculiarity consists in the lower end of the punch being made smaller, and a shoulder being made above it; so that the main portion of the core of the hole is taken out by the small end of the punch, and the shoulder reams what is left and leaves the hole with a smooth surface, without injuring the fiber of the metal or bending the plate. This appears to be identical with a suggestion made by us in Volume 3, page 105, and illustrated thereon.

◆

Blackboard Paint.—One quart of shellac dissolved in alcohol, three ounces of pulverized pumice-stone, two ounces pulverized rottenstone, and four ounces of lamp-black. Mix the three last named ingredients together, moisten a portion at a time with shellac and alcohol, stir all well together, then add the remainder of the shellac varnish and set aside for awhile, after giving it a thorough stirring. One quart will furnish two coats for eighty square feet of board not previously painted. It dries quickly, and the board may be used within an hour.—*Painter's Magazine.*

It is asserted that "powdered zinc," the granulated metal, it is presumed, can be applied as a paint with oil and a drier, and protect iron surfaces against rust. A good mixture is 8 zinc, 71 oil, and 2 drier.

NOT SECTIONAL.

We believe we utter the views of all associations everywhere when we say that the Stationary Engineer associations are not sectional, but of the United States. They sink local considerations, and merge in one body for mutual advancement; or, in other words, their local feelings inspire them to cover the ground as fully as possible at home, while they also keep an eye to windward for the whole craft everywhere.

◆

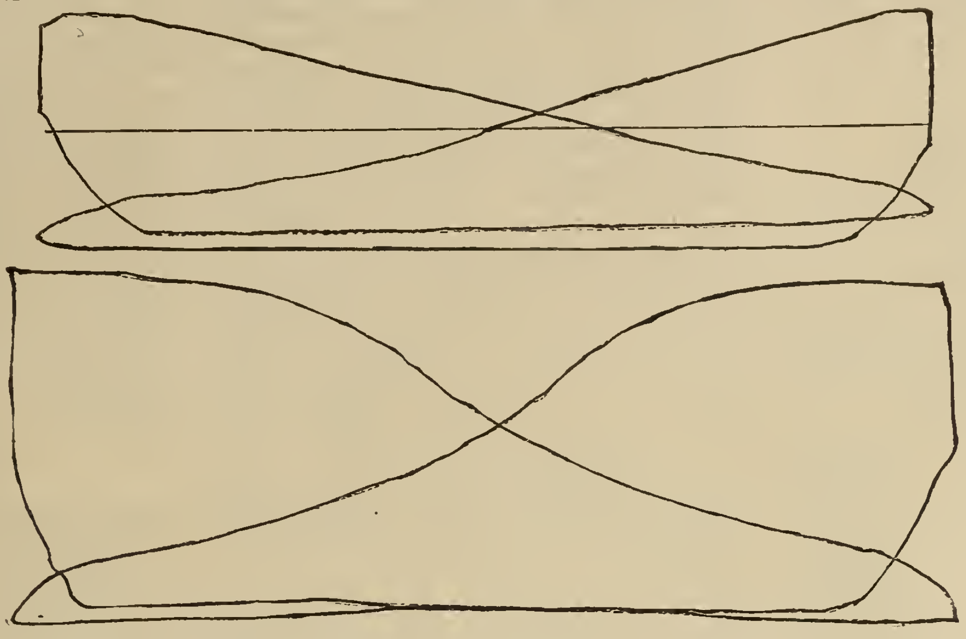
An imitation of ground glass can be produced by dissolving two tablespoonfuls of Epsom salts in a pint of lager beer, and painting the glass with the mixture. When dry the glass will appear as if frosted. There is a much better use for lager beer than this.

◆

One year's subscription will be given for a copy of No. 1, Vol V., now out of print.

SOME INDICATIONS FROM A MARINE COMPOUND ENGINE.

We have received, through the courtesy of Chief Engineer Henry J. Hill, some cards from the engine of the S. S. *Roanoke*, taken by Chief Engineer Terrel, and the data in connection with them is here appended. H. P. cylinder, 38″ × 54″. Revolutions, 60. Steam in boiler, 90 pounds. Throttle, open; cut-off, $\frac{4}{10}$ths. Scale, 40.



L. P. cylinder, 74″ × 54″. Revolutions, 60. Pressure in receiver, $9\frac{1}{2}$ pounds. Cut-off, $\frac{7}{10}$ths. Vacuum, 26″. Scale, 16. Mean pitch of wheel, $23\frac{1}{2}$ feet. Net horse power indicated, 1500.

For three trips the coal consumption was 95 tons of 2,240 pounds each, which includes that used in raising steam at both ends of route, cleaning fires three times. Whole time of one trip, 60 hours; 40 hours at sea, 20 hours on the river. During this part of the run the engine is regulated by the throttle, the cut-offs being thrown out, which, of course, militates against the highest economy. Nevertheless, the consumption upon the data given is only $2\frac{1}{2}$ pounds per horse-power per hour.

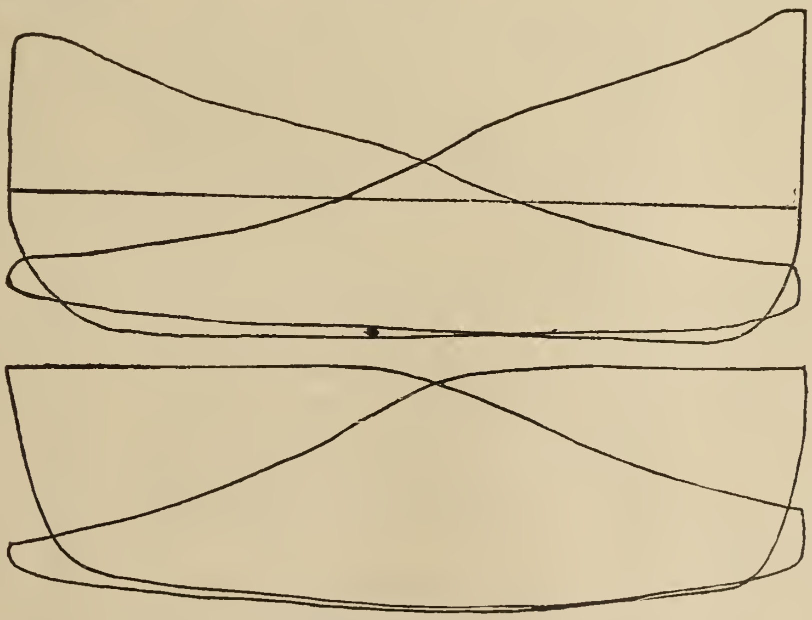
◆

CARDS FROM "THE CITY OF FALL RIVER."

The new compound beam engine of "The City of Fall River" has excited great interest among engineers, it being the first of its kind in this vicinity and having some novel features. The builders of it, however, seem averse to giving any drawings of the design, as we have applied for them without success. We append two cards taken from the engine, which, although meagre in data, and taken at a time when the engine was yet new and perhaps not so well adjusted as it now is, possess some interest. They are the first cards published from this engine. The dimensions, and all the data we have, are here appended.

H. P. cylinder, 48″ × 8′; steam, 72 pounds; revolutions, $24\frac{1}{2}$; scale, 50.

Low pressure cylinder, 68″ × 12′; pressure in receiver, $14\frac{1}{2}$ pounds; vacuum, 27″; revolutions, $24\frac{1}{2}$; scale, 16. Taken Feb. 15, 1883.



Pertinent Comment by the *Industrial World*: "Not long since the writer was informed that a man was in charge of two stationary boilers which furnished steam for two engines. The man said it was an easy job; as he could set the inspirators to keep the water at an even height, and fix the fires so that he could be away half an hour at a time. It is fearful to reflect upon what might occur in that half-hour's absence. Suppose, for instance, some accident had happened to the mill machinery and the engines had been stopped, but the boilers were still making as much steam as before! The injector might have filled the boilers with water, or it might have clogged and the water been cut off. A man with no experience could have no conception of the dangers in such a condition of things, for knowing little, he would fear little. Whoever has the direct personal care of steam boilers should be possessed of intelligence, experience and fidelity.

◆

In regard to clearances of steam engines, that is the space between the cylinder-heads and in the ports, a writer in *The Mechanical World* makes this suggestion; it is a good one:

> "Every steam engine, before leaving the makers' hands, ought to be carefully gauged, and the percentage of clearance should be stamped upon some part, such as the flange of the cylinder, or the stuffing box. This might be put down as equivalent to so many inches of stroke, or as a certain fraction of the stroke. Thus—Clearance: Front = 1-23; back 1-25. Then, when working out the diagrams, the back vertical line would be drawn at 1-23d and 1-25th of the length of the diagram from the extreme back of the front end and back end figures respectively."

The weight of the boilers in the *Providence* and *Bristol*, Old Colony Line steamers, has distorted the hulls to the extent, we are informed, of 18 inches; that is, the bottoms are thrust downward that amount in the largest deflection. The *Providence* is now being rebuilt at Newport, having practically a new bottom put in her, and next season the *Bristol* will also be rebuilt in this way.

A subscriber, "W. M. C.," says: "Would it not be a good addition to your paper if correspondents would send reports of accidents pertainining to engineers? I think it would not only be interesting reading, but would enable others to avoid similar accidents by profiting from the experience." Accidents are not agreeable things to record, and we fancy they are few among our readers; but if they serve as our correspondent intimates, to warn others, they will be useful.

◆

A friend, sending a club of eighteen from a Western railway shop, writes: "Your paper took solely on its merits, displacing in several cases the —— and the ——."

We are glad to hear that it goes on its merits, for that is the only way any paper can succeed. Publishers may canvas, and in this way get up a circulation, but the canvasser must keep going or his trade drops off, unless the paper is its own canvasser.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

WHAT IS ECONOMICAL ENGINEERING?

Economy in the use of steam means the last ounce of fuel and the last drop of water and oil that can be dispensed with. It means no leaks anywhere, careful and constant oversight, and a consideration of the work to be done compared with the means to do it with. Economy does not mean this or that point of cut-off, or a fixed pressure for a given size of engine; it means good judgment, in a few words, and a knowledge of the business. Who can give specific directions how to run an engine with economy? No one, for each condition must be treated by itself. Everything that costs money enters into the consideration.

One thing applies to all steam engines, and that is the admission and release of the steam. This point is alluded to in another article on this page, and we shall not, therefore, traverse it; but, in relation to and in connection with it, it is absolutely essential to economy that an indicator should be attached to every engine. Merely as a steam detective it is of the greatest value, for no one can foresee what is going on under actual work. Measuring points of cut-off and calculating expansions is not satisfactory; it is necessary to know what is actually done by the steam in following the piston through the cylinder, and in what condition it emerges therefrom. This latter would be a surprise to a great many who fancy that success is reached when an engine works easily and goes over the centers without audibly complaining. Silence in the engine-room may be purchased at a very high price sometimes. Back pressure does not come from a cramped exhaust alone, it comes from too low a terminal pressure as well; and when the point of cut-off is early, and the steam expands down to less than that of the atmosphere for, whatever portion of the stroke, it is less the atmosphere presses back on the piston.

Instructing an engineer how to run his engine with economy is like telling a teacher how to instruct a class of pupils. No one condition suits all, and the path to success lies in careful consideration of the special features of every boiler and engine, and the work to be done with them.

LEAD AND COMPRESSION.

A correspondent, in the usual column, has something to say about lead, its objects, and the benefits to be derived from it. Many eminent engineers who have built engines showing high economy, declare that lead is unnecessary, and that they do not use it in their practice.

But it not unfrequently happens that a certain line of practice is adopted for no other reason than that it "seems" good to those who follow it. In the particular point here discussed much depends upon circumstances and work done—as to how much, if any should be given.

Lead and compression are, in a sense, convertible terms, for in some cases—in many—the exhaust is so compressed that it rises almost to boiler pressure. It is not difficult, we think, to show that this is a loss, inasmuch as compression can only be effected at the expense of power, for in the act of compression power is taken from the fly-wheel or moving parts. Those who discard lead and deny its utility show cards containing high compression, for from some source the momentum of the moving parts must be checked, whether by lead or by compression.

For many reasons, chiefly the wide difference of opinion, and of practice, and the nature of work done, this matter will always remain a moot point, for in an experience of over thirty years we have only the same arguments advanced for and against. Locomotive, and high-speed practice generally, use both lead and compression, though, as stated, there are instances in which the former is not. Marine engines have a very large amount of lead on the main valves, for practice, that touchstone of all theory, asserts safe running impossible without it.

As regards the expression just made concerning theory and practice, Sir Henry Bessemer recently said that he had noted that very few views held by practical men were not founded on facts.

LOOK OUT FOR THE CORE-PLUGS!

Large cylinder-heads for marine engines are cast double. They are deep generally, for large engines have wide ports, and the cylinder-head covers the port to the bottom, the steam passage being scooped out on one side of it, next the port. The head, therefore, has two walls; and to get the sand-core out, in between, openings about 4″ diam. are left in the bottom wall. These are closed afterwards with cast-iron plugs screwed in.

An engineer in charge of a large engine noticed a curious sound that he was unable to locate clearly, except that it was somewhere in the cylinder. It kept up for some hours, and then, greatly increasing its intensity for a moment, suddenly stopped. On raising the cylinder-head, one of these core-plugs had disappeared, and was finally found inside the head. It had worked down and out, and was constantly struck by the piston, until, working still further, it was violently struck and driven up through the head into the space where, fortunately, it remained on one side.

This has all the elements of a mystery about it, or would have had, in case the plug had got on to the piston in any way. Then there would have been a general smash-up, and no special cause could be noted, for the cylinder-head would have been so broken that no one could say which part went first.

For every effect there is a cause, though sometimes cause and effect occur simultaneously, and it is hard to locate the former.

Look out for the core-plugs!

NOT A SUCCESS.

The *Pilgrim*, the mammoth steamer of the *Old Colony Line*, is not a success so far, but it is to be hoped that the changes now being made in her will prove beneficial. She is so deep in the water that the wheels are buried, so to speak, and throw water out of the tops of the wheel-houses; bulkheads are being put in to deflect the water. The intention was to carry 50 pounds steam on her boilers, but they are unable to keep that pressure for any length of time; consequently the steam is being cut off shorter with, of course, the result of a lessened consumption, and, unfortunately, less power. The buckets have been raised on the wheels and the dip decreased in this way, but these are all make-shifts to remedy a botched job. She burns about 180 tons per round trip, as against 110 tons on sister ships with the same size cylinders. The reason is that the *Pilgrim* has only a fixed cut-off (Stevens' long-toe), while the others have adjustable cut-offs.

CRYSTALLIZATION OF BEAM-CENTERS.

A certain steamer out of this port has, in a period of twelve years, broken three beam-centers. For the benefit of those readers who are not marine engineers we will say that this detail is a wrought-iron pin about 12 inches diameter in the journals, and possibly 5 feet long over all. This goes through the center of the working-beam, and carries the whole load of it and the power of the engine.

A curious feature of these breakages is that the average life of each center was only four years, and in each case they broke in the same place. The dimensions are ample, and such as have been used in other engines without disaster. Some question having arisen as to the quality of iron previously employed in these centers, the last one was placed beyond peradventure in this respect, being of the very best it was possible to procure.

No question of adjustment or being out of line enters, for the engine works perfectly in all respects. The engineer of this steamer is a man of more than average intelligence, and these breakages annoyed him by their constant recurrence. His view of the matter is that the cause of the mischief is crystallization, and to this he came only through a conviction that it could be nothing else. He was aided in it by the appearance of the fractures, which showed marked examples of large crystals, some of them nearly the size of a finger-nail. These were most frequent about half an inch from the outside of the journal. The gallows frame of the engine is of iron, and it is a question how much this contributes to the trouble. Broken beam-centers are not unknown on wooden gallows frames, but we doubt if any of them have broken three times in twelve years. In the case of an iron frame the vibrations are sustained, and not absorbed, as they are in a wooden one.

As negative testimony, another vessel in the same line has never broken a center, but has frequently been very hot—smoking hot—in this part. The reasoning is that the heating saved this beam-center, by restoring, or destroying, the tendency to crystalize, for it is well known that annealing is resorted to where rods have been long under strain, with, it is said, good results. This is the theory and the practice also, but it is rather difficult to see why. Crystallization is a change of structure, from fibrous to granular, and it is the result of slow, but long continued disturbance of the molecular arrangement. Supposing that crystallization had set in, it is difficult to see how heat could immediately rearrange, or dissipate the crystals already formed or forming. Whether difficult or not, there is no question but that instances occur where steel has suddenly, or within a period of a few hours, been completely changed in its texture, from granular to crystaline. These two states must not be confounded with each other. Authorities (Fairbairn for one) state that crystallization is the result of shock, jar, and long continued vibrations, to all of which a beam-center is subjected; but the text-books also say that crystallization is only apparent where the strain exceeds the limit of elasticity.

As regards the tendency mentioned, is has been very fully discussed already by capable observers, and there are many who deny the possibility of it.

Whether crystallization of wrought iron does or does not occur, the facts here given are on record and would seem to establish one instance, at least, where it is.

OBSCURE PHENOMENA IN IRON AND STEEL.

It seems singular that with all the experiments which have been made, and the countless thousands of tons of iron and steel which have been worked up in the arts, that, speaking in general, so little is known concerning some peculiarities of these metals. Analysis determines the proportion of carbon in both, and also of manganese, silicon, phosphorus and other substances in any given specimen, but beyond certain behavior, distinctly observable, the effect of these substances in varying proportions cannot always be determined. Too much sulphur, as is well known, makes iron red-short, and an excess of phosphorus makes it cold-short; an excess of silicon deprives steel of tenacity and high tensile strength, but in certain proportions these minerals are beneficial, depending upon the purposes to which they are to be put. All this is well known and is not put forward as any novel discovery of our own. What is not so well known is the action which takes place when iron wire, or indeed iron in any shape, is violently disturbed, as regards its original form. In making furniture springs, for example, the wire is coiled in a volute, or often in the shape of an hour-glass; but although made from spring-wire, they require some months of "seasoning," so to speak, before they are fit for market. Upon no known basis can this be accounted for. It is easy to assume a theory and assert that the disturbance of the various particles forming the body of the wire changes its character, and destroys its endurance, but this is very unsatisfactory. No change of structure can be observed, either by the naked eye or the microscope, and so far as accounting for the peculiarity named the theory in question is a failure. Similarly with razors; after a certain period of active service the best ceases to be of use, and demands rest, but its powers are thoroughly restored if it is simply laid by. There can be no question of this fact, it is too well established; the only inquiry to be made is what causes it? "Derangement of molecules" is again unsatisfactory, but this is the only answer trained observers can give.

Side rods and connecting rods are retired by some railroads, after a period of service, and laid away to check any tendency to crystallization. They are then annealed and put in use again, presumably with unimpaired virtues. Crystallization is supposed to be induced in these rods by continuous vibrations, and by shocks and jar. Yet it is by no means certain that it is so caused. An observer whose name has escaped us, hung iron bars so that they would vibrate freely, and caused them to do so for a long time, but on testing them in comparison with their original condition no change was noted; they appeared normal. The wires of the suspension bridge at Niagara and portions of the iron-work also have been tested within a short time and found unimpaired.

It is also said to be the experience of some that steel tools which have laid under water, or have been badly rusted, are found on re-working to be of the first quality, and this is so strongly asserted by intelligent persons capable of forming judgments in such cases, that it cannot be regarded as a mere superstition; neither can any reason be advanced—any cause deduced from legitimate premises—for the alleged facts.

Some law underlies the whole of these phenomena. The crystallization of parts under some circumstances, the improvement of iron and steel springs after a period of rest, and the revivified razor under the same conditions. There is no effect without a cause, and to those fond of research it affords an inviting, and we may add, an expensive field.

A PELLET OF WISDOM.

An acute observer visiting Cleveland with the *American Society of Mechanical Engineers*, during the late meeting, said that "it was good to be there, if only to show one how little one knew." He alluded, of course, to the grand round of the various large shops visited, where he saw divers and sundry processes going forward.

Perhaps our unrecorded friend depreciated his own acquirements, for it is a truism that the best informed are the most modest. His observation, however, should not be lost, for it contains the wisdom of Solomon concentrated to a pellet. Visiting shops, and listening to papers read at meetings, has the tendency noted above. Instead of causing one to plume himself upon his acquirements, visits and technical papers illumine the distance one has to travel before he can satisfy himself that he is more than a tyro—that he is not an integer, but an infinitesimal fraction.

The man who has much to learn is far more likely to acquire knowledge than one who has sounded the depths of wisdom and has no more to learn.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXVI.

A man brought a piston into the shop last week to be overhauled, and I wish that some of the men who work in shops where they split hairs in two could have seen it. It was a veteran and no mistake; a veteran in style and general get-up, but by no means in years, for it had not been made over two. It was evidently constructed from patterns that had been in use from the beginning of the century, and by people who conceive that a piston is in the nature of the plunger of a hydraulic ram, for it was so proportioned that it would have answered for that duty. It was small, only 16 inches diameter, but oh! how solid! The flanges were an inch and a half thick, and the casting ("piston-head," "spider" or what not) was a marvel of clumsiness. I am sure it must have weighed over 300 pounds. In diameter it was only 15¾ inches, though the cylinder was full 16 inches (in a good many places), and it was 7 inches over all; two flanges 1½ inches each, and two rings 2 inches wide. I asked the man who brought it to the shop where it came from and what was to be done with it. He said it came from a saw mill ten miles the other side of Slagtown, and that the follower was cracked, and he wanted a new one.

"Follower cracked!" said Jake, who stood by. "What in the name of Heaven cracked that follower? You couldn't faze it under a drop?"

The man looked a little sheepish for the moment and said, "We hit it with a sledge, by chance."

"Do you run your engine with a sledge?" said Jake.

"No, we don't run it with no sledge," said the man, angrily. "We had the piston out to pack it, and it wouldn't enter somehow, so we took a block of wood and held it on the end of the rod and was trying to drive it in, but my elbow hit on a post close by and I struck a foul blow."

This occurrence is fact.

"Well," said Jake, "you might have saved yourself a good deal of trouble by taking the follower off and bringing it down, instead of lugging the whole piston ten miles and back." He omitted any further remarks as being time thrown away.

"There's something the matter with the springs," said the man.

"I should think likely," said Jake, "from the looks of the rings; there's something the matter with them, too. The best thing you can do when you go home is to throw the rings away and pack the piston with a hemp-gasket, then you can fill up some of the half inch grooves in the cylinder. How did you flute it out so nice?"

The man got up from where he was squatting on the floor near the piston, and said, "I ain't taking no slack on this piston, from nobody, and I don't want you to be so d—— cunning. If you don't want to fix it you can let it alone, and I will go somewhere's else with it."

"My friend," said Jake, putting out his hand, "I apologize. I was a little too free in my remarks, but I meant no harm; you see this thing—piston I mean—is a little behind the times, and there are better ways of packing one than outside of the cylinder. If you will let me tell you something you will see at once what the cause of all your trouble is, and why you came to grief on it."

"Now you talk sense," said the man. "I ain't one of these chaps that knows it all, but it sort of riles me when a man that ain't my boss gets onto me."

Jake was a little to blame in this case; he had no right to be sarcastic, or take a stranger to task about a job brought into the shop, and he assumed a more moderate tone and told the man that the best way to do would be to take the piston apart and see what ailed it. This was done at some expense of time and trouble, and the interior exposed to view. It was the same inside as out; that is to say the rings were extremely heavy and cumbrous, and the springs, made out of spring-steel apparently, about half an inch thick, and with a set screw, or rather a jack-screw, in the middle.

"There," said the man, when the details were all scattered over the floor, "what's the matter with that?"

"A good deal, I should think," replied Jake.

"What's one thing?"

"The springs with the set screw."

"What's another?"

"The thick rings."

"Anything more?" said the man.

"Well, the combination generally," said Jake.

The man spit out a great puddle of tobacco juice, and said: "Now I know what's the matter with you fellows in this shop, right to an allspice, and that is you're too all-fired smart for anything. I told you this piston belonged to a saw-mill engine and you're a-criticizing it like as if it was one of these electric light engines. You mustn't take me for a fool because I live in the woods. I take the papers—mechanical papers, as well as other folks, and I know what's going on elsewhere as well as you do. I get the ENGINEER, and the ——— and the ———, and I can see what improvements are made every week. If you know anything about a saw-mill engine you ought to know that there ain't any place in it for ogees and quirleycues. It's got to be bull-strong and heavy, and stand the racket from the time it snatches the crank pin in the morning till it lets go of it when we shut her off. It's got to rare right up on its hind legs, and whirl them saws through the logs no matter what feed the sawyers put on. When I start this engine it keeps going same gait right along, and the saws is bound to go through the logs, unless the mandrel twists off. We don't care nothing about fuel. What we want is power, and power we get. We can't get rid of the edgings and stuff that lie around, and economy is no account. How long do you suppose a fine-haired engine would last in a saw-mill in the woods?"

"Well," said Jake, thoroughly nettled, but with his temper under control, "I don't suppose it would last long with some folks to run it. I am glad to hear you say you take THE MECHANICAL ENGINEER and other papers, for you can learn a good deal yet, it seems, from them. It is plain you have been in only one kind of a saw-mill, and that perhaps the old-fashioned kind. If you have read carefully, you must know that some of the finest and best made engines in the world drive saw-mills. They are thoroughly made, and built on the most approved principles for the simple reason that they last longer withont repairs. Economy in the use of steam has nothing to do with the matter ; it is the question of repair that comes into the account.

"Look at this, my friend, for one thing: you use high pressure steam, probably 120 pounds, and you think, perhaps, that the piston will leak unless the rings are jammed out—jacked out I might say—against the cylinder bore. That's what you have got these set screws through the springs for. What's the use of a spring if it's got to have a set screw to back it up? It's just the same as a solid block of metal, and you might as well have one. That's where your cut cylinder comes from. There is no need of cutting a cylinder, or having a leaky piston with any pressure of steam, if everything is properly made. All you have to do is to bore the cylinder true, have the piston fit it, and light, elastic packing set truly to it.

"This machine here is no good. I will bet anything that when you get this piston packed you can't budge your engine with less than 50 pounds of steam without any load on it. Thus, if you carry 150 pounds of steam, you have thrown away a third of it just to move your engine. Don't you carry more steam now than you did a year ago?"

The man said nothing for a moment, but apappeared to be thinking over Jake's remarks; but he got up and put out a huge, hairy fist, and said: "Mr. Hess, you're right; I will own up to it. I have learned something since I come in here that I had no idee of. You see, when a man gets to running in one groove all the time, and don't see much but his own way of doing things, he is apt to make mistakes and get one-sided views. You gave me some good advice, and I am going to act on it. You told me to throw these rings away and pack her with a hemp gasket, and dumbed if I don't do it, until we get another piston made that's right."

"Yes, but you can't put a new piston in that scored cylinder," said Jake. "It will have to be bored out."

"I know that," said the man; "but I can run her with a gasket until you make the new piston, and we can get all ready and bore her out between Saturday night and Monday morning."

"There," said Jake, when the man went away, "that's a fair sample of the average man. He is willing to be told if you approach him in the right time and in his way; but you can't bully him into doing a thing, even if he knows you are right and he is wrong."

Thinks I to myself: "Jake, you have learned something too, or you wouldn't have made that last remark."

* * *

A BOARD OF OFFICERS tested a lot of rifles at the Springfield Armory to determine the cause of the bulging of the barrel which occasionally occurs in practice. They find it due to the fact that the muzzle has been stopped by sand, caused by resting the muzzle in wet sand or in dry sand after the gun has become foul from firing. This arrests the passage of the ball, so that the pressure is increased at the point of swelling. It is curious that sand produced this result where wooden plugs, driven in tightly and swelled by steam, failed to do so.

* * *

THE CHIEF tin-producing counties are the following: England, about 10,000 tons a year; Malacca, about 8,500 tons; Australia, about 6,000 tons; Banca, about 4,000 tons; and Billiton, about 3,000 tons. Both of these last-named places are islands of the Dutch East Indies.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. VI.

By J. P. MULLIN.

MOULDING FLY-WHEELS WITHOUT A FULL PATTERN.

Fig. 36 is a section and elevation of a fly-wheel, 8′ 6″ diam. × 8″ face, with hub 11″ long.

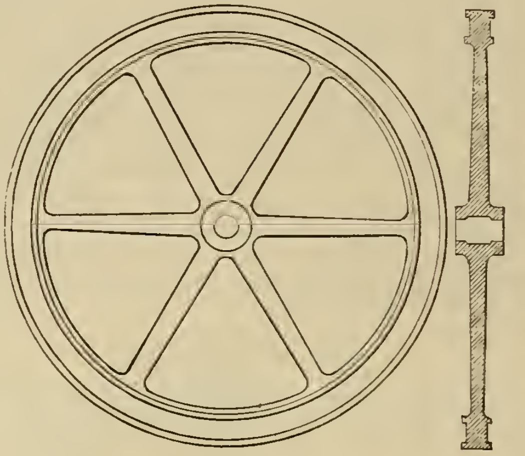
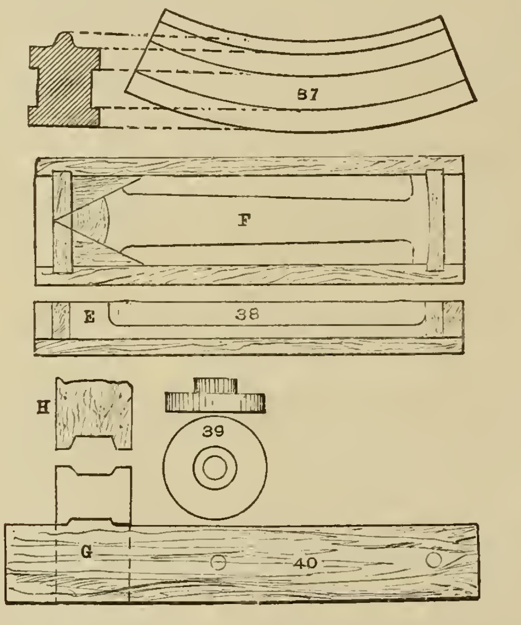


Fig. 36.

Now it frequently happens that the casting for such a wheel is wanted in a very short time (say two or three days), and in this case the following method of making it is a good one:

We make a segment of the rim of the wheel, as shown at Fig. 37. The strips for the panel in the rim of the wheel should be loose on one side of the segment, as they are wanted when finishing the mould.



We now make the arm core-box, shown at Fig. 38. This box has a section of the hub, the bead on the inside of the rim of the wheel, and also half the arm of the wheel set in the ends and bottom, as shown at *E* and *F*. The depth of the box should be just equal to half the width of the face of the rim. In the present example the face of the wheel is 8″; the depth of the box must be 4″.

When the hub of the wheel is longer than the width of the face of the rim we make a pair of plain disks or washers, one of which,—with hub core-print attached,—is shown at Fig. 39. These disks or washers must be the exact diameter of the hub of the wheel, and the thickness of the difference between the depth of the arm core-box and half the length of the hub.

Example: Half the length of the hub, 5½″; depth of core-box, 4″; thickness of washer, 1½″.

Both these washers and hub core-prints must have a hole through the center, about $\frac{1}{16}$ larger than the diameter of the spindle used in the foundry.

G, Fig. 40, is a plain strickle-board, with the projections, on the bottom edge, made to fit the panel on the side of the segment of the rim; and *H* is a piece made to screw to *G*, as shown by dotted lines. The bottom end is cut out the form of the panel mentioned above.

MOULDING.

When moulding make an excavation in the floor the depth of the face of the wheel; set the step and spindle.

Then take one of the washers and hub core-print, Fig. 39, and bed it in, as shown at *J*, Fig. 41.

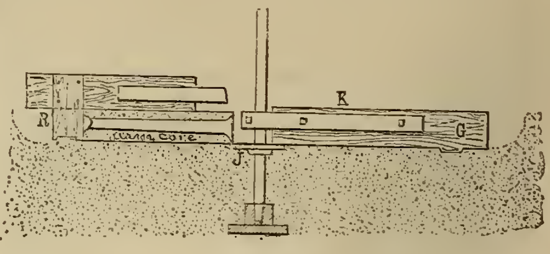


Fig. 41.

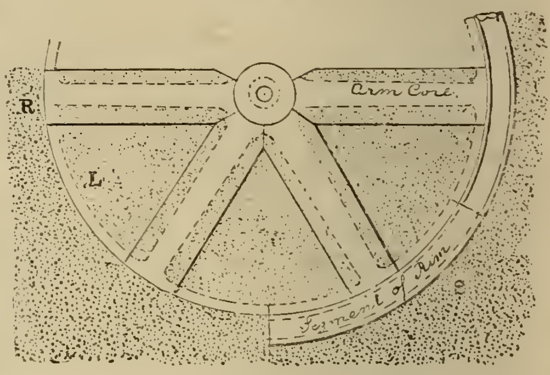


Fig. 42.

We now take the strickle-board, *G*, and bolt it to the arm of the spindle, as shown at *K*. With this scrape off and bevel the bottom of the mould. We are now ready to set the arm-cores, fill in between the arms and around the outside, as shown at *L*, Fig. 42. Having done so, take the strickle-board, *G*, and scrape off the top of the mould and form the panel in the rim of the wheel, as seen at *M*, Fig. 43.

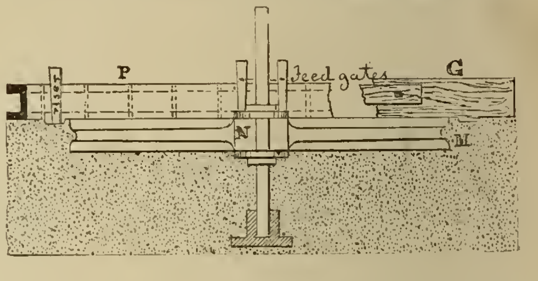
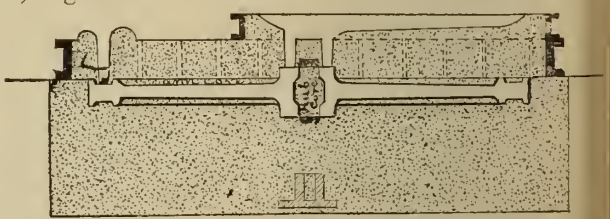


Fig. 43.

The hub-washer and core-print are now set, as shown at, *N*, and the cope-flask, *P*, put on, rammed up, lifted off again and finished.

Now make the strickle-piece, *H*, fast to *G*, and with it scrape out the sand around the outside of the arm-cores, as shown at *R*, Figs. 41 and 42.

We can now take the segment of rim, set it in position and ram up the outside, as seen at *S*, Fig. 42.



We are now ready to take up the spindle, draw the hub-washers and print, finish the mould, close it down, make runners, risers, etc., as shown at Fig. 44.

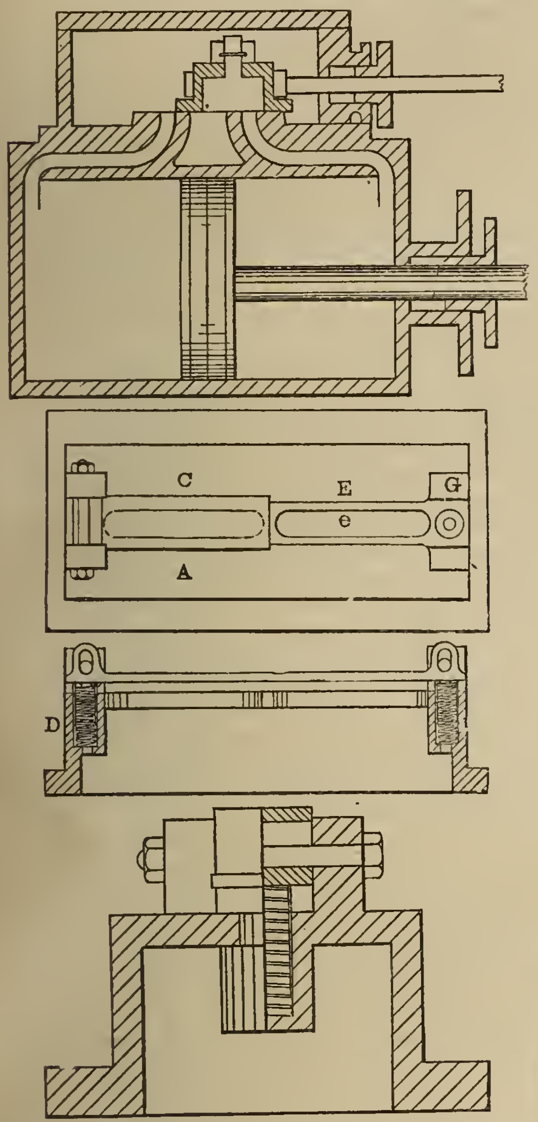
* * *

"IN THE ROUND HOUSE."—No. 5.

BY BERKELEY POWELL.

Experience proves that coal cinders are a slide valve's worst enemy under any circumstances, whether they be plain or complex. These come into the steam-chest from the smoke-box by means of the exhaust-port. When the engine-driver shuts off steam, and the locomotive runs down a grade or into a station, is the time when the damage is done. The piston working without steam in the cylinder forms (before the valve opens the exhaust) a partial vacuum. Instantly, upon the exhaust opening, a body of air rushes in from the smoke-box, carrying with it cinders. The same operation is performed on the return stroke, and repeated as before, until the engine comes to rest, or the throttle is opened and a supply of steam claps it to its seat.

There is an ingenious device sometimes used for preventing this, which is called a vacuum relief valve, and is shown in the accompanying drawing. It consists of a small valve

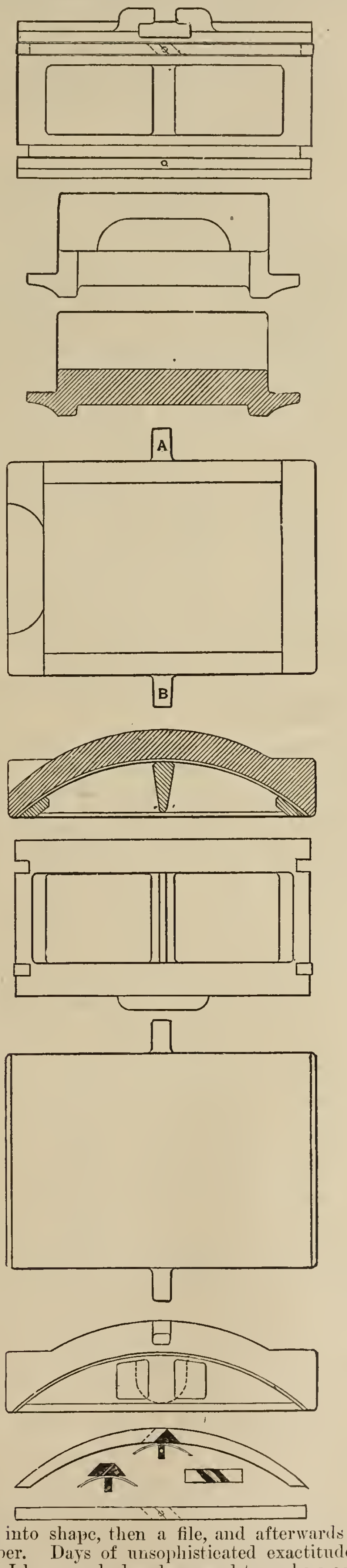


seated on top of the ordinary valve, and covering a port cut through the latter. When steam pressure (from the boiler) is shut off the spring, *D*, lifts the auxiliary valve from its seat, and thus allows air to pass back and forth as the piston travels in the cylinder. I have seen this contrivance used very successfully; it seems effective in preventing cinders from being drawn in through the exhaust ports, as no air is required from that source. It also possesses another merit: after steam is shut off an engine will travel a much greater distance than usual. There being no air pressure or vacuum in the cylinders there is no strain on the machinery or tendency to retard the progress of the locomotive. Enginemen can with this arrangement economize their steam. On the other hand it complicates the simplicity of the valve mechanism and is liable to blow, even if (as the advocates of the idea claim) no cinders are drawn in to prevent its closing. It might be well to bear in mind that the small pins or bolts through the standards should be made of copper, and though bolts are shown on the drawing rivets are preferable. The passages, *e e*, are cast, and auxiliary valve-seat, *E*, planed and scraped to a bearing with *C*. In the drawing, *G*, is the standards, *A*, the main slide-valve, *E*, the relief valve-seat, and, *e*, air passages cored through; *D*, represents the lifting springs.

The simplest form of balanced valve I ever heard of was disclosed to me the other day by a commercial traveler, who informed me, with a serious air, that he had a big thing. My spirits sank when he said it was a balanced valve. But as he assured me there was nothing required other than the plain valve to gain the end I felt disposed to listen.

"You must cast your valve like this," said he, making a rude sectional sketch of what looked like an inverted V. "Now, he explained, that is my balanced valve, and all it requires is to grind the two sides up to a sharp edge on top, and there you have it. Steam cannot press down this valve, as it would slide off on either side."

A few years ago everybody used to scrape the valve faces and seats to a beautiful bearing. Hammer and chisel were used to bring a bad seat into shape, then a file, and afterwards a scraper. Days of unsophisticated exactitude! How I have worked and scraped to make a certain valve face, by breathing on it, show an unbroken bearing all around the edges of the ports. Oh! days that are gone! what do we now do when a valve-seat needs facing? A portable valve-seat rotary planer is attached, and the seat quickly trued, the valve is gone over in a similar way, and placed on the seat; the chest and cover come next in order, and the engine is ready for service. I believe that a good deal of the present cutting of valve-seats would be avoided (where they are lubricated from the cab by a pipe in the old way) if engine drivers would bear one thing in mind: After running some time without steam, valves most frequently cut their seats when steam is first applied. As soon as steam is shut off a large quantity of melted tallow or oil is poured into the steam-chest on top of the valve. The engine frequently runs for some time, often down a long grade, or into a station after this dose has been administered. The consequence is that by the time steam comes again upon the valve, the seat is dry and liable to cut. It is a most excellent plan to wait before oiling the valves until just previous to admitting steam, or, if the engine-driver feels timid about doing this, to use half the quantity intended upon first shutting off steam, holding the balance until just previous to re-opening the throttle. This, however, is a half-way method, which is not satisfactory. It resembles a doctor who practices either homeopathy or allopathy. One or the other method should be used only, and admitting oil to the valve just before the steam seems to me the correct way. It works extremely well.



There is a great deal of controversy going the rounds of some mechanical papers as to where a center prop should be located, in order to gauge on the valve spindle the lead of the valve. Opinions seem to conflict as to whether it should be on the steam chest neck or on the cylinder casting. Very good reasons have been advanced against either practice. Many shop hands I have met are considerably agitated over the question. They have read both sides and are giving this weighty (?) matter great consideration. I will now propose that readers of this article when they again are required to gauge a valve spindle, before putting on the steam-chest cover, place the center prop on the yoke plate, selecting a place on line with the top of the spindle. This will require a gauge long enough to reach in front of the coupling nuts or key, but even then not extremely long. The center prop on the yoke will be exact for all time, and if high enough up to be on line, will have more of the angularity which is found with the gauge when the center prop is located on the cylinder casting.

The accompanying drawing illustrates a very fair type of balanced valve, known popularly as the Nesbitt; this gives as good results as any, and I think can be readily understood from the drawing. The valve and packing on the drawing are turned to a radius of 14″; packing is of cast iron, except the small wedge, which had better be made from brass. The valve spindle has a head on the end turned to drop into recess cast on back side of valve, and shown in the plan.

POINTS FOR CONSIDERATION ON LOCOMOTIVES.

At the recent meeting of the Master Mechanics' Association, in Cleveland, Mr. F. W. Dean read a paper which embodied the following points worthy of considering in locomotives:

"The forms of cylinder casing should receive more attention. This should be entirely without mouldings, should have flat ends, and the parts joined should be flush with each other. It would be well to consider whether, for the sake of simplicity at least, cylinder heads without casings cannot be used with advantage more than they are at present. If they were used in conjunction with solid web pistons, which will be noticed further on, they could be made hollow, thus giving an air space for the non-conduction of heat. The objections to this construction are the cost of founding and the weight. On the other hand, the gain in strength due to this form, when the two webs are connected by ribs, may be an important advantage with the increasing steam pressures which are sure to follow the few leading instances of it which we now have.

"Occasionally we hear of the burning of locomotive cabs. In England and on the continent of Europe, as most of us know, iron is always used for cabs of a thickness of about $\frac{3}{16}$ inch. The roof is sometimes made of wood, easily detachable from the sides and front, and is covered with some waterproof material. This overcomes the objection that an iron cab would be noisy in rainy weather, but the objection that it would be cold in winter and hot in summer may have considerable force. The weight of an iron cab would be an advantage in these days.

[Cabs proper are unknown in England and on the Continent. A large proportion of the locomotives have no shield whatever, but lately a sort of canopy—that is, a roof on stanchions—has been applied. In others, a simple vertical shield is set up. The cab as it exists in this country is unknown.—Eds. MECHANICAL ENGINEER.]

"In seeking the cause of the great consumption of fuel in our locomotives, we must recognize the fact that they are pushed frequently to their utmost capacity, and it is evident that the tremendous rapidity with which the combustion takes place is chiefly responsible for it. In stationary practice a consumption of more than 40 pounds of coal per square foot of grate area per hour is unusual, while in locomotives as much as 130 pounds is sometimes burnt. The chief cure for this evil is an increase of grate area, and this can be accomplished (while keeping the fire-box between the axles) by using a plate frame $1\frac{1}{8}$ inch thick, and the Joy valve gear, which allows the fire-box to be brought up close to the forward driving axle. In this way the width of a fire-box can be increased $5\frac{3}{4}$ inches over the usual width with bar frames, and the length can be made 84 inches, giving a grate 84 inches by 41 inches, the area of which is 23·9 square feet, against 17·6 square feet, the amount usually found in locomotives with their driving axle centers 8 feet 6 inches apart. This is a gain of 6·3 square feet, or almost 36 per cent. If, now, an engine with the smaller grate area should burn 100 pounds of coal per square foot of grate area per hour, a similar engine with the larger grate area, but burning the same amount of fuel, would burn only about 75 pounds per foot of grate. The consequence of this slower rate of combustion would be that a larger exhaust nozzle could be used, less coal would be pulled through the tubes, fewer sparks would be sent out of the chimney, there would be less back pressure in the cylinders, and a considerable gain in economy would result.

"The extensions of smoke-boxes to catch cinders seems to be a decided improvement, but this is attacking the problem at the wrong end. The combination of the deflector and brick arch are undoubtedly very efficient in promoting complete combustion, and in retaining the particles of coal in the fire-box which would otherwise be taken along by the strong draught.

"It appears to be a fact that enough air to support combustion cannot be admitted through the grate, and therefore it is advisable to run with the furnace door a little open, in order to supply the deficiency. This air should be spread outward in all directions by the deflector, to meet the gases which are thrown forward by the arch. In order that this process may be most perfectly carried out, the door should have the hinges at the bottom, and it should open at the top, or if it opens at the side, which is more convenient, it should be in two parts, the upper part being hinged to the lower, and capable of turning back under control of a latch. In this way a thin film of air can be admitted, and both sides of the fire treated alike.

"The 4-bar guide which is so common is weak, expensive, and is perfectly exposed to dust. This should give way to some other form; for example, to a cast-iron bored guide cast solid with the back cylinder head.

"This is the most perfect form of guide and cross-head yet devised, because, among other things, the cylinder head can be turned in the machine which bores the guide, and at the same time, thus insuring perfect alignment. When the opposite driving wheels are at different levels, it will allow the cross-head and piston to revolve, thus doing away with twisting the connecting-rod, wear on the edge of the guide bars, and grooving of the bars and cylinders. Moreover, it allows the upper bearing guide surface, on which nearly all the wear takes place, to be wider than the lower, and it can be boxed in and protected from the dust. In a word, it posses very valuable features.

"Breakages of rock-shafts now and then occur, and the question arises whether it would not be an improvement to make them of gun iron or steel castings, larger in diameter than usual and hollow. In this way a better casting would be probable, and the metal would be better distributed, weight for weight, than in the ordinary form.

"Solid pistons have the advantage of simplicity and cheapness. As they are almost exclusively used in England, it would seem that they would be successful here if understood.

"This association has for a long time considered the matter of the best form and material for coupling-rods with somewhat satisfactory results. A rod made of solid, drawn, weldless steel tube would possess excellent qualities for this purpose. It would be strong, light, elastic, and reasonably cheap. If one of these tubes, $3\frac{1}{2}$ inches in outside diameter and one-half inch thick, be passed between rolls and flattened to a thickness of 2 inches, and then welded to solid eye-ends, it would make a good rod, provided the welding could be well done. This rod would have a depth of about $4\frac{3}{8}$ inches, and if 8 feet 6 inches long, would have a factor of safety of $3\frac{3}{4}$ inches when making 300 revolutions per minute, against $4\frac{1}{2}$ for the heaviest I-form used. This is rather small, but probably larger than that of many rods in use. The writer regrets to say that he is unable to find out the elastic limit, ultimate strength, elongation and contraction of area of this material, but he hopes to lay them before the association at some other time."

It is proper to add that many members strongly opposed the views here advanced in some points.

ECONOMICAL COMBUSTION AND COMBUSTION CHAMBERS.

Coal may be said to be consumed with the greatest possible economy when the whole of the carbon enters into combustion with no more air than is necessary to supply the combining oxygen. The best condition of combustion is the contact of carbon with oxygen, and the presence of a high, igniting temperature. To maintain a high temperature in the furnace, the combustion or chemical combination should be complete before any heat is abstracted from the gases. There should be no smoke, but simply superheated gaseous vapor, carbonic acid, and nitrogen. The quantity of this last would then depend solely upon the thoroughness of the admixture of the combustible gases, so that each atom of carbon might come into contact with the requisite atoms of oxygen. When the atoms have combined, they should be removed as directly as possible, as their presence prevents the combustion of the unconsumed remainder. The best practical arrangements for effecting economical combustion are a furnace composed of a non-conducting material and a rapid draught through and about the burning coal. A furnace composed wholly of fire-brick is preferable, but other considerations frequently preclude its adoption. The course of the current of air through the furnace should not be too direct, nor its volume too compact. But the admixture of the gases will be better promoted if the air be admitted through a series of small jets into the combustion chamber, and if the current of gases be diverted from side to side by suitable obstructions placed in the furnace.

As boilers are now generally set in brickwork, the greater part of the air for combustion is generally into the furnace through the grate-bars. The air spaces between the bars must, therefore, be kept clear of clinker, ashes, etc., by the free use of the slicing bar. It is of great importance, also, that the layer of coal upon the grate-bars should not be too thick, or the air will be unable to pass up through it; and it is also necessary that the depth of coal be of uniform thickness, otherwise a large quantity of air will be drawn in at the thin places, and none at the thick, thus leading to the production of a large quantity of carbonic oxide, which, although invisible, nevertheless contains partly unconsumed carbon. With a properly constructed combustion chamber under the boiler, with air admissions above the grate-bars, the fire-door will not require to be opened as often as a boiler set to receive its air supply through the bars only, as in the former a thicker layer of coal can be carried, and less slicing will be required, thus producing less clinker, as the air admission is not obstructed by ashes and clinker; for, as a rule, the fewer times the fire-door is opened the better; not that the introduction of the coal in large quantities is to be recommended, but because each time the furnace-door is opened there is a rush of cold air into the furnace, which tends to cool the combustion chamber and to bring on leakage of the boiler seams from the contraction arising from cooling.

The ordinary combustion chamber is invariably made too small, both in height and width. The general proportions allowed are so limited as to give it rather the character of a large conduit, whose only function should be to allow the combustible gases to pass through it, rather than that of a chamber in which a series of consecutive chemical processes are to be conducted. Such furnaces, by their diminished areas, have also this injurious tendency—that they increase the already too great tendency of the current through them. The defect of insufficient capacity in the chamber of the furnace above the fuel will be best appreciated when we consider that in it the gases are generated, their constituents separated, each brought into contact with the oxygen of the air, and finally their combustion effected.

The practice of constructing furnace chambers so shallow, and with such inadequate capacity, appears to have arisen from the idea that the nearer the body to be heated was brought to the source of heat the greater would be the quantity received. This is no doubt true when we present a body to be heated in front of a fire. When, however, the approach of the colder body will have the direct effect of interfering with the process of nature (as in gaseous combustion) it must manifestly be injurious. Absolute contact with flame should be avoided where the object is to obtain all the heat which could be produced by combustion of the entire constituents of the fuel.

Dr. Ure observes: "When a boiler is set over a fire its bottom should not be set too near the grate, lest it refrigerate the flame and prevent that vivid combustion of the fuel so essential to the maximum production of heat by its means. The evil influence of leaving too little room between the grate and the boiler may be illustrated by a very simple experiment. If a small copper or porcelain capsule containing water be held over the flame of a candle, a little above its apex, the flame will suffer no abatement of brightness or size, but will continue to keep the water briskly boiling. If the capsule be now lowered to the middle of the flame, this will immediately lose its brightness, becoming dull and smoky, covering the bottom of the capsule with soot; and owing to the imperfect combustion, though the water is now surrounded by the flame, its ebullition will cease." When, however, the object is merely to raise a body to a high temperature, by local application, as when we heat a bar of iron in a blacksmith's fire or a flame, and without reference to the quantity of heat produced and wasted, indirect contact becomes necessary. So much, however, has the supposed value of near approach, and even contact, prevailed that we often find the space over the fire-grate about 12 inches deep, and behind the bridge wall frequently but a few inches deep, so as to bring the flame in contact with the boiler. As a general rule, deduced from practice, it may be stated that the depth between the grate-bars and the bottom of the boiler should not be less than 20 inches where the grate is but 4 feet long, increasing in the same ration where the length is greater; and, secondly, that the depth below the grate bars should not be less than 20 inches, although this depth is not so essential. The forming of combustion chambers back of the bridge wall, extending down below the grate-bar to the level of the ash-pit, is a source of great loss of heat, especially if the subsoil is damp. (The experiments of Professor Tyndall revealed the astounding fact that the power of aqueous vapor, at the pressure of the atmosphere, to absorb heat is 6,000 times greater than that of dry air.) Or, in other words, damp air loses heat by radiation in the proportion of seventy to one of dry air, as heat is absorbed by moisture in addition to the radiation of the walls surrounding the chamber. The writer recently reset a plain cylinder boiler having a chamber open to the ground floor back of the bridge wall. This chamber the writer arched over, about 18 inches from the bottom, and the result was a saving in coal of about 10 per cent. These air chambers are non-radiators. Professor Tyndall's experiments on this subject have clearly demonstrated that dry air is absolutely non-radiant.

In another case four plain cylinder boilers, set on the same plan as that just described, and having the grate-bars but fourteen inches from the bottom of the boilers, were reset by raising the boilers 24 inches above the grate-bars and arching over the combustion chambers back of the bridge wall; and also forming a flue along each side of the boilers, of about 4 inches wide, up to the top of the water line. The result was that while seven tons of coal per day were burnt before the resetting, the coal consumption after resetting was reduced to five tons. My latest practice is to form a flue so as to return the products of combustion over the top of the boiler, and thereby to a great extent reduce the steam down to nearly dew point. The ordinary furnace, as generally built, does not allow sufficient space for a complete mixing of the gases; and although the air admitted, due to imperfect fitting of the doors, mixes with the gases, the temperature of the mixture is not high enough for ignition, and the gases pass off unconsumed. By increasing the distance between the bottom of the boiler and the grate bars, and carrying a moderately thick and hot fire, with a rapid draught, and a proper admission of heated air above the grate-bars, and a thorough mixture of the gases evolved with the hot air admitted, perfect combustion can be attained.

W. Barnet Le-Van.

RECENT IMPROVEMENTS IN COKE MANUFACTURE.

One of the most notable characteristics of the present age is the tendency shown to prevent the formation of waste products of any manufacture. Probably the most notable instance of this is to be found in the various industries which have been created by the utilization of the by-products of coal-gas manufacture. The extensive range of beautiful dyes and articles of commerce which have been produced is a wonder to the ordinary observer and an encouragement to the engineer and chemist to seek to extend the field.

The direction which such attempts have taken may be classed under three heads. First, the construction of coke ovens in which the coal is subjected to intense external heat. Secondly, ovens in which the distilled gases are drawn downwards and the coking process is carried on by means of the combustion of the upper portion of the coke in the oven. Thirdly, ovens in which the evolved gases are after purification injected into the top of the oven along with heated air, and there consumed, thus acting as fuel to effect the coking. In the whole of the three cases the gases produced are treated so as to recover the tar and ammonia they contain, with a view to its subsequent utilization. The difference between them consists in the use which is made, after the recovery of the tar, etc., of the remaining combustible gases. The chief representatives of the first and second classes are to be found in ovens constructed under the patents of Messrs. Simon and Carvés.

The Simon-Carvés oven is a fire-brick chamber from 20 ft. to 30 ft. long, 6 ft. high, and 2 ft. wide. These ovens are built in series, and above each series rails are fixed so that the wagons containing the coal to be coked can be brought directly over the oven to be charged. Between each pair a number of horizontal flues are formed. Each oven is fitted with two hoppers for feeding, and has a door at each end which is opened for withdrawing the coke, and can be tightly closed and luted during coking. In the center of the top of each oven a pipe is inserted for conveying away the volatile gases and is fitted with an hydraulic valve. From this pipe a connection is formed with a range of cooling pipes, where the ammoniacal liquors and tar are condensed and separated from the combustible gases, which are, after being passed through a scrubber, carried back to the fire-places under the ovens, where they are admitted along with heated air and consumed. The *modus operandi* is as follows: The oven is charged and the coal is leveled off by means of rakes inserted in holes formed for the purpose. After charging, the coking is commenced, and as the volatile gases are formed they pass away by means of the pipes referred to, apparatus being provided to insure a steady draught. When the gases are ignited in the fire-place they pass onward under the floor of the oven, and are then carried upward to the upper part of the horizontal flues referred to and travel downwards in a zig-zag direction into the main flue leading to the chimney. When the charge is finished the end doors are opened and the charge is pushed out by means of a portable steam ram. Immediately the oven is empty it is recharged, and the process begins anew. The whole of the process of emptying and recharging can be performed in fifteen minutes.

The Jameson oven is essentially different to the one just described, not only in construction but in its first principle. The oven is of the ordinary beehive type, but has an opening in the center of the floor, to which a number of flues converge. To this aperture a pipe is attached, and the volatile gases are extracted by means of a fan or other exhauster. The construction is thus of the simplest nature, but the principle of coking is, we believe, a novel one. Instead of relying on the application of external heat, the necessary heat in the Jameson oven is obtained by the combustion of the upper layer of coke, which is, in this case, the first formed, and, as is well known, is always more porous than that lying below it. Mr. Jameson furnishes a graphic illustration of the way in which this porous layer is formed by referring to the bubbling action which may be observed on the surface of any ordinary house fire where a bituminous coal is used, and it is certain that a very similar action takes place in a coke oven. After the gases which cause these bubbles have passed off a residue of a light porous coke remains, and acting on the principle that the calorific effect of solid fuel is greater than that of gas, the process under consideration uses this imperfect coke as the fuel to effect its purpose. The oven is lighted at the top, and after the fuel is fairly alight the exhauster is applied and the gases are extracted through the pipe in the floor of the oven and subsequently condensed in a manner similar to the one described. The waste residual combustible gases can be used to give heat wherever required, or may, as the inventor wisely suggests, be used to supply the motive power for exhaustion by their use in a gas engine.

The Simon-Carvés oven reduces the time occupied in coking to about forty-eight hours for each charge, and yields almost the full theoretical amount of coke The average yield by the old system was from 55 to 65 per cent., while the Simon-Carvés oven is said to yield 73 per cent., the theoretical yield being 75 per cent. One very remarkable feature in the coke produced in the Simon-Carvés oven is that, as the width of the oven was decreased from the original width of 6 ft. to its present one of 2 ft. the resistance to crushing steadily increased, showing that the density of the coke was greater when produced in narrow ovens. This fact would tend to strengthen the force of the argument that the greater the heat used, and the quicker the coking is conducted, the better the resulting coke. On the other hand the yield in the Jameson oven is only about 63 per cent. But if, as we believe it is intended, the process of coking is applied to the recovery of paraffin, ammonia, etc., from the masses of shale which are collected at almost all the collieries, the first cost of the Simon-Carvés oven would put it entirely out of the question, while the Jameson oven could be very usefully employed for this purpose. The time occupied in coking a charge in the Jameson oven is about the usual time occupied by ordinary beehive ovens. The amount of tar and ammonia recovered would be, with the same coal, about the same in each case, the amount being stated by Mr. Jameson to be an average of 8 gallons of tar oil, ammonia equal to 10 lb. of sulphate, and 10,000 cubic feet of gas per ton of coal used. On the one hand, then the Simon-Carvés system would seem to have the advantage in the yield of coke and the time occupied in coking; while, on the other hand, the Jameson system possesses advantages in low first cost and consequent adaptability to existing ovens, which would seem to fit it for use in coking, or in extracting the tar, etc., from shale or coal not good enough for coke. The question as to which of these advantages will eventually overbalance the others is a question which must be left to practice to decide, and we are content simply to leave it in that position.—*The Mechanical World.*

REMARKS ON SAW FILES.

Remember that there is no difference whatever in the angles of three-sided equilateral saw-files, the bevels of the sides are always the same; there can be, and is a difference in the cut, some being very fine, and some being very coarse; those that are the finest cut are the most serviceable for saw-filing. The length and size of the file to be used are matters that must be left to the judgment of the user.

In making a selection of a file, bear in mind that there are several qualities; some file-makers have as many as four qualities—first, second, third and fourth. The first quality is, of course, the best, and represents about 75 per cent. of a file manufacturer's product, the other qualities taking up the remaining 25 per cent. Firm names are always stamped on files before they are tempered, and if after they are finished, any of them are found to be poorly cut or badly tempered, the firm name is ground off, and one of several fancy names stamped on each file belonging to a certain quality. Thus if a file-maker should select the word "Jumbo" for his second-quality files, all of his files which are too poor for the first quality and too good for the third have "Jumbo" stamped on them. First-quality files only bear the name of the maker, while fourth-quality ones generally bear no name at all, and are seldom seen and more seldom sold. When you have thought of all these things, ask the dealer for a first-quality file, bearing the name of some well and favorably known file-maker. Select the heaviest file you can get, for a heavy file is generally truer than a light one of the same size, and is better for recutting, a recut file, by the way, being just as good as a new one. Take the file to the light and hold it in a horizontal position, the point of it toward you. The teeth of the file will now be pointing toward you, enabling you to detect all imperfections. If the conformation of the teeth is irregular or uneven, or if the color of the file is not uniform, let it alone. A spotted or mottled file denotes unevenness of temper. If, on the other hand, the file presents a clean, white color, it denotes that the temper of it is hard and even throughout; if, besides this, it has regular and perfect teeth and bears the maker's name, you may rest assured that it is an excellent file. The best files are tempered at a low heat. Files of certain sizes and numbers made since the 1st of June, 1882, are of uniform weight, the file manufacturers of the United States having agreed upon a standard of weights and sizes.

A poor file is a most worthless article; yet it is astonishing how many such are manufactured; and why?—simply because inferior stock is used. Many *saws* are made from worthless steel, but *some* files are made from even worse material. They have been known to be made of iron and case-hardened. It is impossible for such a file to be of any service, even on a poor saw. Then what chance would it stand on one of the best saws.—*Hodgson.*

GASEOUS FUEL FOR STEAM BOILERS.

Mr. W. A. Goodyear recently read a paper on this subject at New Haven. We make an extract from it referring to gaseous fuel:

"The gas which best answers all the most important requisites for a good gaseous fuel is 'water-gas,' consisting essentially of a mixture of equal volumes of carbonic oxide and free hydrogen, obtained from the decomposition of steam by contact with incandescent carbon.

"Much experimenting has been done under various patents within the last few years in the way of attempts to produce a cheap and good illuminating gas by the enriching of water-gas with the vapors of the various heavy hydrocarbons, and these experiments have been at tended with a certain degree of success. But it seems somewhat remarkable that, while so much ingenuity and money have been expended in that direction, the far easier adaptability of water-gas as a means for the cheap and convenient production of heat, and the immensely greater field which is open for its application to this purpose, have been, comparatively speaking, almost entirely neglected.

"The chief cause of this neglect lies probably in the fact that hitherto no method has been generally known by means of which water-gas could be produced at so low a cost and in such large quantities as are required for a fuel-gas. There is good reason to believe, however, that an apparatus devised by the writer will supply this lack, and that water-gas can now be made in any quantities that may be desired, and at a cost that, besides leaving a handsome profit to the manufacturers, will render its general use in cities far more economical than that of any kind of solid fuel."

* * *

CHILLED IRON.

For many years the only kinds of armor that found favor in any country consisted of wrought iron in some form, whether laminated, plate upon plate, or solid. Now a change is taking place, the magnitude and importance of which we venture to think is not realized as yet by the authorities of any country. It is taking place gradually, and for this reason, perhaps, its full significance has escaped notice.

Until comparatively recently wrought iron armor—which for distinction we call "soft" armor—was the only kind employed. The method of attacking it was to drive projectiles through it. Now armor of a harder nature has largely come in, chilled iron shields for coast batteries, and steel and steel-faced armor for ships. This can be made to resist perforation ; it must be destroyed by breaking into fragments. Such armor may be called "hard" armor.

It must naturally follow, both in theory and practice, that a shot of small diameter has a great advantage in only having to make a small hole ; hence the remarkable results which have been obtained by new type guns firing projectiles of small diameter at high velocities. In the work of perforation so great is the advantage that may be obtained by this class of guns, that they naturally have found their way into our most important armaments. Even in the future, perforation was expected to effect great things. Steel shells could be driven clean through thick armor, not only without fracturing, but without up-setting materially ; so that there was a good prospect of their carrying bursting charges into the interior of armored structures, and thus, in a great measure, destroying the value of armor. In 1873 Grusen's *chilled iron armor* had so showed its powers of resistance that its adoption became only a matter of time. It has now taken its place as the only kind of coast armor employed by almost every nation except England. Russia, Germany, France, Austria, Italy, Spain, Portugal, Holland and Belgium, and Denmark, have all in some shape adopted it. This is the hardest kind of armor extant. It is impossible to perforate it. It must be gradually broken up, which can be done with steel projectiles.—*The Engineer.*

* * *

Styrian Steel is the name of a new brand, which has recently been put on the market and is gaining many friends. It is made in Styria, of special ores, and shows extraordinary endurance.

MOLECULAR RIGIDITY OF TEMPERED STEEL.

The author has remarked that in all alloys of iron the molecules are far more rigid than in the pure metal, and further, that with steel, tempering adds greatly to this rigidity. Soft steel, when compared with hard drawn iron, shows that the mechanical hardening of iron has not in any great degree diminished its molecular freedom. Even the softest steel shows a high degree of molecular rigidity, as compared with the hardest iron, but far less than that of tempered steel. This would seem to indicate that steel in its softest state is still an alloy, though only feeble quantities of carbon may be held in that condition. We thus perceive that a great physical change takes place in iron upon the slightest alloy with carbon, and that tempering produces this change in its highest degree. The author, therefore, is strongly in favor of the view propounded long since, that steel, when tempered, is an alloy, containing fixed carbon in a far greater quantity than when soft. We know the physical properties of magnetic oxide of iron, of iron and tungsten, and of iron and sulphur. Now, in all these the writer has found that the iron loses its molecular freedom when even slightly alloyed. The physical results are therefore the same as those produced in tempering steel, and the induction balance thus indicates strongly that tempered steel shows the characteristics of a true alloy. We could not have such a great physical difference between iron and steel, as above noticed, except by corresponding changes in its mechanical properties.—*Professor D. E. Hughes.*

* * *

BRONZING IRON.

Iron articles are easily coppered or brassed by dipping in copper solutions, or else coppered or brassed by the galvanic method; these coatings also scale off after a short time, especially if the iron surface was not thoroughly cleaned, when exposed to the influence of moist air. By the following process it is easy to provide iron articles with a handsome bronze-colored protoxide coating; it resists the influence of humidity pretty well, and besides this, the operator has it in his power to produce any desired bronze color in a simple manner.

The cleansed and scoured articles are exposed to the vapors of a heated mixture of concentrated hydrochloric and nitric acids (1 and 1) for from two to five minutes; and then, without unnecessarily touching them, heated to a temperature of 300° to 350°. The heating is continued until the bronze color becomes visible upon the articles. After they have been cooled, they are rubbed over with petroleum jelly, and again heated until the jelly begins to decompose. After cooling, the article is anew rubbed over with petroleum jelly. If now the vapors from a mixture of concentrated hydrochloric and nitric acids are permitted to operate upon the iron article, light red-brown tones are obtained. However, if acetic acid is mixed to the mentioned two acids, and the vapors permitted to operate upon the iron, oxide coatings are obtained, possessing a handsome bronze yellow color. All gradations of colors from dark red brown to light red brown, or from light bronze yellow to dark brown yellow, are produced by varying the mixtures of the acids.

I have in this manner coated T-rods, 1·5 meters long for iron boxes, with such oxide layers, and to-day, after ten months, during which time they were continuously exposed to the influence of the air of my laboratory, constantly laden with acid vapors, they do not betray the slightest traces of change.—*Prof. Dr. J. Oser, in Dingler's Polyt. Journal.*

* * *

VARNISH FOR FOUNDRY PATTERNS AND MACHINERY.

A varnish has been patented in Germany for the above purpose, which, it is claimed, dries as soon as put on, gives the patterns a smooth surface, prevents warping, shrinking, or swelling, and is quite impervious to moisture. This varnish is: 30 lb. of shellac, 10 lb. Manila copal, and 10 lb of Zanzibar copal placed in a vessel, which is heated by steam, and stirred during four to six hours, after which 150 parts of the finest alcohol are added, and the whole heated during four hours to 87° C. This liquid is dyed by the addition of orange color, and can then be used for painting the patterns. When used for painting and glazing machinery, it consists of 35 lb. of shellac, 5 lb. of Manila copal, 10 lb. of Zanzibar copal, and 150 lb. of spirit.—*Scientific American.*

[This seems to be Dutch shellac, not particularly improved by the copal. Where does the patent come in?—Eds.]

* * *

An ordinary straight belt must run squarely on to the pulley or at right angles with with the shaft. Hence, if you wish to connect with a belt two horizontal shafts, at right angles with each other (say an engine shaft near the floor, with a line attached to the to the ceiling), it will require a quarter turn, and the principle governing a straight belt must be observed. First ascertain the central point on the face of each pulley, at the extremity of the horizontal diameter, where the belt will leave the pulley, and set that point on the driven pulley plum over the corresponding point on the driver. This will cause the belt to run squarely on to each pulley, and it will leave at an angle greater or less according to the size of the pulleys and their distance from each other. This rule will render the setting of a quarter twist as easy and as certain as the setting of an ordinary straight belt.—*Professor Belt Lace.*

* * *

NEW MATERIAL IN THE ARTS.—VULCANIZED FIBER.

The fiber is made in two qualities, hard and flexible. The hard, which may be turned in the lathe, takes a very good thread and may be highly polished, is supplied in three colors—black, red, and white. It is used for journal bearings and bushes in cotton-mills, for railway track bolt-washers, and for pneumatic carriers, the General Post-office authorities employing them as such in place of leather and gutta-percha. In connection with electrical apparatus it is of great value, and a number of electric light companies are using it for the insulation parts of lamps and for certain parts of dynamo machines, as it will stand great heat, and is a better insulator and cheaper than either of the other substances usually employed. Another of the uses to which the hard quality is put is that of ferrules for the condenser tubes for marine engines. Such tubes are generally joined with wood ferrules, which, after being in use a little time, are liable, owing to expansion and subsequent contraction, to leak. The vulcanized fiber ferrule expands like wood, but does not go back again; consequently, it retains a firm hold on the ends of the tubes. The fact that grease does not affect the fiber is a great advantage.

The soft fiber is an excellent substitute for leather, rubber, gutta-percha, etc. Its ability to withstand the action of hot and cold water, acids, and grease renders it of particular value to engineers, etc.

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WARD'S STEAM GENERATOR.

The boiler here illustrated has some novel features that are worthy of attention. It is of the class called by some “pipe-boiler,” by others “coil-boiler,” but neither of these apply specially to it, as the coils are not continous, but are in rows or “manifolds,” terminating in vertical tubes.

The great feature of this generator is its circulation, which is natural, and induced by the system of construction. It is a sweeping circulation, the water being constantly flowing over the heated surfaces, from the bottom to the top, as fast as it is fed in. The result is, of course, great evaporation in proportion to capacity. Some experiments are now in progress to determine the exact amount of this, but are not yet concluded.

In detail, the action of the boiler is described as follows by the inventor, Mr. Charles Ward, Charleston, W. Va.:

“The feed water being introduced at *H*, or any convenient point, is conducted by an internal pipe (having an inverted ‘rose’ on its end) to the center of the main cylinder, *D*, where, in its slow descent in small jets, it becomes heated by contact with the surrounding water, and precipitates the mud into the bottom of the drum, *K*, before entering the tubes.

“The generator being filled to the proper water line and fire introduced, it is evident that the heat developed is rapidly absorbed by the water in the tubes, *M*, which, becoming rarified and expanded at once, pours over through manifold, *C*, into the central cylinder, *D*, causing an active circulation to and from the same through the lower horizontal manifold, *B*, vertical manifolds, *L L L*, generating tubes, *M*, and upper manifold, *C*.

“This forms a continuous circulation of water, the rapidity of which is accelerated by heat, making the heating surface more active in proportion as the fires are forced, and the demand for steam increased. This not only facilitates the generation, but secures dry steam, by presenting an ever-changing current of water laden with heat, ready to form steam on reaching the dome.

“The heavier remaining water descends again to make the circuit. Any tendency of water to follow the steam to the steam pipe, *G*, is prevented by a perforated diaphragm introduced in the center cylinder, *D*, just above the upper horizontal manifold, *C*, causing the steam to rise through numerous small holes over the area of the cylinder.

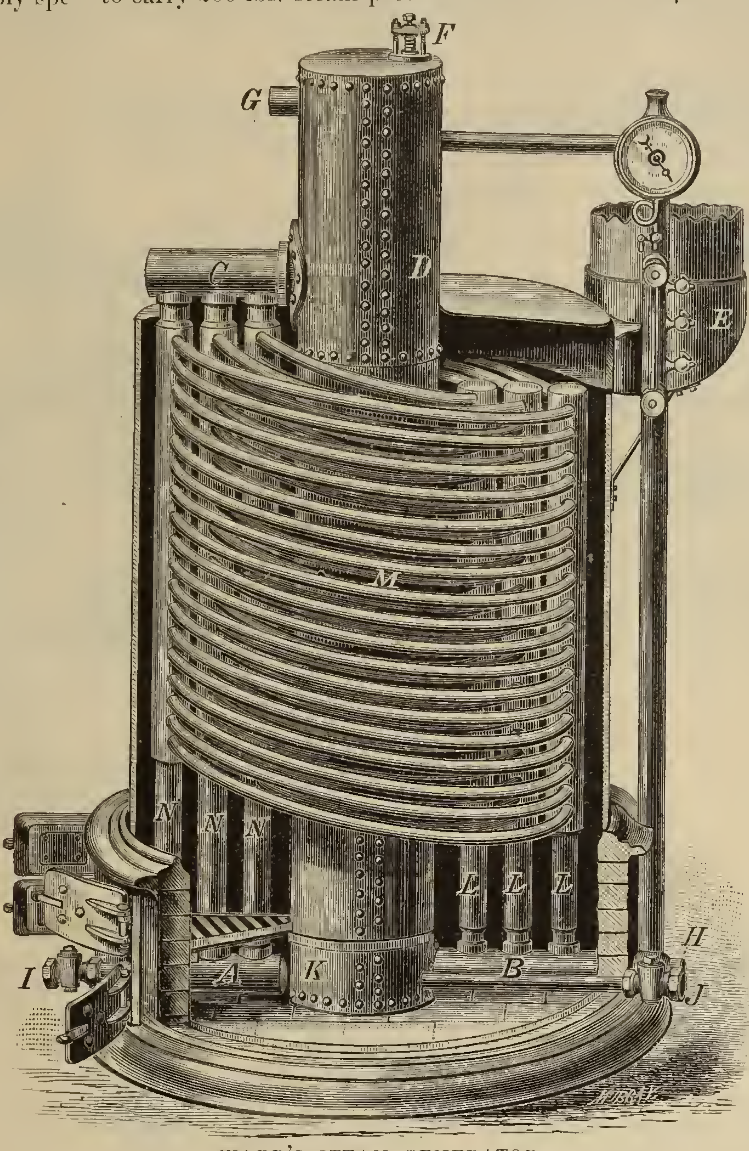
“To avoid the disastrous result of unequal expansion and contraction, every individual piece is free to expand and contract independent of any other.

“By removing the cover of the smoke box and the upper manifold, *C*, any of the piles of circles may be *raised* out of the jacket for examination or repairs, and replaced in a short space of time.

“The cleaning of these boilers is accomplished by first blowing off the mud through the valve, *J*, and afterwards flushing the tubes by opening the mud valve, *I*, which draws the clean water through the manifold, *B*, vertical manifolds, *L L L*, tubes, *M*, down through the vertical manifolds, *N N N*, horizontal manifolds, *A*, and mud valve, *I*, thus perfectly cleaning the tubes should any dirt remain in them.

“The half circles or tubes are connected to vertical manifolds by right and left hand bushings, which may be easily renewed at a small cost.

“These generators have been thoroughly tested with success during the past four years, on steamers and tugs, and are inspected by U. S. Inspectors, and tested to 300 lbs. and allowed to carry 200 lbs. steam pressure.



WARD'S STEAM GENERATOR.

“These generators work the muddiest of the river waters and are self-contained, or, in other words, require no setting. All that is necessary is to place the boiler and make connections from the collar, *E*, to the smoke stack or chimney. They are particularly adapted for steam vessels, tugs, yachts, etc. The parts are easily accessible for examination and repairs. They are free from danger of explosion and cross strains.

“A boiler of this kind, having eleven hundred square feet of heating surface, can be put on a floor space of forty-eight square feet.”

Two of these boilers are in the steamship *Meteor*, the vessel which meant to cross the ocean in five days; they were the only satisfactory part of the vessel. Information can be had by addressing the inventor, Mr. Charles Ward, Charleston, W. Va.

⁂

THE SAVANS, who are always trying to find out why a water-wheel runs faster by night than it does by day, could make more money for all hands if they would tell us why it is that over-work costs more money—much more—than regular work. In default of their attacking this question, we will attempt a solution of the matter. The reason over-work—Sunday or night work—costs more than regular work, is that less of it is done in a given time. The reason why less of it is done is that the men are tired from their day's work; their energies flag, and the stimulus of increased payment—generally double wages—does not supply the place of rest. Persons paying for over-time are buying their whistle at a very high price.

AT THE National Exposition of Railway Appliances, a new speed recorder for use on locomotives was shown. It indicates to the engineer, on a gauge similar to a steam gauge, the speed in miles per hour the engine is running. At the same time it makes a complete record of the trip, showing the variations in speed, distance traveled, amount of switching, and where done. The chart shows what speed the train was making at any given point and time. The instrument is attached to the locomotive under the boiler, and takes its motion from the forward trucks, which cannot be slipped. The advantages of the use of such an instrument need very little elaboration. The engineer has always before him the speed which he is making, and can thus make the pull steady either by daylight or in dark, stormy nights. He is not dependent upon guess-work, but has a sure indicator right before him. The record enables the officers of the road to know just how engineers operate their locomotives at every point, crossing, bridge, switch, etc. The value of such a record in an economical point of view cannot be overestimated.—*Railway Review.*

THE “SMOKE INSPECTOR” of Cincinnati does not have a good time, and he has come to the conclusion that the city ordinance which demands the burning of smoke is void, for the reason that smoke is incombustible. His conclusion as to the smoke is sound; and he now demands that none shall be made. He thinks bad firing is the cause of much smoke, and in this also he takes a sensible view. Firemen should be examined, he says, as to their fitness for the duty they assume, and if found capable, licensed. If, thereafter, they produce smoke, they are fined, and if still intractable, their licenses shall be taken away. This plan might work if local politicians did not interfere.

⁂

THE NEW GUION LINER, the *Oregon*, is intended to beat the *Alaska*, as yet the fastest ocean steamer afloat. The *Oregon* is 520 feet long, 54 feet beam, and 40 feet deep from upper deck; she has much finer lines than the *Alaska*, and more power. Her engines are triple expansion, with cylinders 74″ in high pressure, and two low pressure 104″ × 72″ stroke. She has 9 boilers 16·6′ diam., with 72 furnaces. The crankshafts are crucible cast steel.

⁂

A CONTEMPORARY WRITING about “Smithing and Forging,” begins as follows:

> “In the art of the ironworker the most important element is percussion. The mere weight or pressure of several tons would fail to produce the impression which can be made by a hammer whose weight is but an ounce, and that hammer wielded by the hand of a tiny child.”

After this no one wants to read any more.

⁂

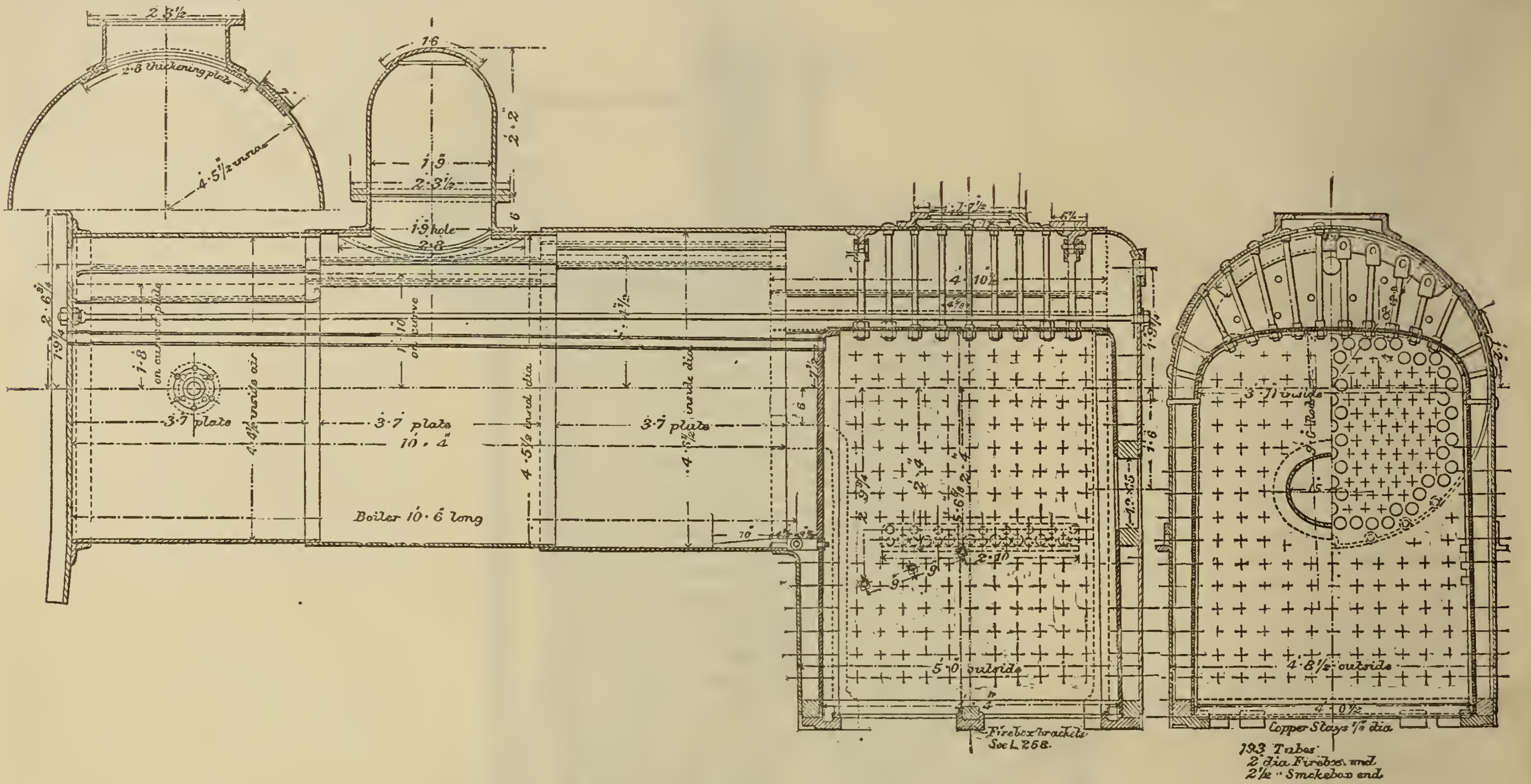
A RETORT has been invented whereby the waste lumber of saw-mills—edgings, slabs, etc.—are converted into charcoal, alcohol and turpentine. The slabs are put in at the base and the charcoal is taken from the top. The fire can be kept continuously burning.

⁂

SUPPOSE we have a square tank and wish to make a round one to hold the same number of gallons, how shall we get the size? By this rule: Multiply one side of the square by 1·128, the product is the diameter of a circle of equal area.

AN ENGLISH LOCOMOTIVE BOILER.

The engraving herewith shows an English Locomotive Boiler, the specification for which is appended—"Barrel dome, fire-box, casing, and smoke-box tube plate, and all angle iron rivets and stays to be made of best Lowmoor iron. The barrel to be made telescopic and formed of three plates, transverse joints to be single riveted, longitudinal seams are to be butt jointed and have inside and outside strips, and to be double riveted, placed above the water line, the middle plate to be strengthened by a plate riveted on the inside under the dome. The tube plate to be attached to the barrel by a ring of angle iron, bored, faced, and turned edges riveted to both. The dome to be welded and top riveted on, flanged at the bottom to fit barrel; the joint flanges must be well faced to make a perfectly steam-tight joint. The fire-box foundation ring to be of form shown, and the casing plates to be double riveted at the corners. The fire-hole ring to be oval, and both fire-box and casing plates to be kept clear of the inner edge of the ring. Barrel stays must be arranged, as shown on drawings. All edges of plates must be planed. Great care must be taken that the plates are brought well together before the rivets are put in. All rivets must completely fill the holes, and the heads must be true and central. The holes must be slightly countersunk, drilled, and rimered out perfectly fair with each other in all plates and angle irons. Drifting will not be allowed, and any calking that may be required must be done with a broad-faced tool, so that the plates may sustain no injury. Boiler to be tested with water to a pressure of 200 lb., and steam to 160 lb. per square inch."



SPECIFICATION OF AN ENGLISH LOCOMOTIVE BOILER.

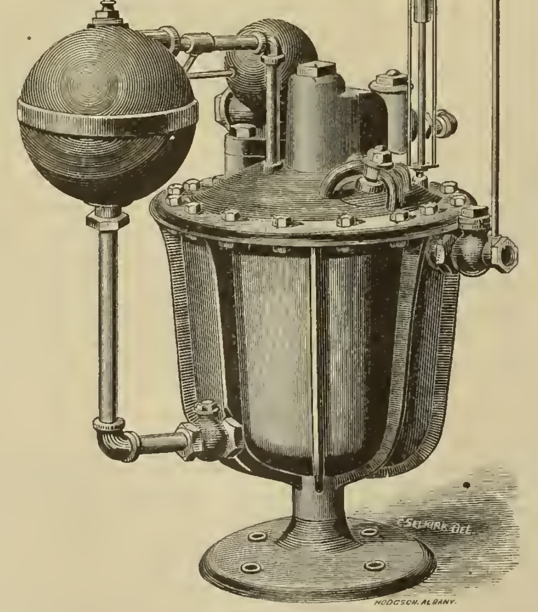
* * *

AT A RECENT MEETING of the Master Mechanics' Association a member said: "From two and a half years' experience in its use, I find the extended smoke-box beneficial to this extent—economy in fuel, cones, netting, smoke-stacks, etc.; also more free and regular steaming qualities, insuring against fires, and guaranteeing cleanliness to both train and engine. I now have twenty-one locomotives equipped with the extended smoke-box or spark arrester, thirteen being passenger engines and eight freight engines, including one switch engine. During the past two and one-half years that it has been in use, no fires have occurred, and the trains have been much cleaner and more pleasant to ride on, as the sparks are deposited in the extended smoke-box and not hammered back over the trains to annoy passengers and injure the paint of the coaches, etc. As a rule, a train of six coaches using a fair quantity of coal, the locomotive will deposit from forty to fifty bushels of sparks in the extended smoke-box in a 100-mile run. In point of economy a saving of fuel is effected, since by it we can use from ¼ inch to ½ inch larger exhaust openings, thereby getting a better steaming engine.

Mr. James Meehan, of the C. N. O. & T. P. Railway, claimed a saving in fuel of 20 per cent. is effected as compared to the old diamond stack and lift pipe. Mr. Meehan, in connection with the extended smoke-box, also uses the brick arch in the fire box."

NEW "SPECIAL BUCKET" RETURN TRAP.

We illustrate herewith a new return steam trap manufactured by the Albany Steam-Trap Company, and by them called the "Special Bucket" Return Steam-Trap. The return steam traps manufactured by this company are so well known, especially the gravitating one, commonly known as the "Albany Return Trap," used in nearly every civilized part of the globe, that there is no need of explaining them here. This company were the first, fourteen years ago, to introduce the well-known return steam-trap for the purpose of receiving condensed water under pressure and returning it to the boiler; the gravitating trap being so named because its action is dependent upon the gravity of condensed water in the gravitating sphere, to counterbalance the weight at the other end of the lever supporting it. To give sufficient fall to work properly, a device called the equalizing valve opens communication with the steam space of the boiler, establishes an equilibrium of pressures, and allows the water to descend through the check-valve into the boiler. The company occasionally found in their experience, from the limited space available in some places, that it was difficult to arrange the pipes to and from the gravitating sphere. To meet such cases they now manufacture the special bucket return trap (illustrated herewith), which will perform all the work done by the gravitating trap, and is equally satisfactory in its action. It is an automatic return steam-trap, with rigid connections. The steam valve and devices actuating it are contained wholly within the trap itself, thereby obviating the necessity of stuffing boxes and similar contrivances. Circulars and price lists on application to the Albany Steam-Trap Co., Albany, N. Y.



* * *

IN ANSWER to various inquiries of friends as to whether we shall be personally present at the *National Association of Stationary Engineers*, to be held in October at Chicago, we have to say that we shall not. Much as we would like to we think it is better for all that we should not. We shall not be present in person, or by representative in any way. Our reasons for this are here plainly expressed; we do not wish it to be inferred that our advocacy of the cause of the stationary engineers is from any other motive than a disinterested one. We speak for them because we wish to aid them all we can, not from any business reason, or with a hope of getting subscriptions to this paper.

* * *

TEMPORARY ABERRATION.

We feel complimented when contemporaries find matter in THE MECHANICAL ENGINEER worth reproducing in their own columns and credit it to us, but we sometimes observe cases of temporary aberration regarding this latter, which grieve us. Our esteemed and coruscating friend, H——l of the G——n C——r sins in this respect to the extent of two columns, in his July issue, but he didn't mean to and will not do so any more. So does another western contemporary whose initials we will not mention, and all and sundry make free with items, containing a page of information condensed into ten lines by us. "It is a sin to steal a pin," but a very much greater to pounce on items; very often there is more labor on them than in a leading article.

* * *

BIG TROUBLES are not so annoying as little ones. A man can sit astride of the roof of a house, for instance, for some time, and view the world with complacency, but a nail-point projecting in the heel of his shoe brings him to bay at once.

SOME NEW INSTRUMENTS FOR DRAUGHTSMEN.

Our engravings represent some new instruments for draughtsmen which will be found very useful. Through them the neatness and exactness of an engraving may be secured in shaded work, and by their aid the time required is very much reduced, in some respects, for in one of them three instruments are combined.

Fig. 1 represents the positive section liner, which, as its name implies, enables a draughtsman to line sections with absolute accuracy and almost mechanically—that is, without watching to see that the lines are evenly spaced. Concerning this latter no defect is more disagreeable. They impart an appearance of weakness and uncertainty of purpose to what is otherwise a good piece of work.

As seen in the engraving, the rod, *R*, passes through two weights, *W*, and is securely held therein by two binding screws. Upon the under surfaces of these two weights is securely fastened very fine cloth, which effectually prevents them from slipping on the surface of the paper; but to remove all doubt, the weights are perforated by two very fine needle points, which can be screwed down into the paper. As will be seen, the instrument can be placed on any part of the paper in any position. The whole mechanism, which is exceedingly simple, swings over the round rod, *R*, so, that in section-lining a drawing of complicated machinery, the blade can be lifted up to see when the lines are running out.

The blade turns on a pivot, so that it is easily adjusted for any angular position. An accurately cut rack and pinion, precisely 6 per inch, pitch, is used to propel the head, *H*, carrying the blade, and enables distances to be measured on the paper with the greatest accuracy.

Mounted on the pinion, *T*, is a notched wheel of 64 teeth; by releasing the cam, *G*, a spring tooth instantly engages in them; these will be found sufficiently fine for nearly all varieties of section-lining.

The lines can be made much finer by simply turning the blade at an angle, as shown in the illustration.

In shading round work recourse is had to card-board disks, two of which are shown to the left on the engraving; they will save a great deal of time, doing away at once with the excessive care required in shading a cylindrical surface by the ordinary means.

These printed disks tell exactly the different thicknesses of the lines, and how they are to be spaced to get those beautiful blending effects so much sought after. In using them it is only necessary to select the one for the required diameter (each is marked the diameter it is best suited for), and after placing it over the notched disk, *H*, bring the blade to the outline of the intended cylinder, after which the disk may be revolved on the pinion shaft until the starting line, as indicated by the arrow, is brought under the index pointer. Now, if the binding screw is screwed down tightly, and the spring tooth disengaged from the teeth on the notched wheel, *N*, by simply turning the cam, *G*, the lines may be drawn, taking care to observe just when the lines are to be increased or decreased in thickness, as indicated on the inner circle of the printed disk.

The result will be a surface with all the fine effects of light and shade, and so blended as to produce the proper appearance of a cylindrical object.

Fig. 2 combines a section-liner, protractor, and T-square. Being positive in all its motions, measurements in fractional and decimal parts of an inch can be made with mathematical accuracy; lines can be drawn at any angle, in any direction, and on any part of the board.

Our readers, being all professional men, will see at a glance the uses of this instrument, as its intention and application are apparent from the engravings.

These goods are manufactured by W. Gardam & Sons, 96 John Street, N. Y., who will give information and price lists on demand.

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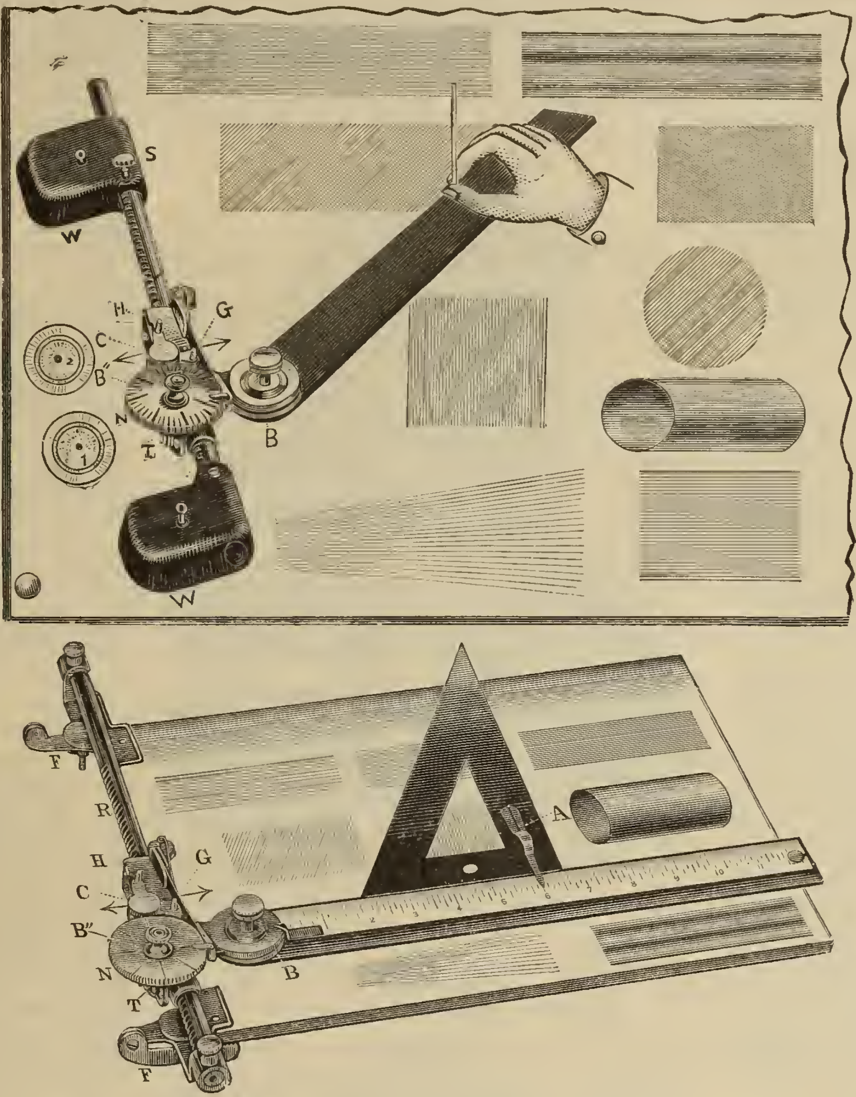

SOME NEW INSTRUMENTS FOR DRAUGHTSMEN.

A NOVEL DRILLING MACHINE.

Apropos of our remarks on self-feeding drilling machines, the Putnam Tool Company (S. W. Putnam's Sons) Fitchburg, Mass., forward us an engraving of a new tool of this class which has many points of useful novelty about it, not the least of which is the manner in which the drill is driven. In this machine gearing is dispensed with, there being none anywhere about it. The spindle is driven by round belting through a pulley on top of it; the round belt passing over two idlers, one on each side of the frame, and thence vertically downward to another wheel on the cone pulley shaft. These pulleys are of large diameter, and the system affords a perfectly noiseless drill. There are many other novel features, among which are the power feed of three gradations, controlled by automatic stop motion; also sensitive (adjustable) lever feed with depth-gauge attachment.

It has a patent leveling device for drilling table, large base plate, eccentric belt tightener, patent balanced spindle having vertical traverse of eight inches, with quick return motion, and improved oil reservoirs for automatically lubricating the spindle collars.

Aside from its improved construction this machine presents a handsome appearance, and is an ornament to any shop.

The automatic feed is simply a cone pulley on an auxiliary shaft by the side of the spindle, on which is another cone pulley. This is, without doubt, a satisfactory and efficient rig, for the feed is self-adjusting for all ordinary conditions.

As STATED ELSEWHERE the engines of the *Aurania*, the new English steamer which broke down on her first trip, will have to be rebuilt, but the work will not be done in this country. The Cunard line never has any work done here that can possibly be avoided. An inquest was held over the remains, and it was asserted that it would be so expensive to make new cylinder moulds in this country that it was better to send the ship home. This is long-headed with a vengeance. There is no occasion to make patterns, for none are needed. Cylinders could have been cabled for and have been in the sand in a short time. They could have been bored out and shipped to this country long before they were needed to set up, but there is nothing like circumlocution and red tape, and "how not to do it."

The latest intelligence respecting these unfortunate engines is that the ship is to be taken to England with the two low pressure engines only. As these are 104″ diameter, they will drive her at a good speed. The cause of the break-down was the breaking of the connecting rod of the high-pressure engine close to the butt, in the fillet. Our informant, a chief-engineer of an English line of steamers, says that the rod was butt-welded! If this is so, there is no wonder that it broke.

THE PILGRIM, of the Old Colony line, the new mammoth steamer, swims 18″ deeper than she should, and as a consequence has a low free-board. What will be done with this steamer is a question to be answered in the future, but as the vessel now is it will be hard to find a remedy for all her ills. Too much rule of thumb, and scorn of science, brought her to this pass.

THE *Scientific American* has a photograph of some iron castings sent to it from Japan. These castings were poured just after an earthquake, and look a little "scabby." Japan must be a handy country for moulders, if they can put off scabby castings on earthquakes as a cause. We have seen some castings much worse than the photographs in question where earthquakes are unknown.

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OUR EXPERIENCE is that discontinuing subscriptions promptly upon expiration is the only correct and just plan. A newspaper is merchandise, and a certain sum is paid for a given quantity of it. It would be quite as sensible for a merchant to give two coats for one price as for a publisher to send a paper two years, or indefinitely, for the price of one year. Yet this is done by many publishers, and some large subscription lists exist in this way. When the publisher gets short he sends bills, and keeps sending them until he is tired, for in nine cases out of ten delinquent subscribers are very loth to pay for what they have not ordered, and possibly do not want. If a man needs a paper he is very willing to pay the small sum demanded for it. We have followed the plan indicated from the start, and our subscription list is absolutely and positively, in every instance, except a dozen complimentary copies, paid for in advance.

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THE *Age of Steel* says:

"There were 16,000 rejected models sold at auction at the Patent Office last month, principally for the metal they contained. The aggregate amount realized was $502. A private sale of the most valuable took place, the amount realized being $260. The highest figure for any one article was $80."

They will all be repatented again pretty soon.

A CURIOUS INSTANCE of the slight causes which promote oxidation, the experience of a manufacturer of fine cutlery is related. He found at one time a large portion of his goods being returned to him as in damaged condition. Instead of bright clean surfaces, he found rusty, deeply-oxidized blades. After much watching to determine the cause, whether damp paper, the ill-will of some of his agents, or other cause, it was located upon the man who sorted and wrapped the knives in packages. Everything he touched was found to rust, from the peculiar acid character of his skin exhalations. It is well known that some persons cannot carry pocket-knives or bright iron articles, as keys, etc., about their person without becoming very rusty.—*Paper World.*

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

MUTUAL AID ASSOCIATION.

Editors MECHANICAL ENGINEER:

With your permission I would like to say a few words to the trade through your valuable journal. While I advise all organizations of labor to adopt the mutual aid system, I speak now, more directly to stationary engineers' associations. They will soon meet to hold their second national convention, and I think each society should discuss this matter thoroughly in advance, and instruct their delegates how to act in the matter. Surely, where there will be so much talent, and so many other similar societies to pattern after, there is no good reason why a mutual aid association should not be attached and be in working order thirty days after the convention. No member can give any good reason for not joining, unless he already belongs to a similar society. Still, there may be some who will say: "Oh, I can't afford it!" Well, brothers, what will become of your wives and children should you be taken away before your time? Even when your time is up we know full well you will leave nothing if you do not join us! It seems to me that no man can look me in the face and say he has done all he could for his family when he has not done something to stave off want and poverty from them. Our mutual aid association should be carefully considered; and every engineer should give it more than a passing thought. Some throw cold water on it because they belong to other societies, but this is outside of the question. We are now members of a stationary engineers' association; to join other societies it will cost from ten to twenty-five dollars, initiation fee, and from six to ten dollars dues, annually, besides assessments at each death. On the other hand, in our association there are no dues whatever, except a dollar or two to join, and assessments at the death of members. Some say the society may break up; so may any society or company. These are the chances of life, but even in this event no man would sit down and cry over it. Every cent paid in went directly to the widows and orphans of deceased brothers, not one penny for rent or salaries; bare expenses of transmission only being deducted. But the mutual aid is not an experiment, many such associations exist and are in a prosperous condition. I have belonged to one for the last eight years—the Marine Engineers' Aid Association—and it is doing lots of good. It will be hard to improve on their constitution, which, with a few alterations could be adopted for ours.

Sometimes I hear men say: "There isn't enough in it to make it an object." The answer to this is that if all would join at once and induce others to do so we should soon build up a large following. Others seem to think it is necessary to be examined by a doctor before being accepted, these are foolish objections. Since we organized the Marine Engineers' Association, No. 4, in this city, we have lost six members by death. The oldest forty-seven years of age. Most members would be accepted by any insurance company in the country, but we also have others who would not be taken; yet they seem as well as they were twenty years ago, following their business daily right along.

Now, brothers, I practice what I preach. I belong to the Marine Engineers' Mutual Aid Association, I have subscribed to the Stationary Engineers' Mutual Aid Association that is to be, and I have had a thousand dollar policy in the Union Central of Cincinnati for the last fifteen years. I may say I am as well protected as the average man in our profession; but for all this, I want to see the institution I am talking up in active operation.

I think all members should take Secretary Davy's advice and deposit a dollar with their treasurer, so that when the Convention meets, and a general secretary is elected, we can put the money into his hands and proceed at once to obtain a charter, print policies, and get in thorough working order. Hoping to hear the views of others on this subject and have their active co-operation through your columns, I leave the matter on its merits.

Since writing the above I can point all my remarks by an instance—that of Bro. James O'Neil, a member of No. 4, M. E. A., who recently died in this city. This brother has been ill a long time, the event was not unexpected, and his demise is sincerely mourned. He was a most worthy man, and is greatly regretted by hosts of friends. He held policy No. 5 in the Mutual Aid Association, and belonged to "The Foresters" as well, showing good judgment in doing what every man should endeavor to do for his family—that is, provide for their education, so that they will not be driven into the shop before they are able to read and write.

Brother O'Neil was always foremost to respond to the calls of others. Whenever we took up a donation for a worthy object he would respond liberally. He will not soon be forgotten. The St. Louis Marine Engineers' Association has also lost a member, and it seems to me that these incidents remind us all of the uncertainty of life and the necessity of making what provision we can for those dependent upon us. The Mutual Aid Association offers such provision, and we should not delay one day in becoming members of it.

WILLIAM PONSONBY.

CHICAGO, ILL.

CASES IN POINT.

Editors MECHANICAL ENGINEER:

My attention was attracted by a letter in your issue of July 21st, by J. H. Reid, of Detroit, entitled "Learning by Experience." I have noticed many batteries of boilers in this place set in the manner he states, viz: Without any means of shutting one off from the rest. It is the custom with boiler makers here to set their boilers with a mud-drum running across the whole width of the setting, with openings for each boiler, and no check or stop valves to either. At the water-works in this city, only a short time ago, I overheard the engineer ask one of the firemen how much water he had. The answer was: "the boiler on one side is full." "Well," said the engineer, "the rest must be," and he immediately stopped the pump without inquiring further.

This was with a battery of six boilers set as Mr. Reid describes. There are gauge-cocks on the two outside boilers, but if I remember rightly, there are none between. What a field of labor for the Hartford Steam Boiler Inspection and Insurance Company is here!

Another case I have in mind is a hotel of three hundred and fifty rooms in this place. Two 42″ boilers are set in the same manner. One of the former firemen was firing for the firm that employs me, and in the course of conversation I asked him how he used to tell the height of water, as I had never seen either cocks or glass gauge. He said: "There are gauge-cocks on both sides, but we never tried only one side!" How it is possible to keep the water the same height in two boilers I fail to see. With the two I now have charge of, which I found without check valves (although they did have stop-valves), I found it impossible to prevent the water from shifting from one to the other, and that through a 1½″ pipe. What must it do with a large pipe and no obstruction? No wonder so many boilers in the west and south explode and "nobody to blame."

Another place I went into had two 42″ boilers fed by a little steam pump that a boy could almost carry off in his pocket! The largest stream it could possibly throw was ¾″. I was there over half an hour and could not find the steam gauge, although I searched for it carefully, and the "engineer" did not try the water during that time. He supposed he was carrying 90 to 100 lbs. but "didn't know." I was raised where both check and stop valves are considered a necessity, for every boiler, whether two or one hundred in a battery, and if they were always set as above with a reasonable amount of attention, they never give trouble from low water; it cannot pass from one to another so long as the check-valves are operative.

NASHVILLE, TENN. TRAMP.

FROM STATIONARY ENGINEERS' ASSOCIATION NO. 1, CANTON, OHIO.

Editors MECHANICAL ENGINEER:

Dear Sirs:—The Stationary Engineers' Association No. 1, Canton, Ohio, had an election on July 11th, when the following officers were installed:

R. D. BRADLEY, *President.*
JOSEPH RICHARDS, *Vice President.*
JESSE T. KING, *Secretary.*
GEORGE WELDEN, *Treasurer.*
DAVID S. BAIR, *Guide.*
W. A. CHAIN, *Sergeant-at-Arms.*
THOS. T. PHILLIPS, C. C. MILLER, CHRIST. SCHNEIDER, *Trustees.*

For a small society we are doing well, and the members are improving themselves as engineers. This is a settled fact. After a while, when the returns are all in, you will hear further from the Buckeye State. Cincinnati has dropped into line, and others will follow suit before long.

How do you like our seal?

CANTON, O. R. D. BRADLEY.

[We are always glad to hear from our friends in this line, and know that the Buckeye State can furnish its quota to the cause. We like the seal, and consider it very appropriate. It represents a steam gauge; around the outer circle are the words: *Stationary Engineers' Association No. 1, Canton, Ohio,* and on the inner, *Chartered Jan.* 19, 1883. The dial and index finger are inside of this, and we observe by it that the association is carrying only twenty-six pounds of steam at present. Just fired up, probably.—EDS.]

REPORT OF SECRETARY DAVY OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

EDITORS MECHANICAL ENGINEER:

I herewith send you my report of the Engineer's Association, also address of secretaries, and I would request that each secretary write to all others at least once every quarter.

LOCAL ASSOCIATIONS.

CHICAGO, No. 1, Wm. Ponsonby, 361 Hubbard st., 248
KEYSTONE COUNCIL, Phila., Pa., G. F. Peifer, cor. Johnson and 20th sts., 113.
CHESTER, Pa., James E. Platt, 1027 Upland st., 19.
MERIDEN, CONN., Wm. M. Gage, 283 Crown st., 13.
DENVER, COL., H. T. Howard, 498 Arapahoe st., 14.
CARTHAGE, MO., W. H. Davis, 15.
CANTON, OHIO, Jesse T. King, 19.
SAN FRANCISCO, CAL., Jas. Bell, 1314 Pine st., 24.
LOUISVILLE, KY., Jas. S. McEunis, 615 Shelby st., 20.
WILMINGTON, DEL., M. J. McNelly, 1006 Poplar st., 27.
DETROIT, MICH., A. M. Davy, 32.
NEW HAVEN, CONN., F. A. Foster, 124 George st., 34.
NEW YORK, City, Wm. Conroy, 239 Broadway, 68.
BALTIMORE, MD., J. B. McClure, 212 Elliott st., 50.
BROOKLYN, N. Y., J. J. Hughes, 57 Wyckoff st., 73.
PROVIDENCE, R. I., A. H. Warner, New Court House, 82.
ST. PAUL, MINN., Jas. Sweeny, 123 East 3d st., 25.
OWASSO, MICH., Andrew Jackson, 11.
ROME, N. Y., C. H. Tracy, 9 Merchant's Mill, 11.
GRAND LODGE OF MASS., G. A. Grover, 88 Clinton st., reports the membership of Boston, Lynn, Worcester, and Hamden, Mass, 132.
MEMBERSHIP REPORTED, 1030.

Two hundred new members have been admitted, 9 suspended, 3 expelled, 12 applicants rejected, and 5 associations chartered during the quarter. The following associations have failed to make reports: Cincinnati, Ohio, Rochester, N. Y., St. Louis, Mo., and Chicago, No. 2.

One hundred members have signified their desire to have the Mutual Aid started at once, on or before Aug. 1st. Those who have signified their wish to join the Aid, will pay their admittance fee to the proper person who should report name to me at once.

A. M. DAVY, Sec.,
175 Elmwood Ave., Detroit.

"CAUTION" ON COMPRESSION.

Editors MECHANICAL ENGINEER:

In answer to *A. M. Z.* of Brooklyn, N. Y., whose letter was published in No. 1, current volume, I would like to say a few words about compression. We should not go to extremes on this, and create a great resistance to motion on the second half of the return stroke; it is enough to merely arrest the momentum, and prepare for the change in direction of the reciprocating parts. What is "gained" by compression is lost in power; it is a brake in fact, transmitted through the piston to the fly-wheel. This latter cannot be checked at once, so it receives a springing, twisting motion through the arms which, in some cases, goes far towards causing accidents. If the fly-wheel were solid, we would have no end of break downs with high compression. Either the crank or the wheel, or perhaps both, would surely get loose on the shaft, for no workmanship, however good, could stand the test of the constant surging and twisting which goes on where the piston is violently driven forward, and forcibly brought up again in the opposite direction on a cushion of steam.

I claim that any compression, greater than that needed to gently check the motion, is a clear loss. I have erected a large number of compound engines, also ordinary condensing and non-condensing engines, all of which run quietly with low compression. They are (the compound) very economical, tests showing not to exceed 1.9 lbs. coal per h. p. per hour, speeded from 350 to 630 feet per minute on the piston.

Actual practice is now, has been, and always will be in advance of theories. CAUTION.

TROY, N. Y.

MARINE ENGINEERS' ASSOCIATION, NO. 40.

Editors MECHANICAL ENGINEER:

Herewith find list of officers of No. 40. M. E. A., organized at Galveston, Texas, lately:

Worthy President, R. G. Murray; W. V. P., E. Greaves; W. T., Charles Perkins; W. R. S., Samuel Perkins; C. S., Israel Clark; F. S., William Bristol; Chaplain, A. Baldy; Conductor, P. Riley; Doorkeeper, George Pendergast.

There are a goodly number of members, all working marine engineers. We are extending our lines, and would be glad to see No. 33, of New York, with 200 members, and there would be, if engineers would consider their own interests.

JAMES H. REID, *President. M. E. A.*

DETROIT, MICH.

ONE OF THE LARGEST if not the very largest vertical engine in existence, is thus described by the *Age of Steel.*

The largest upright engine ever seen in this city is now being erected. It stands 33 feet high, measuring from the base, and weighs 112 tons. The cylinder is 42 inches in diameter and stroke 5 feet. The engine stands upon a foundation 13 feet deep, containing thirty-one car-loads of large stone.

PRIMING OF STEAM BOILERS.

Suppose a 10-inch cylinder with a 2-inch supply pipe (such ill-proportions are to be found in use by some who complain of foaming) and the piston velocity to be at the moderate rate of 300 feet per minute. In such a case the area of the cylinder is just twenty-five times as great as the area of the steam pipe, and the steam in the pipe must move twenty-five times faster than it does in the cylinder; or equal to 7,500 feet per minute, which is a little more than eighty-five miles an hour. With this velocity a lessened density is caused immediately around the mouth of the pipe, and the steam pressure in remoter parts of the boiler forces water instead of steam into the vacuity, just as the atmosphere forces water into a suction injector. If the steam pipe were twice the area, the steam would have only half the velocity, and so in proportion. It is not the amount of steam that is taken that causes priming; it is the velocity, whereby we disturb the equilibrium of pressure in the boiler, and boilers should have plenty of steam room, water space, water level, and width of spaces to help equalize the pressure; and steam pipes should be proportioned and placed so as to disturb the equilibrium of pressure as little as possible. Taking steam from two or more different parts of the boiler often helps very much.

But dirty water: how does that act to cause priming? I found a satisfactory answer to this question in a very simple way; at least it satisfies me, although others may have a different light. After wondering for years why dirty water should foam any more than clean water, I happened to be in the village drug store when the old doctor himself was tending the soda fountain. One customer took plain soda water; it sparkled some as the gas escaped from it, but there was no foaming. The next man took "plenty of syrup" in his, and it was all foam. I asked the old doctor why the first glass did not foam like the second one? He said that there was more gas, more effervescence in the first glass, but there was nothing but the weight of water to prevent its escape, while the syrup was of a glutinous or adhesive nature, and formed films and membranous cells which hold the gas from escaping, the whole forming so light a substance that it rose up in what we called froth, or foam. Here was the answer to my question. The impurities of the water are adhesive, and form films and cells which hold the steam, and yet are carried upward by the steam, and the lightness of the foam makes it easily carried off with the steam, even at a moderate velocity of escape.—*A. N. D. in American Miller.*

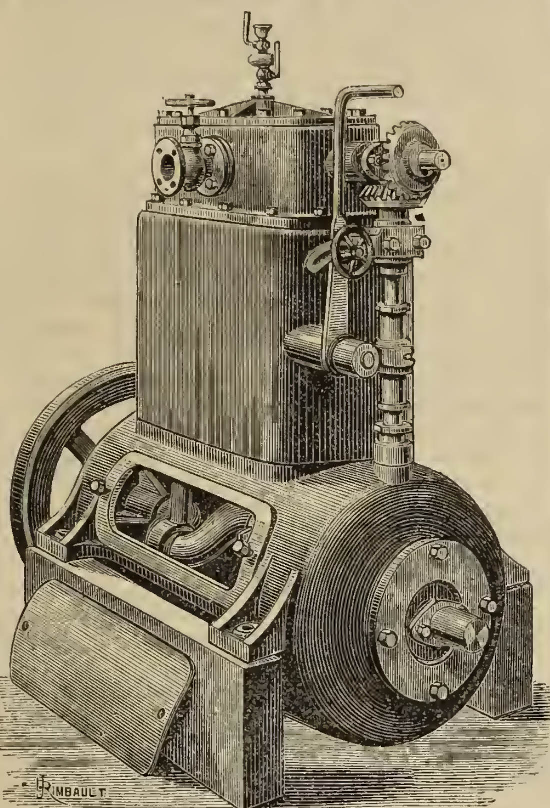
SPECIAL MACHINES are used much more in England than in this country. Here is an account of some boiler-shop machines recently made in England: "Another special machine was a circular planing machine for dealing with the plates after they have been bent. In this machine the plate forms the guide for the tool, so that whatever the shape of the plate is itself, the path for the slide which carries the tool box and a specially arranged balance weight comes into action to keep the tool always to its work, whether traveling upwards over one-half, or downwards over the other half of the plate. Among other interesting processes was the flanging of marine boiler and plates, which is done by a powerful hydraulic press. By this machine boiler-ends 18 ft. diameter, 1 in. thick, with 10 in. flanges, can be flanged in two places, and the furnace holes flanged at the same time. The plate to be flanged, after being sheared to the size required, is heated to a red heat all over. It is then drawn from the furnace into the press and is held against the upper dies by a die-plate carried by a series of rams. The main rams then lift the table with the blocks, which turn up the overhanging edges of the plate, thereby forming the flange."

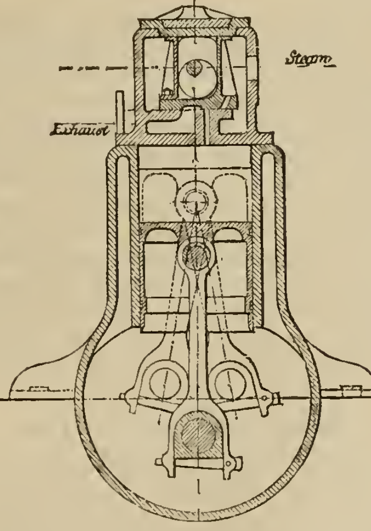
THE OFFER of a year's subscription for No. 1, Vol. 3, is withdrawn, as we have received several.

ANOTHER THREE-CYLINDER ENGINE.

The engine here illustrated is of English design and intended for high speed. There is little novelty about it, except in its design, which is neat and compact. In other respects it is similar to many. *Engineering* says:

"Each engine has three single-acting cylinders, the steam being admitted to and released from each cylinder by an ordinary slide valve working horizontally on a face in the top cylinder cover, as shown in the section. The valves are driven direct by eccentrics formed on an eccentric shaft, which passes along the tops of the cylinders above the valve faces, and which is driven from the crankshaft by bevel gear, as shown in the perspective view. When the engine is made for reversing, the vertical intermediate shaft (through which the motion is transmitted from the crankshaft to the eccentric shaft) is divided into two parts, which are connected by a sleeve sliding a spiral feather. By means of the bell-crank lever, shown in the perspective view, this sleeve can be shifted vertically, the motion thus given to it partially rotating one part of the vertical shaft with respect to the other, and so partially rotating the eccentric shaft and shifting the eccentrics from the position in which they would give the valves the proper motion for going ahead, into that for going astern, or *vice versa.*





A YOUNG MAN, twenty years of age, brought up in a city all his life, called our attention to the fact that the water was overflowing the office basin; he said it was running through the small holes on top *that communicated with the floor.* He was enlightened on putting his hand underneath and feeling the drain-pipe connection.

REMEDY FOR SUNSTROKE.

Sunstrokes are not uncommon, and every one should know how to treat them. The method appended is good. The writer says:

"About fifteen years ago I discovered a speedy remedy for sunstroke. I have had quite a number of cases which I treated according to this remedy, and in every instance the patient has been able to walk home in less than two hours. It has received the approval of several physicians, who, from personal knowledge of its efficacy, have indorsed it. No man need die in an ambulance nor while awaiting the arrival of a physician.

"Any cool headed man or woman can relieve the sufferer at once and without fear of any evil consequences. The method is simple and easily carried out. Draw the body into the shade; place it in a sitting position against a wall or anything that will be a support for the back; loosen the collar of the shirt or dress; throw ice cold water over the head copiously; give a stiff dose of Jamaica ginger—say an ounce or more—to a half glass of water. Keep up the application of water after the ginger has been given, but moderately, and it need not be ice cold. Let the patient have plenty of air around him, and in an hour's time he will get up and walk home. This is all the treatment necessary, and it is based on common sense. The oppression on the brain caused by the heat is relieved by the cold water, and the blood is sent from the head to the body. The ginger (if not obtainable immediately brandy will answer, though the essence of ginger is the strongest stimulant and quickest) prevents anæmia, or lack of blood, by stimulating the vessels and sending fresh blood back to the brain."

Don't forget it.

WHAT IS A TECHNOLOGICAL INSTITUTE?

What is a technological institute? President Chas. O. Thompson in his inaugural address of the Rose Polytechnic Institute, at Terre Haute, gives a happy definition of it. He says:

"There is great confusion just now in the use of terms, technical education being used to describe all that which aims at a directly practical end as opposed to the education given at the college. The word technology, which formerly signified the terms used in the sciences, now means the application of the sciences to industrial ends. The term polytechnic, originally used to describe schools of technology, has refused to yield to the more desirable synonym, technological, partly because it is an easier word, and partly because it contains a suggestion of the many-sidedness of the subject which the better word lacks. There is no good word corresponding to polytechnic or technological to apply to the persons who practice the profession indicated, and so these persons are called, now as always, engineers, and the business engineering. A few still cling to the term scientific schools in speaking of these institutions. In the present prevailing confusion of terms the best that can be said is that a polytechnic school teaches technology to engineers."

He also said:

"No graduate of any school is at that time an engineer. The qualities of good judgment and reason grow only in the atmosphere of experience. No diploma can be regarded as meaning more than that the possessor has passed successfully the examinations at any particular school. Graduates should begin at the bottom of their profession and their school training will tell best and most effectively in the rate of their advancement.

"A superintendent who has not had the training of the shop is as useless as Achilles without his weapons—he may assume to lead, but he does not; on the other hand, the man who attempts to lead without natural leadership, however wise, is as useless as the weapons without Achilles."

FROM CALIFORNIA a staunch friend writes:

"I am glad of a chance to get hold of the paper long enough to read '*The Professor in the Machine Shop.*' His experience, though corresponding well with my own, put into his language, has many times set me to thinking of other branches, and started other trains of thought that have been of great advantage to me."

He goes on to speak of the weekly edition, and hopes to hear of one soon. Upon this head another correspondent from Springfield, Mo., says:

"It would meet my views even if it were double the price, but I observe the readers do not all think alike. I should say they could find time enough in a week to read their paper."

Evidently one friend has not much, for he writes:

"I work sixteen hours a day, and it is as much as I can do to get a chance to read the paper when it comes out, let alone a weekly."

How would it answer to publish the paper as a weekly, at a weekly price, and let those who wish read it weekly, and the others who want it fortnightly read it every two weeks, both paying the same price?

Possibly some would object!

THE
Mechanical Engineer.
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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

THE APPROACHING CONVENTION OF STATIONARY ENGINEERS' ASSOCIATIONS.

In October next the Second Annual Convention of Stationary Engineers will be held in Chicago, and it is needless to say the event will be an interesting one, not only to the members in particular, but the trade generally. The first occasion of this kind was but little more than a formal announcement of intention on the part of the stationary engineers of a few cities to attempt an organization. At that time it was quite uncertain as to what reception would be given the proposition, but the past few months have shown that it is likely to become a strong institution. A great many new societies have been formed and more are forming, and there is no doubt whatever of permanency, with ordinary good judgment and the total absence of anything like sectionalism or jealousies as to office. We mention these because individual ambitions often work great evil to societies, but the management, spirit, and temper shown so far give little ground for apprehension from this cause.

The Associations of Stationary Engineers like some others, the Marine Engineers' Associations for instance, mark a new era in trade societies, for they encourage and support the real interests of both employer and employed. The old idea that an association of this kind must necessarily combine against capital to succeed, was promptly disclaimed in the articles of association indorsed at the first convention, and the officers have labored earnestly, by tongue and pen, to spread this vital point far and wide. Non-interference in the matter of wages, no combination against the interests of employers, no discrimination as to duties or hours of labor, these are the corner-stones of the foundation, and it is needless to say they rest on solid bases. Nevertheless, in spite of all that has been done to put this prominently before employers of engineers, very many of the former find it hard to believe in it.

They suspect that there is a cat under the meal somewhere. They find it difficult to dissociate from their minds the object and intent of old-time societies of this class, and accordingly they look with but little favor on the new regime. This is natural enough, and to be expected. A new departure like the one here discussed, is sufficiently radical to be received with caution by conservative people, but it is a genuine instance, and a truthful avowal on the part of engineers of their aims.

In the end, in the fullness of time, their objects will be better understood, and instead of opposing such societies employers will do their best to promote them. This is done already in some States, as our pages have recorded, and it will be done in many others hereafter. Employers have given material aid, not only by their presence, but in donations of books useful to the trade.

In the approaching convention we hope to hear of a full representation of all societies now organized, and to attain this, discussion of ways, and means, and objects to be carried out, or points to be guarded against, should be discussed now by local societies. Anything that will tend to make the Association truly national, embracing all of the best men in the trade in all parts, should have careful consideration.

It is not too early to begin to select delegates, and these latter we think should be chosen for their ability to speak, for each local society should put its best talker forward. Mere personal presence counts for little in discussion.

A BENEFICENT INSTITUTION.

Elsewhere a frequent correspondent makes a special plea for the consideration of a Mutual Aid Society, in connection with the Stationary Engineers Associations, and it is needless to say it should be adopted at the coming convention. When it is seriously discussed, as it will be shortly, its benefits, nay its necessity, will be apparent to all. Very many, perhaps, fancy by encouraging its adoption that they are committed to some responsibility which at some future time they may have to shoulder, but this is not the case. No one is committed to anything, and those who vote for the Mutual Aid Association are not compelled to subscribe even, unless they wish to. That is to say, the individual, or society, who votes for the adoption of a Mutual Aid Society is not obliged to avail himself, or itself, of the benefits, though they certainly should when so much can be had for so small an outlay.

Individual members, however, should seriously consider the risks they incur, and see their way to establishing this beneficent institution permanently. No man wishes to have those dependent on him exposed to the mercies of the world, or to send his family bare-handed out into the world to fight for bread. Still less does he wish to trust to the charity of neighbors or communities; charity is a broken reed, and whoever leans on it will find it give way under him. The Mutual Aid Association is not a charity in any sense of the word. It is a bond to help one another in case of death, and in accepting its benefits no man is beholden. In the event of death to any individual his family receives only what they, through him, have already done for others; it is their right, and not an obligation. We cannot add anything to the arguments advanced by our correspondent; there is, in fact, no need of argument; the advantages of the society alluded to are so patent that we have no doubt but that it will be promptly established.

DISINGENUOUS.

In the course of some remarks at a recent meeting of the *Society of Mechanical Engineers* Mr. Chas. E. Emery said:

> "Last fall the New York papers were filled with accounts of explosions of steam pipes, and in spite of all protests refused, except in their advertising columns, to call attention to the fact that there were two steam companies and that the difficulties were on the lines of but one of them. Few read the advertisements, and the press outside of New York copied only the news items, so to this day there is a general impression all over the country that steam enterprise in New York has been a failure."

This is disingenuous upon the part of Mr. Emery, and incorrect as to fact, for many papers noticed and made the distinction he claims was not made. Further than this: we personally applied for facts in the case, and were told by Mr. Emery himself that the President of the company did not believe in newspaper reports, and they did not care to furnish anything for publication. We remarked to Mr. Emery at the time that it was strange that this should be the case, and that it was a very foolish thing for the President to do; that neither he nor any one else could despise the influence of the press, etc., etc.; but this seemed to have no effect. Mr. Emery now bewails the wide publicity the accidents were given, as also that the impression prevails that steam enterprise in New York is a failure. This opinion does prevail undoubtedly, because it has never been a success anywhere.

SMOKE CONSUMERS.

The cities of Chicago and Cincinnati have ordinances which require steam users to burn the smoke from their establishments, under a penalty of a fine if they fail to do so. Such ordinances cannot be enforced, and any fines imposed could be recovered in due course of law, for they require an impossibility. As well might the authorities demand the burning of the exhaust steam, for it is about as combustible as smoke. To demand the suppression of the smoke nuisance is not unreasonable, for it can be avoided to a very great extent, but it cannot be consumed when once made. In this latter line the whole trouble is contained, and when once it is recognized it will be obviated.

Very much can be done with furnaces as they already exist, but with some boiler settings in use difficulties will always be experienced, and with hap-hazard, wasteful, careless firing the same is true. An idea prevails that any man who can use a shovel can fire with soft coal, but this is a very great mistake. Persons who are applying smoke consumers, so-called, will incur useless expense, and in the end be compelled to throw them out.

A little reflection should convince any one of the natural difficulties in the way. Smoke is composed of watery vapor, volatile carbon, and gases in constantly varying volume and temperatures. That any apparatus can disassociate these elements and ignite them in the furnace is absurd on the face of it; they certainly will not burn combined. The only way out of the difficulty is to make no smoke, which means a new school of firing in this instance.

TOOL POSTS.

A great deal of spurious wit is vented annually on tool posts and their assumed difficulties of adjustment for the work to be done, but it seems to us that most of the trouble is invented for the writer's purpose. That is to say, he "evolves it from his inner consciousness" with the object of overthrowing it by some device of his own.

With tools properly dressed, and a post originally made of the proper height for the lathe and the work usually done in it, the ordinary fixtures—whether stepped washer or one slightly beveled, answer the purpose. If there is a range of elevation of from one-quarter to half an inch, that is all that is required. Where a lathe-tool is used until the cutting point is level, or below the level of the shank, and the post was made for a cutting end one inch above the shank, it is quite evident that the common fixtures are inadequate, but it does not seem necessary to invent a new fixture when the tool dresser can remedy the matter in a few minutes.

THE POSSIBILITY OF HIGH SPEED ON RAILWAYS.

A writer in *Science* for July 6th has some interesting remarks published elsewhere, but we regret to observe that his assertions are unsupported by any facts or data; consequently we are unable to place implicit confidence in them. *Science,* if we understand its aims, intends to fill a place in professional literature not now occupied, and we take the liberty of calling its attention to the fact that assertion is more valuable when supported by figures. There are some figures in this article which we have criticised, but they are so at variance, in the matter of speeds on English railways, with those recently made public by reliable observers, that we feel doubtful about accepting them. The writer also feels perfectly confident that the American passenger locomotive of the present day is capable of making 60 miles an hour (continuously, we presume) with a heavy train, but he does not give the grounds for his statement. Master mechanics find the greatest difficulty in building engines that will do the work in question, and if the writer knows where there are engines in this country which can make 60 miles an hour with heavy trains, for even three hours, he will do a service by mentioning them. Mere speculation and loose statements on professional articles are of no value whatever, and may be safely left to the penny-a-liner.

ACCIDENTS TO FOREIGN MARINE ENGINES.

We have it constantly insisted upon by foreign contemporaries that their work is, of all others, beyond criticism and incomparably strong. They build engines and lathes "bull-strong" and clumsy, so that they will outlast the Pyramids, and they never make any mistakes or cheap work. Nevertheless the *Aurania,* a crack ship on her first trip, went all to pieces in her engine-room, and will have to be practically rebuilt. More complete destruction can hardly be imagined. Moreover the press is full of chronicles of other disasters to foreign steamers, breaking shafts, losing wheels, etc., etc., which go to show that human nature is fallible all over the world, and that our cousins are as prone to bad jobs as the rest of mankind. For the area of their territory as many accidents to machinery happens as in other countries and loud assertions of superiority seem in no wise to diminish them.

OUT OF REACH.

It would seem to be wholly unnecessary to remark that the range of graduation on the dial of a steam-gauge is no measure of the capacity of the engine, or strength of the boiler; but such impressions seem to exist, as we have seen in a letter shown us by a manufacturing firm. Witness the following sentence: "I have one of your make of engines with steam-gauge of 150 pounds, to which I have been thinking of attaching a saw; and I wish to know your price on a saw rig suitable for that power."

It is said there are many such persons, and this firm have felt it necessary to restrict the range of pressures on the dial, as many users will carry all the steam the gauge can register.

This is an explanation of the frequent explosions of agricultural and saw-mill boilers, and is interesting in view of the fact that gauges are made, graduated, bought and sold with as little reference to the capacity of the boiler as the grocer has of the adaptability of the materials he sells to the digestive powers or the health of the individual buyer; and every user of a boiler ought to know it.—*Cincinnati Artisan.*

This is very sound and sensible, though it hardly affects our readers, who are not of the class named. The difficulty is how to reach such persons. They do not read, and they are beyond being told anything. An engineer visited us recently, and said that in a new establishment in his town the engineer in charge was a man who asserted that two boilers at 30 lbs. pressure were equal to 60 lbs. on the engine. "He reads dime novels," said our informant.

Such persons are out of reach in one sense, and it is only by the slow process of education that the breed will, by and bye, become extinct, as the dodo is.

CONCRETE GIBBERISH.

With their immense resources it is strange that the daily papers do not see the necessity of employing at least one engineer upon their staff who can give an intelligible account of disasters, or trial trips of new machinery. As it is these events are signalized by attempts to describe matters clearly beyond the capacity of the writers with the result, in one instance, shown below. The reporter is endeavoring to tell what happened to the *Aurania,* the new Cunard vessel which broke down on her first trip to this port. He says:

"It was while the passengers were thus engaged that the crank shaft attached to the middle piston, an enormous bar of solid steel ten inches in diameter, suddenly snapped in twain. The suddenly liberated piston rod shot up through the top of the confining cylinder, tearing the thick steel plates all to pieces, and with one tremendous burst and a report like that of heavy piece of ordnance a vast volume of steam, carrying with it fragments of iron, burst through the skylight and escaped heavenward. The havoc wrought in the engine-room was terrible. Not a cylinder escaped laceration. Iron braces were bent and torn, heavy beams were perforated, glass an inch thick from the skylight was blown into the air and rained down upon the deck in a dangerous shower. A passenger was sitting near the stern and was slightly cut by falling glass. For a moment or two there was almost a panic on board, those on deck being frightened by the noise of the explosion, the rush of escaping steam and the sound of some terrible pounding which was going on in the lowest depths of the engine room.

"But it was not on deck nor yet in the upper part of the engine-room that the real point of danger lay. Down three greasy pairs of ladders, in the depths of the ship's hull, far below the cylinders, in the dark hole where stokers grow faint from excessive heat and where the grimy engineer on duty holds his post of responsibility, there was enacted a scene which rarely has an equal. The lower portion of the broken crank-shaft, a mass of steel weighing many tons, was, of course, fastened to the main shaft of the ship, and as this continued to revolve from the working of the other pistons an immense arm of steel went flying about like a huge flail. The effect was awful. Iron and steel were knocked to splinters. A supporting column of wrought iron a foot in thickness was broken in two and one piece weighing a ton was bitten out, so to speak. Wherever the flail struck destruction followed. The air, already choked with scalding steam, was filled with sparks of fire caused by the blows of steel on steel and iron. The place was infernal. Nothing but prompt action could save the sheathing of the vessel from being pounded through. The engine must be stopped. And yet the little steel brake which controlled the whole tremendous mechanism was situated only about two feet from the arm of the thrasher and right in the midst of the scalding steam and the blistering sparks."

"James Moore," who writes for the *Milling World* appears to be a versatile genius. His talent runs in very much the same vein as that of many foreign writers whose articles have been published in our pages. He recently enlightened the world with his views on "Chimneys and Draught," and they are identical, it seems, with those of the *London Builder.* This is a very asinine proceeding on the part of the *Milling World.*

Water is sometimes used for testing boilers through its expansion by heat, and this is the ratio of its increase. At a temperature of 42° it is at its greatest density or 1·00000 in bulk; at 62° Fahr. its bulk is increased 1·00083; at 92° 1·00477; at 122° 1·01116; at 152° 1·01934; at 182° 1·02916; at 212° (boiling point) it is 1·04012.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXVIII.

I suppose every shop in the country has its fussy man, for wherever I have been, in rather a wide circuit, he was always present. Sometimes he runs a bolt-cutter, and when this is his calling woe betide those who have dealings with him! I recall one now, of this genius, David—— who looms up darkly through the mists of a quarter of a century. David was a little the most exasperating person in his line that ever got inside the four walls of a shop. He was not only fussy but he was provoking, for if he found out one was in a hurry for anything, waiting for bolts, or what not, he would deliberately set to work to make a general clearing up and overhauling of his machine, and the space adjacent for ten feet around. He selected pressing occasions for general repairs, and no man ever went to him for a lot of $\frac{3}{4}$ nuts, for instance, that he did not bring out an old broken tap, which he had laid away for just such times, and say: "Tap's broken; can't do it." This, be it remembered, was in the days when jobs were done as they were needed, and store-rooms were unknown.

But let David go; he has gone, in fact, many a long year ago, and "the place that knew him once knows him no more forever." In his stead is a younger man and a newer machine, but often, as I went by the place and looked in, I could see only David, and his imperturable face looming up in the shadows.

Our fussy man runs a lathe, and last week, when we were getting up the new piston for the saw mill man he was in his glory. The job was a hurried one, and, of course, knowing that, our friend rose to the occasion. All he had to do was to stick that spider in the lathe and bore it out, rough it off and fit the rod to it; which was all ready turned and waiting on the floor. Did he do this? Not he. He began operations by carefully going over the ribs of his lathe *inside,* and cleaning off chips that had lodged out of sight, and he was proceeding to overhaul the lathe generally when I thought he had gone about far enough. Jake is away on a short holiday, and I am looking after the shop, so I went out and said to him, with some irritation, no doubt:

"Bill! what on earth are you up to?"

"Getting ready for that piston, Mr. Moulton."

"Getting ready for it! It don't look much like it to me; looks as though you were going to rebuild the lathe. Why don't you just put that chuck-plate on and go ahead? The man wants the piston as soon as he can get it."

"I calculate to put it in the first thing this afternoon," said Bill.

"First thing your grandmother," said I, somewhat irrelevantly; "Put it in now, and let the lathe alone; time enough to overhaul that some other day."

"I was just going to take the carriage off," said Bill, "and scrape it up a little; it wiggles some, thwart ships, and I can't make a good job facing off those rings with it that way."

"Wiggles! What do you mean? Who ever heard of a lathe-carriage wiggling? It don't wiggle a mite; it's a notion of yours, Bill. I tell you what it is: you're a good man and a first-rate workman, but these old woman's notions you have, and your fussy can't-get-ready-in-time ways keep you back. There is no sort of reason why you should not have that piston ready by the time you say you will begin, and I want to see you clap that chuck on now and go ahead with the job before I leave the place."

He did not like it much but he went at it all the same, and the piston was lying on the floor all faced up by five o'clock, ready for the rings. We made a light, solid piston and sprung the rings in, and I may say here, that as regards the piston itself, there never was a better job. The piston fitted the bore of the cylinder completely, or as nearly as we could make it, say a scant sixteenth clearance, and after the first week, when things had worn down to a surface, it was "tight as a bottle;" but this is foreign to the purpose of this narrative.

Our fussy friend, and his congeners all over, occupied my thoughts for some time, and after some study over it I came to the conclusion that it was a weakness of human nature, and to be borne with as best one could. Certainly it is a weakness, and a most unfortunate one to the individual himself, for not every machine manufacturer would put up with it. Most persons would say the man was lazy and slow, when he was not, and they would charge to disinclination what really belongs to pottering and fuss.

When our fussy friend gets actually at work he goes on well enough; he drives at a good speed, and all the feed the work will bear, but he is apt to get into difficulties with his tool, and insist upon its being set just *exactly* so, to the hundredth part of an inch, or he will have none of it. It makes no difference whether he is on a lathe, or a planer, or a bolt cutter, or merely at the bench, the same evil effects are noticeable in him and his work. I said he was a good workman, and this is true in so far as fit, dimension, and correctness to drawing are concerned, but there is, after all, an indescribable something visible in the manipulation, that leaves a mark behind him.

* * * * *

I wonder why the editors of The Mechanical Engineer would not begin a series in their next volume entitled "Mathematics for Mechanics," or some such thing?

I am sure, from my acquaintance with the trade, that it would be of great service to large numbers. When I say "mathematics" I am fully aware of all that the word implies, and its terrible import to many; but I do not think that the subject is so very alarming. No one need pale before it. Mathematics is simply the science of numbers; and while there are "fancy mathematics," so to speak, which involve more or less mental training and ability to comprehend, it does not require any greater number of pounds of brains than the average skull will hold to tackle every day mathematics. These are just as essential as a hammer and chisel and a file, and the man who dispenses with them trains in the rear rank. There is no sort of use in trying to make a gear-table or an index-plate stand in lieu of figures, for the time comes, sooner or later, when a thread or a gear not laid down in the chart has to be cut, and the man who has no knowledge of ratios and how to state them is, as I said, the outside man—he is left.

Mathematics for mechanics would hit nine men out of ten in every shop; and if the articles were written by a man who was accustomed to dealing with mechanics he would find a large audience. In speaking of this matter I am by no means forgetful of the fact that all cannot deal with figures readily. It is with them as with every other faculty of the mind—all are not equally versatile. A man with musical talent can pick up a fiddle and saw off a tune $3'\,7\frac{3}{8}''$ long, or any other length demanded, but another man cannot touch the strings without souring all the milk in the neighborhood, or causing people to shut their windows for blocks around. For all this, though some are disqualified, and would find it difficult to make any headway, however simply such articles were written, there are multitudes whose early opportunities were neglected to whom they would be of great value. Consider the thousand and one simple calculations that come into use daily in machine shops and engine rooms, and then see how useful a knowledge of the methods by which they are made would be! Look at the speeds of shafting and of pulleys; the sizes for certain velocities, the odd screw threads, the pitches of gear and the sizes to turn gear-blanks to before cutting; consider the lengths of belts to go around certain pulleys whose diameters and centers are known—in short, the whole routine of the shop, which is only now guessed at, or arrived at by the rule of thumb! If we look at the matter properly we shall see that the only way to find out these things is by fixed rules and methods which have been tested. They are found by simple calculations, easily made by any man fit to run a lathe or an engine, and I hope to see some such scheme started in The Mechanical Engineer next winter.

Of course, there are some so shallow that they would sneer and pooh-pooh at the idea of any man wanting to study elementary mathematics; but such opposition as that should not weigh with the editors any more than a hair on a hay scale would. Such persons as are alluded to above would sneer at a baby sucking at a bottle, forgetful that upon that same they grew and thrived.

Perhaps in my desire to see this thing set going I may run counter to the wishes of the readers, who may not thank me for the suggestion, but I do not believe that I do. I am a close reader of the correspondence page of our paper, and I think, from the tenor of what I see there that the writers represent the constituency, and that the intelligence shown by them will warrant what I have said. At any rate, if the idea is unpalatable, a little epistolary kicking is in order.

"IN THE ROUND HOUSE."—No. 6.

ERECTING LOCOMOTIVES.

By L. O. Danse.

As stated in a previous issue, the original author of this series, C. Berkeley Powell, M. M. C. S. R. R., had completed only that portion already published when he was called to his present post. This, unfortunately for us, resulted in his having to leave the matter where it now stands, and he has not yet found time to complete them.

The writer, whose name is at the head of this article, has undertaken to finish the series, and we ask for him a hearing. Naturally there will be a change in style and method of treatment apparent, though it was our intent to have the original schedule adhered to.

Mr. Danse will deal chiefly with erection and the management of engines on the road.

Erecting shops are provided with a series of tracks and pits, similar to those of a roundhouse, except that they are parallel, instead of converging, and served by a transfer-table outside the building, instead of a turn-table in the center. This transfer-table is arranged to run in front of the boiler-shop, and connect with the testing-track and the track by which the finished engines leave the shops, so that all the heavy moving can be done on it. The work of erection is done by "erecting gangs." Each gang is headed by a gang-boss who directs the work, and each is assigned to a separate pit. An overhead traveling crane is usually provided above each pit, for convenience in handling work.

No two engines are erected in precisely the same manner, but the following outline will give a general idea of the method pursued.

The boiler of the engine to be erected is first operated upon. It is brought from the boiler shop to the proper track of the erecting shop, and is then blocked up perfectly level over the pit.

Next the cylinders are adjusted with their half-saddles under the smoke-box, leveled by their valve-seats, and the frames are temporarily put in place. Battens are now fixed in the front counterbores of the cylinders, and lines stretched through their centers to the back ends of the frames. The "frame gauges" are put on the frames to hold them the right distance apart, and a straight edge is laid across them. They are then leveled across, and lined up with the cylinders. The frames are now bolted to the cylinders, and the cylinders to the smoke-box. The liners to go between the frame, and fire-box are now fitted, and the furnace bearers, after being marked and planed out to fit over the stay-bolts, are bolted in place. The waist-sheet is now fitted to the boiler and frames. The foot-plate is then fitted to the frames; and also the back boiler-braces, brace-stays and tail-bar. Then the tubes are fitted into the tube-plates; and the smoke-box braces fixed in position, as also the smoke-box front and door. The throttle, dry-pipe, T-pipe and arch-pipes are now fitted to the boiler, the whistle, pop and safety-valves to the dome, and the grate-bars into the fire-box. The gauge, blow-off and surface-cocks, and steam-gauge, blower and heaters, injectors and checks are now attached, and the engine taken to the testing-track, where the boiler is tested by hydraulic and steam-pressure, to determine whether there are any leaks. The leaks having been calked, and the testing completed, the engine is returned to its place over the pit. The guide-yokes are now fitted to the frames, and the guide-yoke braces are bolted to frames and boiler. The pistons are put into the cylinders, and the piston-rods keyed into the crossheads. The front cylinder heads and casings are put on. The boiler is lagged and jacketed, and cab and running-boards attached. The engine is then jacked up so that the drivers can be put in place. The driving wedges are put in, and the pedestal caps adjusted. The springs, equalizers, saddles and hangers are put on.

The rocker-boxes and arms are then put in place; and the reverse-shaft and stands fitted.

The reverse-lever and the sector are next fitted in place.

The main and parallel rods are then put on; the driving boxes are jacked up until the driving axles are in line with the centers of the cylinders, and the eccentric straps and rods put on.

The link-blocks are put on the rockers; and the links and hangers fitted to them and the lifting arms of the reverse shaft.

The reach-rod is connected up.

The valves, yokes and stems are connected up, and the valves are set.

The valves being set, and the entire engine fitted up, she is taken to the trial track; the tender is coupled on, and the test of practical running made by the inspector. While steam is being raised for the trial, the inspector carefully examines all parts of both engine and tender, to see that they are perfect in every respect.

The engine remains in the hands of the inspector until the boiler and lagging cease to give off smoke—which they will do until the paint and lagging are perfectly dry—and until all defects have been remedied.

The inspector being satisfied, the locomotive is pronounced complete and taken away from the works.

Locomotives for foreign use, which must be hauled a long distance, are dismantled before their departure. The main and parallel rods, pilots and stacks are removed and packed into the tender; and the tank and boiler are emptied. The engine is then attached to a freight train as if it were an ordinary car. A man is sent with each engine to keep the boxes and bearings well oiled, as new bearings make considerable trouble from heating.

If the gauge of the locomotive's wheels does not agree with that of the track over which it goes out, it must be loaded on a gondola, or platform-car. In this case it may be necessary to dismantle her still further if there are any overhead bridges or tunnels on the road, in order that she may not be too high.

Locomotives having but a short distance to go, and agreeing in gauge with the road, are run to their destination under steam.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. VII.

By J. P. Mullin.

CYLINDER WORK.

There is no other mechanical term in the dictionary so comprehensive, nor one which covers such a great variety of forms as the word "cylinder." And—comparatively speaking—there are no other castings required for the construction of general machinery in which the quality is of more importance than in cylinder castings.

Fig. 45 is a section and end elevation of an air cylinder for a large compressor, and in this case it was necessary for the casting to be—practically speaking—perfect, as it had to stand a hydraulic test of a very high pressure.

As will be seen by the drawing, the cylinder is made in two sections, the inside or liner—which is surrounded by a water-jacket—being a separate casting turned and fitted to the body, the joints being made at the belts *A*.

The outside, or body of the cylinder, has an opening for a sediment door cast in the bottom, as shown at *C*, which is afterward covered with the plate *D*.

The pattern for the inside or liner is shown at Fig. 46. It has two draw-irons on the top end, as shown at *E*, and the bottom flange and and print *K* are made loose at the dotted line *F*.

Fig. 47 is a side elevation of the body of the cylinders. Both the flanges and the ribs and feet, *G* and *H* are loose, as shown at dotted lines, and the facing for sediment door and the boss on the top of the cylinder are also loose, and in position with the dowels, *B*.

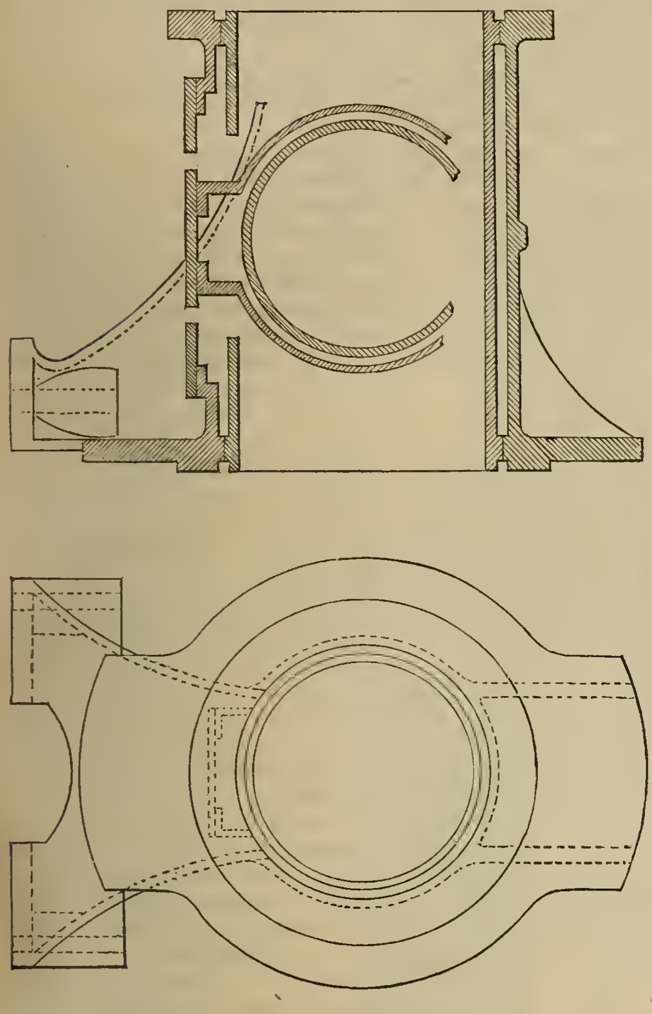


Fig. 45.

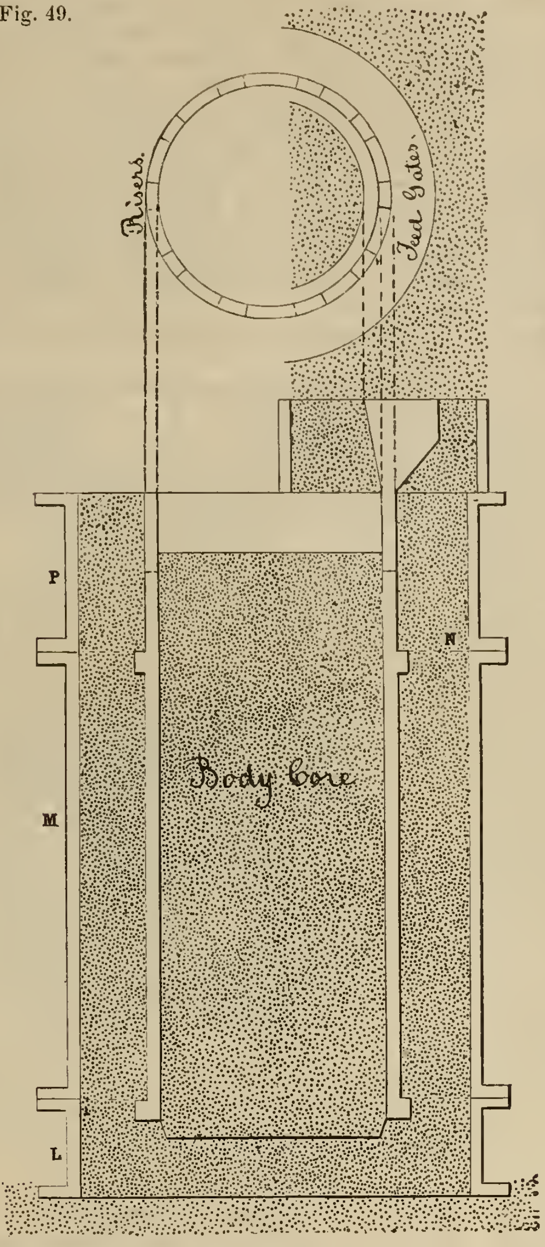


Fig. 49.

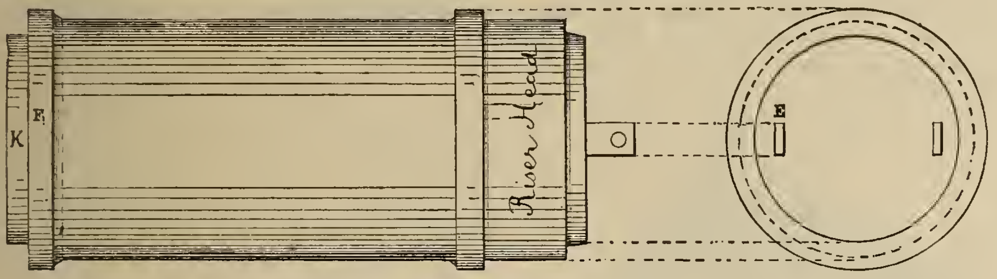


Fig. 46.

A plan and section of the core-box for the sediment door opening is shown at Fig. 48. It is an open box, parted through the center at *J*, and the top made concave to fit the body-core of the cylinder.

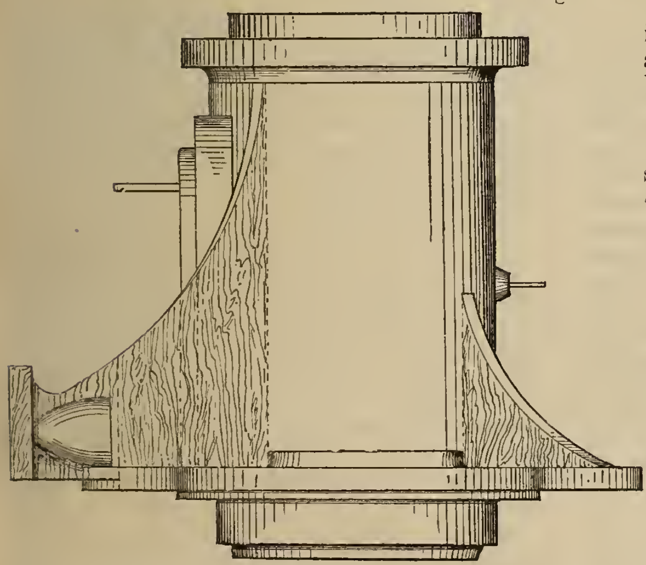


Fig. 47.

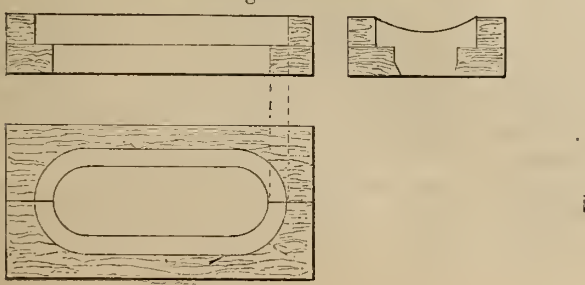


Fig. 48,

MOULDING.

The plan of casting the inside, or liner section of the cylinder, is shown at Fig. 49. The bottom flange of the pattern and the print, *K*, are first set in the flask, *L*, and rammed up level with the top, where the parting must be made. The body flask, *M* is then put on and the pattern set in place, and moulded up level with the top edge of the flange, and parted at *N*. We are then ready to set on the cope, *P*, ram it up and set feed-gates and riser-pins, lift it off again and draw the body of the pattern, while the bottom flange and print, *K*, will, of course, remain in the mould until the body flask, *M*, is lifted off, when it can easily be drawn from the sand.

We are now ready to finish the mould. Set the body-core, put the flask, *M*, back in place again, close down the cope, and make feed-gates and risers as shown.

When moulding the body of the cylinder, we first set the pattern in the position shown at Fig. 50. By setting it thus, we have a chance to fill in and ram between the ribs and feet, *G* and *H*. When the section of the body flask, *R*, is set, as shown in the figure, we can then fill in and mould up to about the center of the pattern. The section of flask, *S*, is then set in place and moulded up to *T*, where the parting must be made. We are then ready to set the flask, *V*, fill it in and ram it up, as shown in the engraving. The mould must then be turned over, and the cope flask, *W*, Fig. 51, put on, filled in, rammed up and lifted off again. The pattern can then be drawn from the sand as follows:

First draw the top flange, and then the body of the cylinders. The ribs, feet, bottom flange and other loose pieces remaining in the mould.

We may now lift off the body flask and set it in the most convenient position to draw the different sections of the pattern still remaining in the sand.

When the mould is finished and the cores set, it is all closed up, as shown at Fig. 51, and the feed-gates and risers made much the same as those shown at Fig. 49.

"Mr. R. O. Carscadin, of the Chicago, Rock Island and Pacific Railway thought the best place for the check in the boiler was in the forward part of the boiler. Had two engines built with the check placed some four feet from the fire-box, and the flues giving a great deal of trouble by leaking, he took out the flues to reset them, and found a quantity of mud had collected round the flues, close to the fire-box. Put the flues back without changing the position of check on the boiler, and in a short time they were leaking again. Took them out a second time and then changed the check to the extreme front end of the boiler, and put a pipe in flue sheet which stopped all trouble from leaky flues. He recommended the putting of the check for the feed-water in the front end of the boiler."—*Railway Age.*

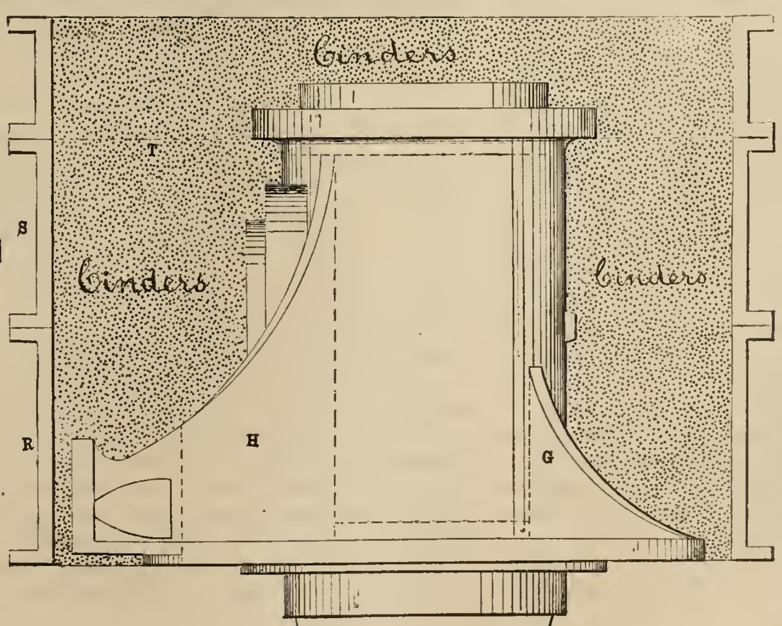


Fig. 50,

HERE IS A WHOLE SERMON in a few lines:

"The boilers of the Hitchcock & Bradley Bending Co, at Ashtabula, exploded with terrible effect on the morning of June 12th. James Grubharn, the night watchman, was instantly killed, and the building totally destroyed. Loss, $50,000. Eighty men are thrown out of employment. The boilers were repaired and filled with water the day before, and the watchman instructed to fire up at an early hour, the next morning. It is supposed that leakage during the night was the cause of the explosion."

"It is supposed" is good, but why should there be suppositions about steam boilers?

DISCUSSION AT THE MASTER MECHANICS MEETING.

At the last meeting of this Association, interesting discussion upon the points below mentioned took place, a portion of which we quote from the *Railway Gazette:*

"Mr. Taylor said that some of the engines on his road had the Jarrett water-table. Those engines were good steamers, but the trouble was to keep them tight. Another defect in them was that after the fuel passed over the water deflector, it would invariably fill up between the deflector and tubes. He suggested to the boiler-maker to make another deflector and put it in there and cut it away from the flue sheet, so as to let the dirt pass down and the flame have a chance to pass up between the deflector and flue sheet. From this he got a good result. He admitted, however, that he could not put those things in and maintain them if he had the sort of water to use that was used in the western country. Of 20 engines on his road having these deflectors, it would be impossible to find one that had ever had a rivet burned out or a crack in the sheet, excepting where there was a mechanical defect. He considered the water-table more economical than the brick arch. He obtained as good results from the water-table as from the brick arch from the fact that the fire has got to pass over it and down between the flue sheet and the arch, and the greater the distance the flame has to travel, the more heat goes through the sheets.

"Mr. Sedgley had found by experiment that the same engine gave as good results without the arch as with it, and while ten years ago the brick arch was used universally on his road, now out of 540 engines not one was equipped with it. His practice was to admit air just above the fire through hollow tubes. He thought that all who had had experience with a perforated pipe without a dome, would agree that in that section of the country it was not practicable to run them, the water being so impure that the pipe cannot be brought far enough from the water to prevent the priming of the engine from carrying too much into the cylinder. In New England, where the water was pure, it was practicable; but in his judgment it could not be done any better than with a dome. Where was the dryest steam obtained, near the water or far from it?

"Mr. Flynn said that he had tried the brick arch, but did not find it economical. There might be some economy in its use where extraordinarily good coal was burned. He had built some tubular boilers shortly after the war and made them 9 inches wider and 10 inches higher than the old wagon-top boilers, which latter were always noticed for their hardness in getting steam. The engineer and firemen had to be very attentive in order to make the trip successfully. To his astonishment the engines with the boilers made as described became very perfect steamers, a result which he attributed to the enlarged steam reservoir. He disfavored the perforated steam pipe. The steam must be dryer the further it is from the surface of the water. His experience corresponded with Mr. Sedgley's in regard to the use of the brick arch. He had found that the only way in which a saving was made by the use of the brick arch was in causing the enginemen to run with as shallow a fire as possible.

"Mr. Smith had not found any economy in the brick arch he had first put in, a fact owing, as he soon ascertained, to the accumulation of sparks in front of the arch. These he removed by a strong draft through the lower row of flues. The result was a saving of fuel.

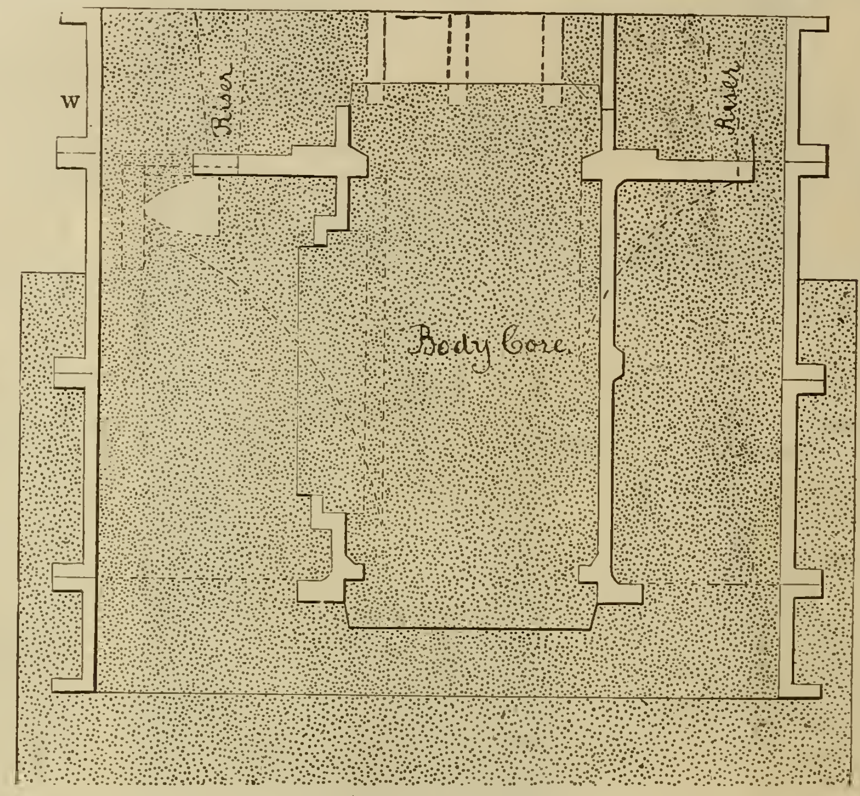
"Mr. Wilder said that he was now building a number of passenger engines intended for burning anthracite coal. The fire-boxes are 120 inches long and 33 inches wide. In order to be able to get the fire-box over the back axle of the engine we have to slope it up, and we also slope the crown-sheet down. We use the ordinary crown-bars, and hold the crown-sheet and crown-bars with rivets. The dome sets very nearly over the front end of the fire-box, near the flue-sheet. We are using a number of those engines for burning soft coal, and with a fire-box of that shape we get even more economical results than we do with the ordinary square fire-box.

"Mr. Sprague said that in the engines that he had been building he made the crown-sheets all in one piece, avoiding seams and running the crown-bars longitudinally on most boilers. Sometimes he stay-bolted them.

"Mr. Wilder, in answer to a question from Mr. Lauder, said that for a long time they had very little trouble with the water-tubes, but after two or three years' service he had found that the tubes began to fill up and they had had to put in plugs opposite to them. Whenever they washed out the boilers they took out the plugs and scraped the tubes.

"Mr. Wilder described the Groesbeck & Wright spark arrester, which he had been trying lately. This spark arrester has an extended smoke-box and a lower chamber, the botton of which is held shut by a steam cylinder working with a crank. This chamber is filled with water. A deflector comes out just above the flues on the sheets. It runs down, and the deflector has a joint on the center which can be raised and lowered to give the requisite amount of draft. No netting is used. All the sparks are precipitated into the water. A float warns the engineer when the depository is full. By moving a cock he can open the door at the bottom and all the sparks are washed out, and the door can be shut by the reverse action of the steam in the cylinder, and the chamber fills up again with water. So far, this device had proved to be the best thing of the kind he had ever seen. Where this spark arrester was used, the smoke coming from the engine had very rarely any color whatever.

"Mr. Setchel said that they had on the Ohio & Mississippi road a pipe running along the side of the boiler with a funnel-shaped mouth coming down to the top of an auxiliary reservoir here, and also a valve hung upon hinges opening from the cab, and they are able to discharge the sparks either while running or at stations without throwing any on the engine; by opening the water valve first and then the spark valve, thus discharging the sparks very quickly, and very easily. It is the first of the kind that has been used, and it is not patented."



FOUNDRY PRACTICE, ETC.
(See preceding page.)

ADVANTAGES OF RED LEAD FOR IRON.

I maintain that the paint which most effectually protects iron is red lead. Not in color is it so well suited; but that is only a secondary consideration, and easily overcome by painting it over with any color desired. It contains the following advantages for the preservation of iron, which is the main object to be gained:

1. Dries easily with raw linseed oil, without an oil-destroying drier.
2. After drying, it remains elastic, giving way both to the extension and contraction of the iron, without causing the paint to crack.
3. It imparts no oxygen to iron, even when constantly exposed to damp—a fact to which all farm-wagon makers can testify.
4. It hardens, where it has been spread thickly, without shriveling, forming the toughest and most perfect insoluble combination of all paints. Iron ship-builders use it for painting the hulls of iron ships—namely, two coats of red lead and two of zinc white.

It should be known that pure red lead powder, after being slightly pressed down with the finger, shows no lead crystals. When they are visible it is merely partly converted, and not first quality. It should be ground in pure old linseed oil, and if possible used up the same day, to prevent it combining with the oil before it is applied, losing in quality. No drier is necessary, as in the course of a few days the oil forms a perfect, hard combination with the lead. American linseed oil is as good as any imported. Red lead paint spreads very easily over a surface, and the best finish can be made with it, even by a novice in painting.—LOUIS MATERN, in *Carriage Monthly*.

TWO SMALL LOCOMOTIVES.

The *Age of Steel* says:

"The smallest locomotive engine ever built in the United States for regular work was turned out by M. M. Buck & Co. lately It is twenty-one and one half inch gauge; diameter of cylinder, 6½ inches; stroke, 10 inches; diameter of driving wheels, 22 inches; weight without water, 5,250 pounds."

Here is another:

"H. K. Porter have under way at their light locomotive works a locomotive for pushing rail blooms at the Scranton Steel Works It weighs about three tons and is only two feet gauge. The cylinders are five inches diameter and 10 inches stroke. There is no cab, as it will run inside of the steel mill. This is the smallest locomotive ever built in Pittsburgh, if not the smallest built in this country, for practical use."—*American Manufacturer.*

Any more anywhere?

THE ENORMOUS DIFFERENCE between hand-work and machine-work in cost is well shown in the construction of models and jigs for interchangeable work. Before a sewing-machine or a pistol can be made on this system, a complete working model must be constructed, and often the cost of this model, and the appliances (not machinery proper) for making, costs thousands of dollars, most of it necessarily being made by hand.

"THE GOLDEN SPIKE has been made and suitably engraved, which is to be driven in a few weeks in the last rail of the Northern Pacific trans-continental line. The ceremonies of this important event will take place about ten miles west of Helena, Montana, probably about the latter part of August."—*Railway Age.*

Isn't this rather silly business for grown men?

THE OFFER of a year's subscription for No. 1, Vol. 3, is withdrawn, as we have received several.

DIAMOND DRILLS FOUR THOUSAND YEARS OLD.

Recent discoveries leave little room to doubt but that the diamond drill, which is deemed a modern invention, dates back to the time when the Pyramids of Egypt were built. We find a most interesting account in *Engineering* of these discoveries, and we republish them herewith in part :

"A recent investigator, Mr. W. M. Flinders Petrie, has brought a sudden accession to our stock of knowledge, and by careful observation and the collection of a number of samples, mostly half-finished articles damaged and rejected in manufacture, has arrived at the startling conclusion that the hard stones employed by the Egyptians, the diorite, basalt, and granite, were cut with jewel-pointed tools, used in the forms of straight and circular saws, solid and tubular drills, and graving tools, while the softer stones were picked, and brought to true planes by the aid of trial or face plates.

"The proofs are that the cut surfaces do not show as smooth-ground surface as a stone sliced with diamond dust does, but a grooved surface, like freestone cut by a toothed saw, or like rough-sawn timber. And that this grooving is not due to the action of any loose powder, is proved by the grooves being just as deep in hard stone (like quartz), as they are in softer stone (like felspar), where both occur side by side in the same specimen. Examples of this grooving we illustrate here. Fig. 1, one-half actual size, as are all the illustrations of this article, is a core from a tube drill hole in granite; on this, in one part, a continuous spiral of the lines of cutting may be traced for a length of 3 ft., passing five times around the core; and though, owing to rocking of the drill it cannot be traced from end to end, yet no shallowing or widening of the grooves, indicating wear of the cutting point, can be seen in the course of the continuous spiral.

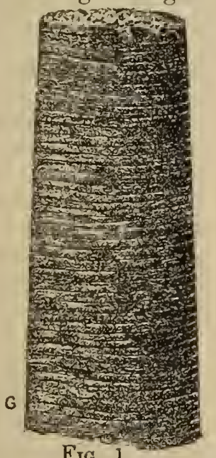


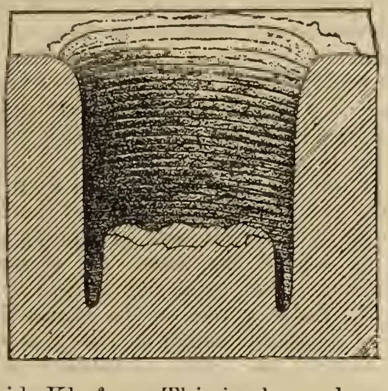
Fig. 1.

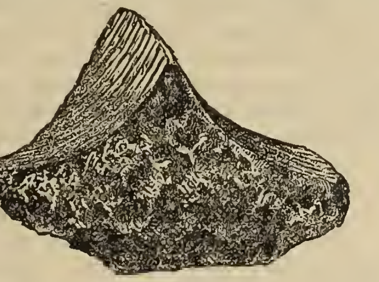
"Considering these examples of work—the definite grooves produced, their depth, continuity, and equality throughout, the capacity of the cutting point for dealing with the hardest materials, and the rapidity with which the cutting was done, the tube drills sinking $\frac{1}{10}$ in. in granite at every revolution—it seems certain that no instrument but a metallic tool set with fixed jewel points could produce such results. The passage of the grooves without any interruption through the quartz, felspar, hornblende, and mica of the red granite (as seen on the specimen in Fig. 1) is also a feature which shows brilliantly the capabilities of the tools, and the skill with which they were constructed. The strain on the cutting points in thus passing from a softer material into a patch of quartz would be enormous, far greater than if working continuously in quartz; and yet there is no starting, no burring, and no failure of the cutter.

"On modern lapidaries' work, done by a wheel fed with loose diamond powder, numerous shifts in the plane of the cut may be seen, showing the outline of the wheel; but no grooves or definite ploughings in the material produced by individual points of diamond. Similarly in the tubular drillings done with soft iron and sand by the Chinese, or in similar work by other nations, there is never seen any trace of ploughing out of the material; and, indeed, it seems physically impossible that any particle of a loose powder could become so imbedded in a soft metal by the mere accident of rubbing, that it could bear the immense strain needed to plough out a groove of considerable depth in such a hard material as quartz; or make a groove passing continuously through hard and soft material without any interruption or difference. This systematic use of jewel points set in some basis may, therefore, be considered as proved by the existing work, and the fact that the loose sand left in a cut, and also the sides of some of the cuts are found to be stained green, leads to the conclusion that the metal of the setting was bronze.

"What the jewels were is not yet known. The range of possible materials is limited to five minerals—beryl or emerald, topaz, chryso-beryl, sapphire, and diamond. Experiments made with beryl and sapphire show that their edges will fail under far less pressure than is necessary to produce cuts such as above described. Some amorphous stone is needed, and it is only the scarcity of diamonds which makes us obliged to refer to corundum as a likely agent.

"Though sawing was thus freely used for cutting the outsides of the great granite and basalt coffins, some other means was requisite for hollowing out the insides of such vessels. Here the inventive genius of the fourth dynasty exactly anticipated modern devices by adopting tubular drills, as the readiest and cleanest way of removing material with the least waste of force. These tubular drills varied much in diameter, thickness, and length. One of the finest examples (about 2 in. in diameter) is in the pivot hole of a door in a lintel of the granite temple at Gizeh, built by the king of the Second Pyramid, Khafra. This is shown here, drawn from a cast which Mr. Petrie obtained by means of a gutta-percha mound. Here it will be seen that the core could not be broken out entirely, owing to its running into a tough patch of hornblende. The granite core already described (Fig. 1) is also a fine illustration of tubular drill work, and would be considered a creditable result by modern men using modern tools. The holes in limestone show how closely they were placed together for hollowing out material; and the holes were all skilfully spaced so that each annular groove of the tool overlapped and used as much as possible of the cut next to it, so as to economise labor to the utmost.





"Hence it seems almost certain that the tubular drill principle, of which examples are here described from $\frac{1}{4}$ in. to nearly 5 in. in diameter, was carried still further into sizes suitable for removing rock on a large scale; sizes which must have needed several men to turn the capstan head of the drill. Many other traces of the use of tubular drills were mentioned, as, for instance, in roughing out statues, but more particularly for beginning the hollowing of the insides of vases and bowls, which were afterwards finished in the lathe.

"A peculiar feature of the cores and holes made by the tubular drills is a certain amount of tapering, which is always to be found. This tapering cannot have been produced by the mere rubbing of the side of the drill in turning round in the hole, since not only would such a cause be quite inadequate, but the grooves ploughed out by the cutting points are just as distinct on the sides of the tube or core where it is tapered, as on the lower part. Hence it seems that not only did the Egyptians set cutting jewels round the edge of the drill tube, as in modern diamond crown drills, but they also set them in the sides of the tube, both inside and out. Thus the hole was continually rimered larger by the tool, and the core turned down smaller as the cutting proceeded, and so the tool could be withdrawn more readily from the groove, as the annular space was thus wider at the top than at the bottom. Other drills, not tubular, were used for very small holes, such as those in the symbolic eyes, which are drilled in syenite, 1·2 in. long, and only 0·08 in. in diameter.

"Experiments made by the author seem to show that the minimum pressure upon a 4 in. drill could not be less than half a ton, and was probably two tons, and this is amply confirmed by the speed at which the tool is seen to have advanced, and is in accordance with the experience of modern engineers. Upon the granite core (Fig. 1) the grooves are a double spiral, showing that they were made by two stones at opposite sides of the tube; the pitch of the thread is $\frac{1}{10}$ in., the circumference of the core about 7 in., and therefore the rate of sinking was $\frac{1}{70}$th of the distance traveled by the tool. The wonder is how any bronze tube or saw-blade could bear the requisite pressure without doubling up, and how the jewels could be set in sockets to support them against such a violent drag.

"The finest examples of turning in hard stone, however, are in the British Museum. Among these are a small, highly-polished, narrow-necked vase in diorite, or rather in transparent quartz with veins of hornblende, which has its neck only 0·05 in. thick, and a large vase of syenite turned inside and out remarkably thin considering the size of the component crystals. But the greatest triumph is a bowl of diorite (No. 4716), translucent and full of minute flaws, which must render it very brittle; yet this bowl, 6 in. in diameter, is only $\frac{1}{40}$ in. thick (·024) over its greater part; just around the edge it is thicker, but a small piece broken out of the body of it shows its extraordinary thinness, no stouter than a thin card. An alabaster vase, of Unas of the fifth dynasty, almost rivals this in thinness, being only $\frac{1}{25}$ in. to $\frac{1}{30}$ in. thick, but the softness of the material makes it of far less interest.

"In addition to the tools we have already described, graving instruments were employed in the production of intricate forms. Blocks of stone were likewise hammer dressed; sometimes saw nicks were cut $\frac{1}{2}$ in. deep round a block, and then the hammer dresser was left to work the surface down to the plane of the grooves. Also on sawn blocks the surface to be placed in contact was usually hammer-dressed to have sufficient space to hold the cement, while the edges were left quite smooth. For dressing surfaces to a true level the regular custom of the workmen was to use a trial or face plate, prepared as a true plane and smeared with red ochre; wherever the ochre came off on the stone they knew there was an excess, and accordingly dressed it off. The tool used appears to have been a sort of small adze, with which the stone was sliced down very delicately and regularly by hand. All the blocks of the Great Pyramid casing were prepared with these facing plates, as may be seen by the remaining touches of ochre on the prominent points. Not only on building stones, but also on rock dressing, the same ochreing is visible. Where the stone was much larger than the facing plate, as was the block of granite over the king's chamber doorway, about 8 ft. by 12 ft., then a diagonal draft was cut along the stone from corner to corner, and thus any wind in the plane of the face was avoided. In a painting at Thebes the workmen are apparently shown chiseling down a stone to a plane face; they have a string stretched quite clear of the stone over an offset block at each side, and are then applying an offset piece to the face of the stone to see whether the face is in excess. This is a skillful method of working, as the excess does not bulge out the string, and can be exactly measured as they proceed, while the string does not need to be removed as the chisel can be used under it. Working on a vertical face the bellying of the string does not affect it."

THE OFFER of a year's subscription for No. 1, Vol. 3, is withdrawn, as we have received several.

HIGH SPEEDS ON RAILWAYS.

While there can be no doubt, that as regards cheapness and rapidity of construction, general excellence of bridges, locomotives, and cars, the railways of this country are ahead of the rest of the world, the signaling arrangements here, with few exceptions, are rudimentary and inefficient, and render fast traveling a matter of considerable difficulty, if not danger. It is impossible to run a really fast express train if the signals are ambiguous, and if every level crossing is made a compulsory stopping-place. The saving in time by fast trains can only be fully felt in a great country, where very long journeys are not only possible, but are frequently undertaken; but hitherto this fact has been little appreciated, and people have been content to travel at a slow speed, and put up with frequent stoppages, because the railways were new, the rails roughly laid, and many bridges unsafe at a high speed. But of late years these conditions have been materially changed. The wide-spread use of steel rails, the greater care bestowed on the road-bed, and the introduction of iron bridges of first-class workmanship, have rendered high speed perfectly safe and easy on most parts of good roads in the eastern and middle states; but it is rendered unsafe where switches are so arranged that they may be left open to an approaching train without any signal warning the engineer; or the signals are so formed that the difference to the eye between a clear or all-right signal, and a danger or stop signal, is slight in snowy weather, or under certain atmospheric conditions which render the difference between colors imperceptible, though a difference in form may be perceived.

The real gain of time to a business-man, obtained by a difference of a few miles an hour in the speed of a long-journey train, is best illustrated by an actual case: a man in New York who wishes to do a day's work in Chicago. He takes one of the fastest and best appointed trains he can find—the Chicago limited. It leaves New York at nine A. M., and lands him at Chicago at eleven the next morning, having accomplished nine hundred and eleven miles in twenty-six hours fifty-five minutes, allowing for the difference in time between the two cities. This makes an average speed of 33·8 miles per hour, including all stoppages. But assume, what is surely not extravagant, that as high a speed can be attained on the Pennsylvania or any other first-class American road as on an English main line, and what shape does the problem assume? On one English road, the Great Northern, the distance between Leeds and London (a hundred and eighty-six miles and three-quarters) is done in three hours forty-five minutes, including five stoppages; on another, the Great Western, the hundred and twenty-nine miles and three-quarters between Birmingham and London is run in two hours, forty-five minutes, including two stoppages; and as neither of these routes is particularly level or straight, and both pass through numerous junctions with a perfect maze of switches and frogs, they give a fair idea of what is possible in speed on the railroads of this country. These figures give, respectively, speeds of 49·8 and 47·2 miles per hour. Taking as a fair average forty-eight miles an hour, including stoppages, the journey from New York to Chicago should be done in eighteen hours fifty-nine minutes, or, say nineteen hours—a saving of seven hours fifty-five minutes on the present time; so that, if the train were arranged to leave at fifty-five minutes past four in the afternoon instead of nine o'clock in the forenoon, the whole of this time would be saved in the busy part of the day; effectually adding a day to our imaginary traveler's business and dollar-making life.

It may be thought that such a deduction is unfair, as the English style of car is so much lighter than the American; but, as a matter of fact, the average English express train is considerably heavier than the Chicago limited, and conveys about three times the number of passengers; and, as trucks and oil-lubricated axle-boxes are not yet universal there, the tractive resistance per ton is probably higher. It certainly, therefore, seems not only possible, but feasible, to attain these high speeds in this country, where, owing to the long distances to be traveled, they are more valuable than in England; and the great step towards attaining that end is the adoption of proper and efficient signaling arrangements. All the other steps are achieved: the American passenger locomotive of the present day is perfectly competent to drag a heavy train at a speed of over sixty miles an hour; the cars, as now constructed, can travel safely and smoothly at that speed; and the steel rail, the well-ballasted tie and perfect workmanship of the modern iron bridge, can well support the thundering concussion of an express train at full speed. But this speed can only be maintained for a few miles at a time if the engineer who guides this train be doubtful whether the dimly-seen signals imply safety or danger, or if the laws of the state bring him to a full stand where his road is crossed by a small corporation with a high-sounding title, which owns one locomotive with a split tube sheet and two cars down a ditch.

To run a fast train, a clear, uninterrupted road is absolutely necessary; and the reason is not far to seek. To move a body from a state of rest to a velocity of sixty miles per hour or eighty-eight feet per second, an amount of work must be performed equivalent to lifting that body a hundred and twenty-one feet. Now, it is apparent to the simplest capacity that it requires a pretty powerful engine to overcome the resistance of a train running at sixty miles per hour without every few miles putting on brakes to destroy this velocity, and then to lift it a hundred and twenty-one feet again to attain speed; the resistance of the air, and the friction of bearings on journals and of flanges against rails going on all the time. As a matter of fact, showing what severe work this is on an engine, the Zulu express on the Great Western railway of England, which is the fastest train in the world, has been repeatedly carefully timed; and it is found, that, though running over an almost absolutely level and straight road, it takes a distance of twenty-six to twenty-eight miles to attain its full speed, about fifty-eight miles and a half an hour.—*Science.*

◆

THE PRACTICAL ADVANTAGES OF TRADE JOURNALS.

The importance of trade journals is indicated by the fact that they are wholly supported by the trades that each represents, and cannot be said, to any appreciable degree, to be read by the outside public. Some shrewd observers of human nature maintain that the nature and quality of a person's reading, and the departments of a paper to which he turns with greatest eagerness, are sure indexes to his avocation.

Notwithstanding the cordial support given to trade journalism it may be said that it is not wholly understood or appreciated by those most interested. Much more could be made of it if its readers were only to consider themselves as contributors and correspondents. There is probably no member of a trade or profession who does not wish to know something or have some doubt removed. There are probably few, whether employers or employed, who have not discovered something in their special calling, which, if known, would be of practical value to those of his own trade. Many of the best workmen hesitate to take up the pen to enlighten others, though they are willing to do so, and know that they have ideas which would be helpful to their fellows, simply because they cannot turn out their sentences in a style which they consider proper for a widely-read paper. This is largely due to false modesty, and perhaps though indulging in many a brilliant idea, often a valuable invention or suggestion of real practical utility is buried in a man's bosom and dies with him. It is the idea, and not the language which clothes it, that is important.

If all artisan mechanics were to consider their own trade journals as the storehouse for their ideas, and a free exchange for all communications affecting their calling and interest, every journal of this class would grow in importance and general interest. It would be a means of improving their condition, enhancing their skill, stimulating original thought, awakening a more friendly feeling among mechanics, and effecting a better understanding between employers and employed.—*British and Colonial Printer and Stationer.*

◆

A NEW YORK TOW-BOAT FIFTY YEARS AGO.

A writer in the *Telegram* says:

"The old boat would look queer enough now, but she was as staunch as she was ugly, with her square stern—like a North River sloop—and a bow as round as the full moon. Her timbers were live oak, and you could wash your hands overboard from her guards, she floated so deep. She was about 98 feet long, 22 feet wide and 7 feet 6 inches depth of hold. Her paddle wheels were very far forward and the boiler was abaft the engine, which was, of course, of the 'steeple' pattern, a type now nearly extinct. She had no upper deck, but was steered from a pilot house, built as wide as the gallows frame; over the companion way leading down below deck, to the forward cabin. There was also a small cabin below deck aft, just forward of which and projecting some three feet above deck was the boiler, made of pure copper. The engine was 36″ × 6′, and there was fun sometimes when it got caught on the 'dead center,' for it took all hands with capstan bars to pry it over. In those days we burned pine wood, which, piled up along the deck fore and aft, made the old craft look like a floating wood yard.

"The system of signals between the pilot and engineer at that time was crude indeed. She had only one bell, a 'jingle,' to start her ahead, and to back we would ring the 'church' bell—a big brass affair perched on top of the gallows frame. To go fast either way we had to stamp (once or twice) on the floor of the pilot house, which, being nearly over his head, was understood by the engineer. Her engine would make you laugh now. Cranks, shafts, &c., all were of cast iron, and its greatest working pressure was about eighteen pounds. She could hardly get out of her own way. She was afterward made deeper, lengthened and rechristened the *Buffalo*, and run for many years to Albany.

◆

THE WEIGHT of any bar of wrought iron may be found by these rules: Flat and square iron: multiply the area of the end in inches by the length in feet, and this product by the constant number 3·33; the quotient is the weight in pounds. Round iron: multiply the square of the diameter in inches by the length in feet, and the product by the constant 2·61; the quotient is the weight in pounds.

◆

SOME STERNWHEEL BOATS building in England for South America have compound engines, 20″ and 33″ by 60″ stroke in cylinders; return tubular boilers working at 140 lbs. natural draught. The hulls are 130 feet long; 28 feet beam, and draw 15 inches; they have made 15 miles an hour. The engines are in the stern and the boilers in the bow.

◆

DYNAMOMETERS SHOW that train traction averages ten lbs. per ton. Dudley's "dynograph," a refined and more highly cultured instrument than the ordinary one, says 11½ lbs."

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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THE MECHANICAL ENGINEER.

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Enlarged 1883.

New York, August 18, 1883.

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HOW CARS ARE RUN OVER THE NEW YORK AND BROOKLYN BRIDGE.

The engravings herewith represent the principal features of running street cars by endless wire ropes, that is, in so far as the attachment and detachment of the car from the cable is concerned. The cable runs under ground in a tube, and is supported by rollers at certain distances. The tube has a long slot in it, shown in the section, and in this the carriage or cable-grip, so to speak, runs. As will be readily seen, the cable runs over this carriage and at some distance above the rollers, so as to clear the tops of them as the cars pass along the road. It always runs at this height. The cable is gripped to the carriage by a clamp operated by a hand-wheel and screw.

◆

Iron notes a proposed rolling mill for rolling iron and steel, to be delivered to the rolls in a molten state, by which it is claimed it will be freed from gases. The rolls are to be hollow, and a current of water passed through them to chill the surface of the metal.

We should like to be told how molten iron can be rolled!

Some experiments recently made, says the *London Engineer*, on a length of steam pipe gave the increase of length 2 in. per 100 ft., or 2 in 1200, the rise in temperature being from 60 deg. to that of steam at 80 lb., namely, 325 deg. or 255 deg. The expansion was thus 0·0016 for the 255 deg., giving a coefficient expansion of 0·00000651 per deg. F.

The Winans Packing Company, 408 Bleecker street, N. Y., are, on account of constantly increasing demand for their goods, placing additional machinery in their building, and will be soon able to meet all orders on receipt. It has acquired a wide celebrity all over the country, and is universally liked where introduced and fairly tried. Our readers will notice a somewhat extended advertisement of these goods on the back page.

◆

James F. Hotchkiss, 86 John street, this city, was awarded a bronze medal at the Exposition of Railway Appliances, Chicago, in a competition between his well-known boiler cleaner and two others. If the users of the Hotchkiss Cleaner had been on the committee, the award would have been a gold medal instead of bronze.

◆

Look at this!—The boys say that Atchison, Kan., South St. Louis, Mo., Toledo, O., Muscatine, Ia., Urbana, Ill., (?) Kansas City, Mo., Pittsburg and Leadville, Col., are all marching up to join the National Association of Stationary Engineers. Good. Everyone speaks well of it. *The Locomotive* for July has a friendly word and a pat on the back for it, and it is bound to be one of the strongest and most intelligent trade organizations extant.

The steam yacht fleet continues to increase in this port, and the new accessions are vessels of great beauty and costliness. Very few are under 200 feet in length, being in reality iron steamships built for pleasure, for they are all of iron, not a wooden steam yacht of any size having been built this summer. The latest is one for W. B. Astor, which is to be 250 feet long, 30 feet wide and 20 feet deep. She will cost over $350,000.

◆

Mr. John Mailer, of San Francisco, Cal., patentee of an improved furnace for steam boilers, send us a curiosity in the shape of a lot of copper, glass, etc., fused together in the air inlet of his furnace, showing the intense heat he obtains with his device. The arrangement is a good one, and is illustrated on page 122 current volume.

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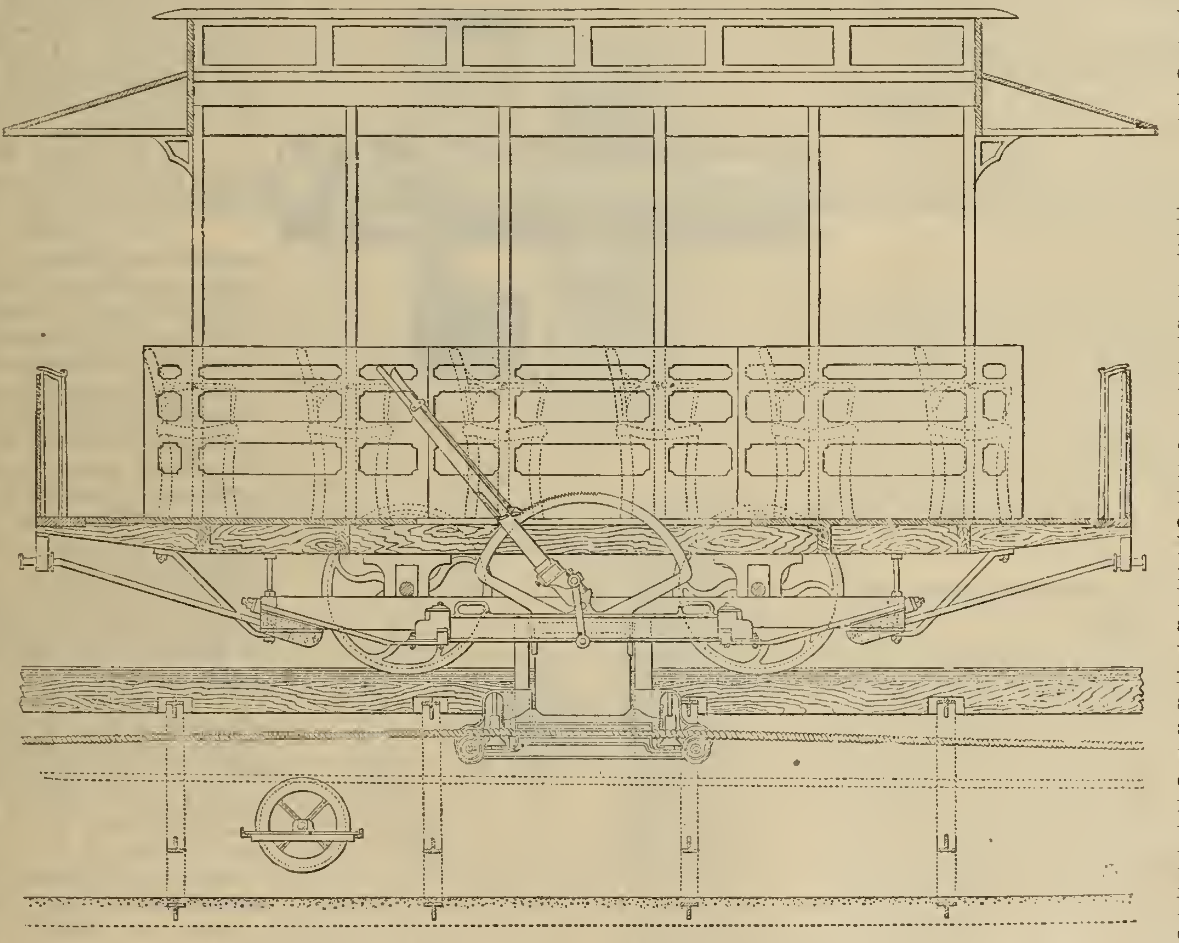
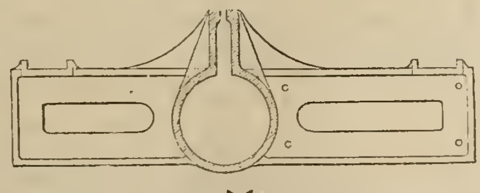


HOW CARS ARE RUN OVER THE NEW YORK AND BROOKLYN BRIDGE.



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TROUBLE OF AN ENGLISH ENGINEER WITH ANTHRACITE.

We find in the *Mechanical World* an account of an experiment with anthracite coal in England, which reads curiously. It says:

"About ten years since I took part in some experiments made with anthracite coal to demonstrate its utility for generating steam. We experienced much difficulty in lighting up and also in keeping the fire clean. Large quantities of wood had to be burnt in the furnace before the coal would light, then the draught had to be kept up to its highest pitch to keep the coal alight, and in the course of a few hours the furnace bars became red hot. After a few days' persistent use of the coal under different conditions as to draught and methods of stoking, the furnace bars warped and fused together, and we had to get a new set of bars put in. We then got some cannel coal, and tried various proportions of this with the anthracite; but although we succeeded in keeping the furnace bars cool, and also burnt the coal, it was hard work for the stoker to keep the steam up, for the poker and shovel and scraper had to be plied every few minutes most vigorously, and the ashpit soon filled. We next got a few tons of Hartley coal and mixed this with the anthracite, and here we met with most success, for a few shovelfuls of anthracite spread over a glowing bed of Hartley coal made a good staying fire, which gave off much heat and kept the steam up. It was found inconvenient to have two sorts of coal about in this way, so we were heartily glad to get rid of the anthracite, and have not since felt inclined to repeat the experiment."

◆

Ordinary clothes wringers are very useful in book-binderies for attaching the cloth covers to the pasteboard bodies. When the paste is applied both cover and body are run through the rolls together.

It is noted by foreign contemporaries that tail rods have been omitted in many recent marine engines, and from the tenor of these remarks it might be inferred that the ship was expected to sink suddenly without them; it is regarded as an innovation to be viewed with some apprehension. A Pacific mail steamship broke her tail rod some time ago, and the piston was taken out, the fragment cut off square and put in again. "She'll no work mon," was the comment of a Scotchman who saw the transaction, but the prediction was false. Marine engines on the lakes, and many others, of large size are without tail rods and experience no difficulties of any sort.

◆

No mention has ever been made, that we are aware, of the difference in diameter between the cylinder of a steam engine hot and the same when cold. In small engines this change of dimension would not be great, but in large ones, and with the high pressures now carried it cannot be ignored. A cylinder 72 inches in diameter has 4,072 square inches area; supposing it to expand only $\frac{1}{8}$th of an inch, which is quite within bounds, it is then 4,085 inches in area, or 13 square inches larger. When this is converted into foot-pounds and pressures, it represents an item of no small importance. Since all calculations are made upon the basis of the bored diameter it follows that they cannot be correct, and that the power is greater by the amount of the relative expansions in the cylinder diameter at extremes of temperature. A thorough study of tihs matter would be of great interest, but from the careful research and calculations demanded, as well, also, the consultation of authorities, it is beyond the pale of editorial matter. No more than a mere reference can be made to it.

New York City is getting richer yearly. The assessed valuation of real estate in 1883 is $1,079,130,689 against 1,035,203,816 in 1882, total assessed valuation, real and personal, of New York City is $1,276,677,164, an increase of $43,200,765.33 in one year.

◆

The area of a flanged plate is the surface inside the flange, from the root or bottom of it, where it springs from the sides, not the whole diameter of the plate. If the whole diameter is estimated the portion exposed to pressure will be too heavily loaded.

◆

The Lectures on Organic Scale by N. W. Williames, published in *The Mechanical Engineer* have been widely quoted but in no instance credited. Our contemporaries seem to consider them common property.

◆

Some large steel forgings are made in England. Among them is a hollow propeller shaft, 55 ft. long and $18\frac{1}{4}$ in. in diameter, with a 10 in. hole through it, and weighing $15\frac{1}{2}$ tons. It is claimed for this shaft that it is 28 per cent. lighter and 30 per cent. stronger than it would be if made of solid wrought iron. The metal is subjected to great pressure while in a fluid state, and the ingots thus obtained are afterwards forged to the required shape by hydraulic pressure. In addition to this large shaft there is a single-throw crankshaft, $16\frac{3}{4}$ in. in diameter by 10 ft. 3 in. in length, and weighing 5 tons 4 cwt. Another is illustrated by a cylinder lining with an internal flange for a marine engine. This was made from a hoop of fluid pressed steel, enlarged to size by forging; the outside diameter being 81 in., inside diameter 77 in., the length 59 in., and the weight 65 cwt. Besides this there stands a 14 in. air vessel to contain the compressed air for propulsion of the Whitehead torpedo. The thickness is from 0·25 in. to 0·33 in., and the testing strain is 1,500 lbs. per square inch. There might be some question of the fitness of steel for lining cylinders as regards friction and liability of cutting.

◆

HOW INSTANTANEOUS PHOTOGRAPHS ARE MADE.

** A New York photographer pulled out from a heap a photograph of a yacht flying before the breeze, with every stitch of canvas spread and the sparkle of the spray dashed over her bows distinctly to be seen. "That," said he, "was taken in the 103d part of a second. I will tell you how we can measure even a more minute degree the length of time a plate is exposed. We have a black disk which we set moving at the uniform speed of one revolution a second. The circumference of this disk is divided into degrees, and near the edge is painted a small white spot. This disk is photographed while in motion, the white spot is photographed as a line of greater or less length, according to the time of exposure, and from the degrees marked around the circumference of the disk we can calculate to a nicety the fraction of a second which it took to transfer the picture on to the sensitized plate. You want to know how we manage to expose the plate for such an infinitesimal space of time? I'll show you in a minute. John, fetch me a slide!" John produced as simple a contrivance as can be imagined. It consisted of two plates working beside the other in grooves. In both of them were two holes; in the under plate the hole was round, so as to fit on to the lens of the camera; in the other it was square. The top plate was so arranged, that slipping over it a number of rubber bands caused it to move at a certain speed over the under one when it was lifted by the fingers and let go. At the precise fraction of a second when the square hole and the round hole are opposite each other, light naturally passes through and reaches the sensitized plate, and the image of the object is projected thereon.

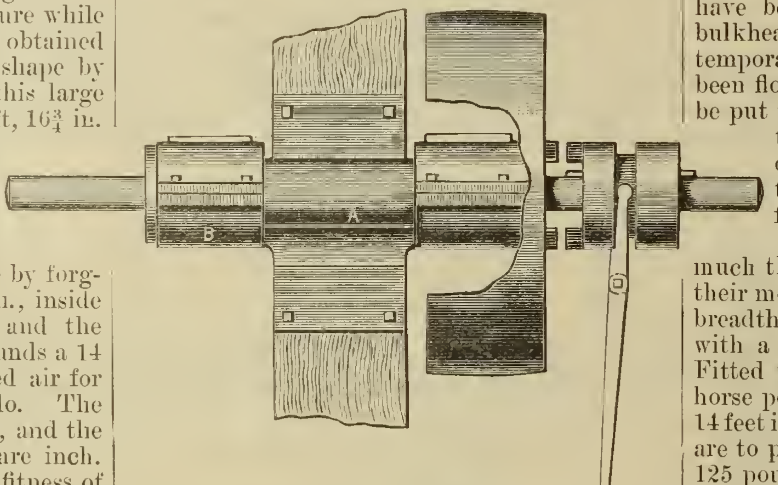
—*Reprinted from a paper which stole it somewhere.*

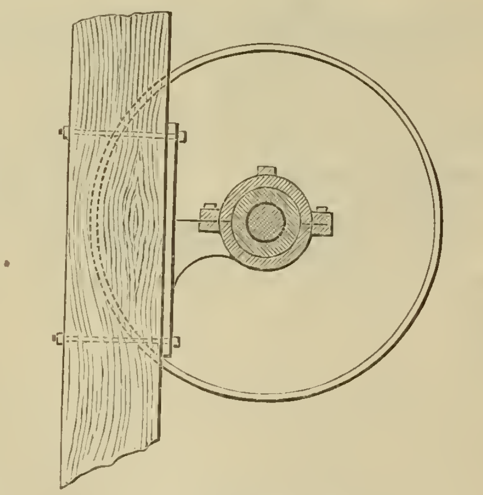
ALBEE'S ARRANGEMENT FOR LOOSE PULLEYS.

The engraving herewith represents an improved design for the loose, or idle pulley on which a belt runs when not driving a machine. From the great strain upon this pulley, its exposed position to dirt falling through the floor from above upon it, and to dust from beneath, as also the difficulty of keeping it lubricated, the common pulley is usually in bad order.

Even when self-oiling fixtures are applied, this statement is correct, for the tendency of the motion is to throw the oil out and away from the bearings.

With the device here shown, however, the loose pulley is a stable and certain fixture. As may be seen, it has its own bearings, independent of the line shaft, being merely shipped over it as an incident of its duty, but in no wise dependent upon it. The pulley itself is not loose, but fast upon the shell, or arbor, *A*, which runs in the bearings, *B*. As a result, it is always perfectly true with the line shaft, and demands but little power. It is especially adapted to small pulleys at high velocities, as in circular-saw and planing-mills, and in such places will prove very desirable. Clutches of any kind may readily be applied to it, and the face may be adapted for round or flat belts, as required.





This pulley has been in use for two years in exposed positions, where it has been found to answer admirably. One of them is only five inches in diameter, and runs 2,000 revolutions per minute; the belt is shifted 5,000 times daily off and on to it, but it still remains in as good condition as when first put up.

We deem it a most desirable device for the purpose. The inventor is G. H. Albee, of Neenah, Wis., who will send price lists and circulars on applications.

◆

COALING LOCOMOTIVES IN AUSTRALIA.

A correspondent of a foreign paper thus describes the method of coaling locomotives in Australia:

"Having had some experience of railroad life in various parts of the world, I was amazed on my arrival at the running shed, to see the coal used, or abused, lying in great heaps on the ground, with ashes and clinkers mixed with some of it. Those who have much experience in coal consumption generally acknowledge that coal can undergo no worse treatment than lying exposed to the influence of the weather, and that its heat producing qualities deteriorate greatly under these conditions. In the United States the stock is generally housed or closely packed. For daily consumption coal is brought as direct as possible from the mines, and is handled as little as possible to avoid breaking it into dust, as very small coal is unfit for locomotives. The coal I saw at Islington was hardly fit for a Cornish boiler, much less for a locomotive, it having been so knocked about. It had perhaps been put on board ship in good condition, thence discharged into trucks, and then by men thrown on to the ground, to be again put by others into baskets, who with the assistance of a few more put it on to a locomotive tender in the manner now described. Two men lifted the full baskets on to a temporary stage, whereon were two more men, who placed the basket on the tender, where a fifth man emptied it."

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ENGLISH IRON STEAMERS FOR LAKE SUPERIOR.

As stated in The Mechanical Engineer last winter, the Canadian Pacific R. R. Co. are building three large vessels in England, to run on Lake Superior in connection with their road.

But an important question which had to be considered was how to get them up to the lakes on which they are destined to ply. Vessels measuring 270 feet in length cannot get through the canals, and hence they had to be so designed that, after steaming out to Montreal, they could be cut in two; and for that purpose the hulls have been constructed with seven water-tight bulkheads, the center one of which will serve only temporary use. After the two portions have been floated up to Lake Ontario they will again be put together and receive their final fittings for permanent service in the navigation of the lakes. It is fully intended that they shall be completed and made ready for that service by next spring.

The vessels, says *Engineering*, have much the appearance of large ocean steamers, their measurements being: Length, 270 feet; breadth of beam, 38 feet; depth of hold, 23 feet, with a carrying capacity of about 2,000 tons. Fitted with engines of about 1,700 indicated horse power, and with two steel boilers, each of 14 feet in diameter by 12 feet 3 inches long, which are to provide steam at a working pressure of 125 pounds per square inch, these vessels are confidently expected to steam at the rate of 13 knots per hour, and to accomplish the full length of their run of 360 miles in a period of twenty-four hours.

These steamers are to ply between Algoma, on Lake Huron, and Fort William, at the head of Thunder Bay, near the western extremity of Lake Superior.

It is curious that the Canadian company should have gone to the useless expense of building these vessels abroad, when they could have been built very much cheaper, all things considered, on the lakes. Work for work, at first cost, they could have been made as low as they can be abroad; but when the cost of sailing them out and partially rebuilding them here is taken into account, there is a large balance against the company.

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The following names of Secretaries of Stationary Engineers' Associations were received too late for insertion in our last issue:

Jno. F. A. Cullinan, 23 Exchange street, Rochester, N. Y.
E. T. Ivester, 818 Beaumont street, St. Louis, Mo.
F. H. Caldwell, 455 Eastern avenue, Cincinnati, O.
E. L. Dicey, 348 West Lake street, Chicago, Ill.

◆

LOSS OF PRESSURE IN CARRYING STEAM LONG DISTANCES.

We addressed a letter to Mr. Chas E. Emery, the engineer of the New York Steam Company, some time since, asking what their experience had been in this line. Mr. Emery's reply is appended.

Editors Mechanical Engineer :

Gentlemen—Yours of the 12th ult. has been crowded out of sight by press of business, conventions, etc.

Our pipes were proportioned for doing very much more work than we have yet obtained, so the pressure is practically the same over the entire system, extending upward of half a mile from the boiler house in different directions. I should have to apply test gauges and read simultaneously, comparing by telegraph, to find any difference.

Chas. E. Emery,
Engineer and Superintendent.

Letters to the Editor.

This column is open to all to express their views in their own way. Except when questions may arise, we shall rigorously cut out all personalities. We are not responsible for the views of our correspondents unless we indorse them.

LETTER FROM A CALIFORNIAN FREE LANCE.

Editors Mechanical Engineer:

I noticed a letter in your paper from an engineer in California, some time ago, promising to let your readers know how some use boilers in this part of the world. In order to keep the ball moving, I will put in my effort.

San Francisco contains about 300,000 inhabitants, and there are about 2,000 stationary steam boilers in constant use. Every steam user is allowed to run his boiler to suit himself, as there has never been any inspector appointed to examine stationary boilers.

Some people do not believe that one is needed, as we have such a fine climate here that it is a very rare thing for a boiler to give out! One steam user, however, held on just a little too long, to a battery of boilers lately, and one, out of a battery of four cylinder tubular-boilers, ripped in the line of its length. It started in the furnace, and went backward carrying another boiler with it, a mud drum twenty feet long, a thirty-inch steam drum the same length, and dumped them both two hundred feet away from their original position. I was satisfied there was nobody to blame, although the disaster caused the death of several persons, for such verdicts are always rendered on these occasions. I came to the conclusion, however, to take a look at the wreck on the day after it happened. The tubes of the ruptured boiler were scattered all over the place, and twisted into all kinds of shapes. I then examined the shell, and on the line of fracture at the bottom it was as thin as an old iron barrel-hoop, and pitted and eaten with holes far above the water line. There were man-hole plates on the bottom, in front, so that these boilers could have been easily examined and their condition known, but it is as much as an engineer's place is worth to complain in regard to a battery of boilers.

Now, who is to blame for such disasters? I examined the boiler thrown from its position by the one which exploded. The man-hole plate on the bottom had been taken off, and I put my hand in the boiler and picked up several pieces of white mineral, like lime, shaped like barnacles scraped from a ship after a long voyage. These must have dropped from the rivet-heads when the boiler struck the ground, for where these so-called barnacles had parted from the rivets, they showed scarlet, or red oxide of iron, proving, beyond possibility of doubt, that the shell of that boiler had been red hot. The cause of this disaster was brute stupidity and dirt, but the dirt couldn't help it

Now, in regard to the repairing of boilers, boiler makers are not always to blame. For example, a steam user says to a boiler maker: "I know my boilers are used up, but I have already been to great expense in other repairs lately, and have no money to buy new boilers with; neither will I have any for some time to come, so just put soft or hard patches on the bottom seams where they are needed."

The boiler maker not wishing to lose a customer, obeys the order, when if he had been allowed to use his own judgment, he would have advised the steam user to abandon the boilers in time.

Cupidity, stupidity, and dirt are the cause of nearly all boiler explosions. Free Lance.

San Francisco, Cal.

FROM BROTHERHOOD STATIONARY ENGINEERS, No. 1, OWOSSO, MICHIGAN.

Editors Mechanical Engineer:

We organized on the 8th of May last, with ten charter members. Meeting in our various engine-rooms, until recently we secured the privilege of using the Odd Fellows Hall. We number 14 members now, and more are on the way, which, considering that Owosso is only a small inland town, is doing well. There are only some 20 engines, large and small, running here; 13 of them are attended by engineers employed for the purpose, the balance are run by the owners or boys. It is a source of wonderment to me that the engineers of the larger towns and cities do not organize promptly. They certainly would if they could realize that it is a source of great benefit as well as pleasure, for a lot of engineers to get together and talk over their week's experience and compare notes, and if they meet with any difficulties in their practice, get the advice of other members of the association.

I remember in days before the war, on a certain Western railroad, the engineers used to get together in the round house on Sunday mornings to do what work they had to do, but the greater portion of the time was consumed in talking over the week's experience, and many were the valuable points that I, for one, gained from those Sunday meetings. So with the Stationary Engineers, if they would organize in each city or town where there are ten or more of them, it would not be long before every engineer that was worthy would be a member of the organization.

We were very agreeably surprised and pleased with a visit from Vice-President George M. Barker, and Secretary Davy, on Thursday evening July 12th, it being our regular night of meeting. We had a very pleasant time. Bro. Barker gave us a glowing account of what the eastern engineers were doing, and Bro. Davy also told us of the doings of the Detroit engineers in his inimitable way, all of which was a great pleasure. It will be a meeting long remembered by us, a bright spot in our lives.

I am a constant reader of The Mechanical Engineer, and permit me here to express my thanks for the many good things that it contains. I have got a good many valuable points out of it.

W. R. Smith,
Secretary.

[We are glad to hear from the Owosso Brotherhood, and hope that this is only the commencement of their favors. Bro. Davy is an ardent worker and a consistent one in the cause, and engineers are much indebted to him for his assiduity. It is the pioneers, those who break the way, who have the hardest time. Let us hear from all brothers everywhere.—Eds.]

A WASTEFUL ENGINE.

Editors Mechanical Engineer:

I have charge of an automatic steam engine, 16″×36″, which is in good condition, having been repaired within the last six months, with new valves, stems and seats, new cross-head and crank-pin, brasses, and the whole engine lined perfectly true.

This engine makes 60 revolutions per minute; we carry 80 lbs. steam, boiler pressure, and it is rated at 80 H. P. Our work does not require more than half the rated power, and, working so light, the point of cut-off is early, and I have consequently a low terminal pressure, but I do not think below the atmosphere at any part of the stroke. I am advised by an expert in such matters that I can effect a saving of 25 per cent. in coal if I reduce the speed of the engine to forty turns and make a corresponding reduction in the size of the driven wheel on the counter shafts. Is this theory correct, and will it be corroborated by practice? I am running this engine with a steam lead of about 3-64ths of an inch. In the event of the terminal pressure being too low would you advise me to increase the steam-lead, and thereby have greater compression; or would the proposed reduction of speed attain the same result? Please answer in your next.

New York City. J. N. R.

[There are doubtless many engines working in a condition similar to that here described, with very poor results as concerns economy. Many fancy that this lies in carrying high steam, cutting off very short, and running at as high speed as consistent with the work to be done, but this is a great error. An engine too large for its duty is a source of expense in every way, and it would be profitable in some cases to bush the cylinder and reduce its diameter to something like the power demanded of it. Our correspondent says he is using 80 H. P. for 40 H. P. In reality he is doing far worse. The engine is 16″×36″, making 80 revolutions per minute, under 80 lbs. boiler pressure. The least admissible point of cut-off with these conditions is 1-5th, which gives a terminal of about 20 lbs. absolute, only, and a mean effective pressure on the piston of 35+. Under these conditions he develops over 100 conventional horse power.

Supposing his point of cut-off to be now 1-10th the stroke; his terminal is only 11 lbs., or nearly four pounds less than the atmosphere; the mean effective is 17 lbs. Such a condition is wasteful in the extreme; there is no object in carrying 80 lbs. boiler pressure to get 17 lbs. mean effective, for that is all he wants to do his work. His remedy is, therefore, to reduce the boiler pressure, follow further, and raise the terminal to certainly atmospheric pressure, and what is better, three or four pounds above it, in order to have a free exhaust. If he lowers the boiler pressure to 40 lbs. his mean effective will be 20¾, and the terminal 17 lbs., when following about 10¾ inches on the piston. This will give as good a card as can be got under the circumstances.

Steam lead has nothing to do with compression; the exhaust governs that. As for the counter-shaft, or line-shaft speed, it is better to increase the driving pulley than decrease the driven. Large belts work badly on small pulleys, and wear out fast in the laps from bending over small diameters. The furnace should also be bricked up to reduce the grate area if less steam is carried, unless steam is wanted for other purposes.—Eds.]

A CHRONIC FOAMER.

Editors Mechanical Engineer:

Please answer the following question:

Can you, or any of your readers, tell me what will prevent the water from priming in a steam boiler? I have an ordinary steam-drum attached to boiler by two 8″ legs. At times, when the engine starts quickly, the steam pipe will fill with water. It is fully 3 feet 6 inches from level of water in boiler to opening in drum for steam pipe to engine. I have tried everything I can suggest myself, or that has been suggested by old engineers. A. H. Goff.

St. Louis.

[Such cases as these have great interest for us; and though we cannot, at this distance, suggest any remedy without knowing more of the details, we can mention a few things likely to cause trouble of the kind mentioned. Brother Goff is a man of experience, so we need not say anything about dirt—he knows what that will do as well as any one.

How much steam room is there in the boiler? The mere presence of a drum is of no value unless there is steam room enough to keep it full all the while without drawing on the capacity of the boiler—that is to say, the steam space should be the magazine for steam, and not the drum.

The philosophy of priming is simply mechanically raising the water by the steam in its efforts to get out of it, and if the steam space is drawn upon and emptied, so to speak, the boiler is sure to prime. The steam space should not be less than one-third the cubic inches in the boiler, supposing it to be a cylinder. From what our correspondent says as to the attachment of the steam-drum by two 8-inch legs, we are inclined to think they are the cause of the trouble. It may be urged that such attachments are common, and work well in most cases; but it by no means follows from this that they will in all. Supposing our correspondent's boiler to be small for the work it has to do, a good draught and a cramped drum, foaming would naturally result. The water being in active ebullition over the fire, would rise through the nearest leg, and not through both legs. The result would be foaming.

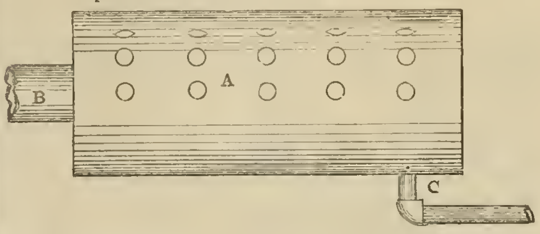
Obviously, our remarks are based upon what physicians call a diagnosis. We know nothing of the circumstances beyond that the boiler foams, and has a drum connected by two 8″ legs. Where foaming is chronic it proceeds from several causes—bad design, which includes cramped steam spaces, cramped water spaces, too little boiler for the work, dirt, and poor circulation. Generally, a dry pipe in the drum will cure the trouble completely. We never knew a case of failure.

In asking advice, correspondents will aid greatly in giving all possible details.—Eds.]

EXHAUST PIPE HEADS.

Editors Mechanical Engineer:

In a late issue a correspondent asked for the best means to prevent exhaust steam from spraying. I inclose a sketch of a device that we use in this city which is quite effective.



A is a sheet iron cylinder, 36 inches long, and 15 inches in diameter. The exhaust pipe, *B*, enters the head, and the exhaust steam escapes at the perforations. These are one inch in diameter, and exceed in aggregate area that of the exhaust pipe. *C* is a drain pipe for condensed water. Two wrought iron stands support the device.

I run four elevator engines, situated in different parts of the building, and in the dull season they stand idle a good deal. When they start they throw much water. This contrivance prevents spraying and produces no back pressure. A. H. Goff.

St. Louis, Mo.

A BAD CASE.

Editors Mechanical Engineer:

There is a stationary boiler-setting in this place that I would like to get the opinions of engineers upon. The grates are 4½ feet from the boiler, and the bridge-wall is 26 inches from the boiler, and there is a 4 inch space between the arch and the top of the boiler, which gives the fire a chance to strike the boiler above the water line. The fire has a chance to go all around the boiler. I would like to get opinions as to its economy and safety. L. I. S.

[Do the proprietors own a coal mine? They need to. The boiler is very badly set—in fact, it is not set at all. No opinion can be given as to its economy. If heat strikes it it is by chance, except on top, where it does no good. The space from grate to bottom of boiler should not exceed 24″; distance from top of bridge wall to bottom of boiler not over ten inches at the outside, and the fire should not go above the water lines. The location of the above boiler is omitted for reasons; it is a genuine letter.]

CARD FROM A. M. DAVY.

Editors Mechanical Engineer:

Of late I have received many letters which were sulphurous in the wording, because I am not as punctual on certain matters as some think I ought to be. Now I wish to say this: I am doing all things as quickly as possible for me. I have to work and support my parents, by days' work in my engine room, and I attend to the duties of the National Association free of charge, but I cannot afford to neglect my daily business for it. I have come to the conclusion that if I receive any more such communications I shall file my resignation with the President of the National Association at once, and perhaps publish said letters with comments.

A. M. Davy.
Detroit, Mich. 175 Elmwood Ave.

RELATIVE PERFORMANCE OF CUT-OFF GOVERNORS.

A Lecture by N. W. Williames, before the Keystone Council, No. 1, Stationary Engineers, of Philadelphia.

I promised to give you a full report of the performance of two governors of different makes for two weeks run, and this I believe will be interesting, amusing and instructive to you in analyzing the subject presented. It embraces very near all in relation to working steam expansively, from small to large clearance. It gives a clear idea of the necessity of an engine being properly proportioned for the work it has to do, and the absolute need of a governor controlling the load.

I will explain the way in which this test came about: Nearly 18 months ago I put a Tremper Governor on an engine. After indicating it and finding the engine too large for a throttle governor to work economically, I reasoned that the best thing I could do was to put on an automatic cut-off governor, believing I had saved all that could be by the use of an automatic cut-off governor over an ordinary throttling governor. It was then proposed to the proprietor that by putting on a certain cut-off governor he could save 25 per cent. more. This I claimed was impossible, but after running the Tremper cut-off for one year the proprietor accepted a proposition from the other party, and the Tremper was taken off and his put on. After it was properly adjusted and had been in use about two months, a test was demanded by the proprietor, as the engineer reported that he was burning more coal than he did with the Tremper governor. This was explained by the party whose cut-off was in use by the assertion that they were doing more work. The proprietor had no report of any more being done, and naturally did not believe they were using any more H. P. He engaged me to indicate the engine, and I reported they were doing no more work than they had been for the last twelve months, as I had the cards taken at intervals during that time. The party of the second part was satisfied that he was doing more work, and his evidence, as proof, was saving 17 per cent. in clearance between the two governors, independent of any of the other advantages. I replied that 17 per cent. of clearance was not 17 per cent. of coal saved or work done, and that he would never be able to show an economy of one per cent. over the Tremper governor with his. It was then demanded by the proprietor that the party of the second part prove his 10 per cent. proposition of coal saved, and we agreed upon a test of the merits of the respective governors. I claimed that we should take one minute indicated cards from both ends of the cylinder every half hour, he to receive half of them every night, and I the other half. He was to run the engine and boiler and get the very best he could out of it, furnishing his own fireman, while the regular engineer was to have charge of weighing the coal and water, and keep a record of all the data, presenting each of us with a copy every day, signed by all three parties. The verdict of the engineer was to be decisive, it made no difference which won. I considered this the fairest way of making a test, particularly when the engineer is intelligent on the subjeet. I think these tables and the accompanying report are very marked as to the ability of the engineer in charge, and I wish all had the same.

Three parties were interested in this test. The party of the second part and his engineer, myself and my engineer, and the proprietor (as deeply interested as either), represented by his engineer. I think no test was ever conducted in a more thoroughly practical way than this one was made. I did everything in my power to make it fair, and to make it equal in the firing. I had our rival's engineer to fire my test, so that the firing would be in both cases alike. You know a change of engineers make a difference in water evaporated and coal burned.

The boiler in both eases was blown off and cleaned, the wood, coal and water weighed, and an automatic counter attached to the engine. The engine was run a given number of hours and minutes each day. Our rival indicated his own test and I watched the cards taken and signed them. I took the cards for my own test, and our opponent saw them taken, and signed them. It was decided to use my indicator, and I used a large one with the 2½ in. cylinder, as you all know I am a strong advocate of a long card, particularly at slow speeds. The indicator used was a Thompson, with a 30-pound spring, and with the tables and the spring you will be able to analyze this subject for yourselves.

The two cards presented I have worked up as a guide for your measurement. No. 1 card is from the Tremper cut-off, and has the maximum and minimum lines on. The maximum has 20·21 pounds mean effective pressure, and the minimum has 9·3 pounds mean effective pressure, while the mean of the card is 14·75 pounds. The mean indicated horse power would be 38·64, while the terminal is eight (8) pounds above the atmosphere. The compression or cushion is 16 pounds, and the initial pressure is 55 pounds on the cards; *F* being the front or crank end of the cylinder. Card *B* has a terminal pressure of 7 pounds, a compression or cushion of 19 pounds, and an initial pressure of 53 pounds. The boiler pressure when this card was taken was 64 pounds. It is the 1.30 P. M. eard of Tuesday, May 15th.

The card marked No. 2 of the rival cut-off has the maximum and minimum on the same indication. The maximum mean effective is 24·12 pounds, while the minimum is 6·15 pounds. The mean of the card is 15·13 pounds. The mean indicated horse power of the card is 39·59. Card *F* has a terminal of 8 pounds above the atmosphere, a compression of 23 pounds, and an initial pressure of 54 pounds. Card *B* has a terminal of 7 pounds above the atmosphere, a compression of 29 pounds, an initial pressure of 51 pounds, and a boiler pressure of 65 pounds. The space in both of these cards between the maximum and minimum, added together and divided by two gives us the mean of each card.

You will notice the wide range of variation in both of the cards, particularly so in No. 2. The horse power of these cards is calculated from the constant of ·03855, which constant is got by multiplying the area of piston by the feet traveled in one revolution. This divided by 33,000, multiplied by the speed of the piston in feet per minute, and the mean effective pressure of the card, will give the indicated horse power. You will notice in No. 1 card that the minimum line never

DATA AND RESULT OF A TEST OF THE MERITS OF A CUT-OFF GOVERNOR, BY S. A. GOODWIN, AND THE TREMPER CUT-OFF GOVERNOR, BY N. W. WILLIAMES.

The engine upon which the tests were made was of the slide valve pattern, speeded before eaeh test to 68 revolutions per minute. Cylinder 18″ × 30″. The boiler used was a double deck return tubular with separate stack.

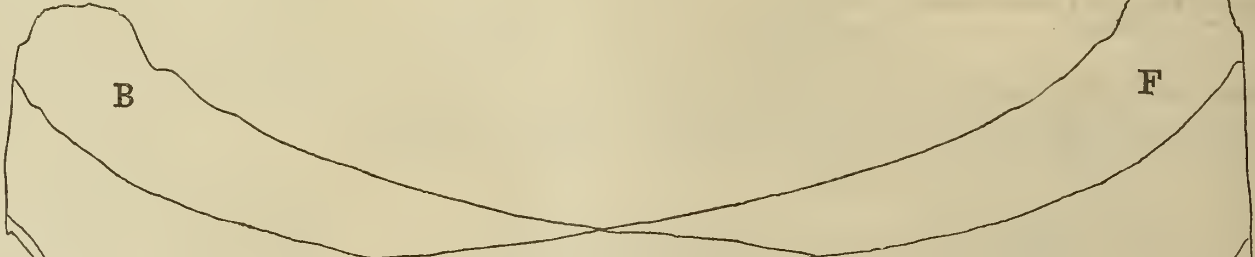
Dimensions and capacity as follows :

Lower Shell	60″ diameter × 15″ long	Upper Shell	48″ diameter × 16·8″ long	Ratio heating to grate surface	48·41
Tubes	95 3·5″ diameter	Heating surface square foot	1621·9	Water space, cubic foot	308·94
Necks, 4	15″ diameter × 12″ long	Grate surface square foot	33·5	Steam space, cubic foot	104·72

Duration of each test 5 days of 10·41 hours, and 1 day of 8·91 hours.

	GOODWIN'S TEST.								WILLIAMES' TEST OF THE TREMPER GOVERNOR.							
	MON.	TUES.	WED.	THURS.	FRIDAY	SAT.	TOTAL	AV'G.	MON.	TUES.	WED.	THURS.	FRIDAY	SAT.	TOTAL.	AV'G.
Pounds water	19536	21234	20852	20812	19327	18536	120297	20049·5	19301	19724	19691	20805	19781	17404	116706	19451
Average temperature	131·41	129·47	144·16	139·83	149·11	152·56	846·54	141·09	140·64	151·23	147.17	146·33	155·78	153·26	894·41	149·06
" height	3·61	3·59	3·47	3·40	3·59	3·78	21·44	3·57	3·20	2·90	2·86	2·52	3·36	3·10	17·94	2·99
Pounds wood	196						196		173						173	
Lbs. coal to raise steam	681	200	200	200	200	100	1581	263·5	500	200	200	200	200	100	1400	233·3
Lbs. coal from 7 A. M.	2252	2150	2100	2300	1900	1900	12682	2113·6	2100	1900	1900	2050	1800	1650	11500	1916·6
Pounds coal total	2933	2350	2300	2500	2100	2000	14183	2363·8	2700	2100	2100	2250	2000	1750	12900	2150
Lbs. coal per hour per sq. ft. heating surface	0·133	0·127	0·124	0·136	0·112	0·131	0·763	0·127	0·130	0·112	0·112	0·121	0·106	0·114	0·695	0·115
Lbs. coal per hour per sq. ft. grate surface	6·45	6·16	6·02	6·59	5·44	6·36	37·02	6·17	6·30	5.44	5·44	5.87	5·16	5·52	33·73	5·62
Pounds ashes	211	304	306	286	227	267	1601	266·8	406	348	370	351	280	351	2106	351
Pounds combustible	2722	2046	1994	2214	1873	1733	12582	2097	2294	1752	1730	1899	1720	1399	10894	1815·6
Evap. per lb. comb'tible	9·57	11·50	11·62	10·33	11·55	11·35	45·92	10·98	10.76	12·70	12·86	12·24	13·01	13.39	74.96	12·47
Evap. per lb. coal from 7 A. M	8·67	9·87	9·92	9·04	10·10	9·75	57·35	9·55	8.77	10·38	10.36	10.14	10·98	10·54	61·17	10·19
Water per hour per sq. ft. heating surface	1·15	1·25	1·23	1·23	1·14	1·22	7·22	1·20	1·14	1·16	1·16	1·23	1·17	1·20	7·06	1·17
Water per hour per sq ft. grate surface	56·08	60·88	59·79	59·67	55·41	62·09	353·85	58·97	55·34	56·55	56·46	59·65	56·72	58.30	343·02	57·17
Average revolutions	67·75	67·88	67·27	67·14	67·76	66·48	246702	67·38	67·69	67.96	67·79	68·12	67·92	67·32	248209	67·80
Per cent. speed realized	99·63	99·82	98·92	98·73	99·64	97·76	594·50	99·08	99·54	99·94	99·69	100·17	99·88	90·0	598·22	99·70
Average boiler pressure	65·4	64·95	65·04	64·86	65·31	64·52	390·08	65·01	64·09	63·80	63·59	65·59	65·18	65·36	387·61	64·60
Ave. temp. of boiler r'm	76·0	81·0	80·8	90·0	76·5		404·03	80·86	76·75	84·6	85·8	84·8	90·8	90·75	513·50	85·58
Ave. temp. outside	56·0	60·5	61·5	69·0	56·0		303·0	60·6	53·4	69·6	64·8	65·4	71·6	70·0	394·8	65·8
Maximum M. E. P.	22·93	23·96	25·47	23·56	24·81	21·91	142.64	23·77	20·14	21·8	23·18	25·25	21·51	20·04	131·92	21·98
Minimum M. E. P.	10·3	9·1	9·8	8·09	8·36	7·09	52·74	8·79	11·58	12·14	12·94	11·4	10·4	10·64	69·10	11·51
Mean M. E. P.	16·61	16·53	17·63	15·82	16·58	14·5	97·67	16·27	15·86	16·97	18·06	18·32	15·95	15·34	100·50	16·75
Maximum 1 H. P.	59·84	62·53	65·96	60·78	64·75	56·0	369·86	61·64	52·56	57·11	60·49	66·15	56·15	51·90	344·35	57·39
Minimum 1 H. P.	26·88	23·75	25·38	20·87	21·81	18·15	136·84	22·80	30·22	31·80	33·77	29·86	27·14	27·55	180.34	30·05
Mean 1 H. P.	43·36	43·14	45·67	40·82	43·28	37·11	253·38	42·23	41·39	44·45	47·13	48·00	41·64	39·72	262·33	43·73
Lbs. water per hr. per mean 1 H. P.	43·27	47·28	43·85	48·97	42·71	56·05	282·13	47·02	44·79	42·62	40·13	41·63	45·63	49·17	263·97	43·99
Lbs. coal per hr. per mean 1 H. P.	4·98	4·78	4·41	5·41	4·21	5·74	29·53	4·92	5·10	4·10	3·87	4·10	4·15	4·66	25·98	4·33

No. 1.



goes below the atmosphere, while on card No. 2 the minimum runs as low as 3½ pounds below the atmosphere. The clearance in No. 1 card is nearly 24 per cent., while the clearance in No. 2 card is only about 5½ per cent. You will also notice a difference in the cushioning of the two lines representing the maximum and minimum card, which is a very fine illustration of the difference in volume of steam delivered from each card. I also call your attention particularly to one of the best evidences presented of leak in a cylinder, as shown by indicator cards. This is the curving outward of the compression line. It is indisputable testimony as to leakage. Some (who pretend to know it all, but have hardly begun to learn) would tell you that the curved line, or little hook in the compression, was due to an instrument in very bad order, but you may depend that in every case where the compression is curved outward (and the higher the compression the shorter the curve with the same amount of leak) there is leakage into the cylinder. When the indicator is forming the compression line the piston of the engine and that in the cylinder of the indicator are coming slowly to rest. Naturally the same amount of leak shortens the curve. With a perfectly tight valve and no lead this curve outward compression line will be defined in every case. When there is no lead and a leak, in case the valve is late there will be added to the curved line a little hook. The later the valve the greater the hook, until it finally turns into a loop. In case of a leaky valve, or with lead, the curved line will be taken out of your compression and a square corner formed on the initial and steam line.

I want to call your attention to another leak which causes great waste. It is seldom detected and but little known. This is in the construction of the piston and rings of an engine. I know this has worried a great many, and it disturbs all calculations as to clearance and expansion curve, as much so as dry or wet steam. We all know the construction of an ordinary steam piston with three rings and a spider, and many have seen the rings fitting loosely between the piston and follower. Now, in every such case, there will be a waste of steam in proportion to the space *inside* of the piston. This loss occurs twice in each revolution, for the reason that the rings are pushed ahead by the piston in its travel. And of course in compressing on the opposite end, steam enters and is compressed inside of the piston as well as in the clearance space. You are unable to account for the small compression when you have measured the clearance. By putting lead on the valve you fill the center of the piston to a pressure equal to the initial, and while the piston is reversing its direction of motion you are losing volume, and blowing away steam into the exhaust at initial pressure. Many may have observed two exhausts at each end of the cylinder. The first puff is the regular exhaust; the second is caused by the reversed motion of your piston losing the compressed steam in the piston and blowing through. Of course this occurs in a very short space of time—only while the piston moves the amount of space between the rings and follower. The regular exhaust is generally in advance of the secondary. Leakage from this cause alone I have known to be 20 per cent. In another case, putting in a copper ring, taking off the lead, and no other alteration (I did not even set the springs out), made a saving of 1½ tons of coal per week, on a 16×36 in. engine at 65 revolutions, 80 pounds boiler pressure, using 8 tons of coal per week. This simple remedy of a copper ring, 1-32 of an inch thick, between the rings and the follower, saved the amount stated.

Another source of leakage in the construction of an engine, particularly in this style of piston, lies in the cylinder being counter-bored too deeply, or in the rings overrunning the counter-bore. Where this latter occurs to the extent of ⅛th of an inch, you will find the springs compressed sufficiently to blow steam between the rings and the cylinder unless you set the springs out very tight—too tight for running without the use of a great deal of oil. I have known cases where the piston overrun the counter-bore ⅝ths of an inch, and by simply making the valve very late, it made a great reduction in coal. These points named become more serious in low pressure engines, and we had a combination of these very leaks in this governor test. Besides the wasteful performance of the governor not controlling the speed accurately, you will notice a difference in the valve setting. In No. 1 card the valve is set a little late. In No. 2 card it has plenty of lead. In No. 1 card the cut-off is arranged as a cylindrical balanced valve, with three ports, admitting steam to the center of the valve. It is worked from the valve stem, raising the valve by means of a rocking bell-crank, and toe pieces hooking into the valve stem. These toes are released by a taper wedge, controlled by the governor balls. The point of cut-off is limited to a little over half stroke.

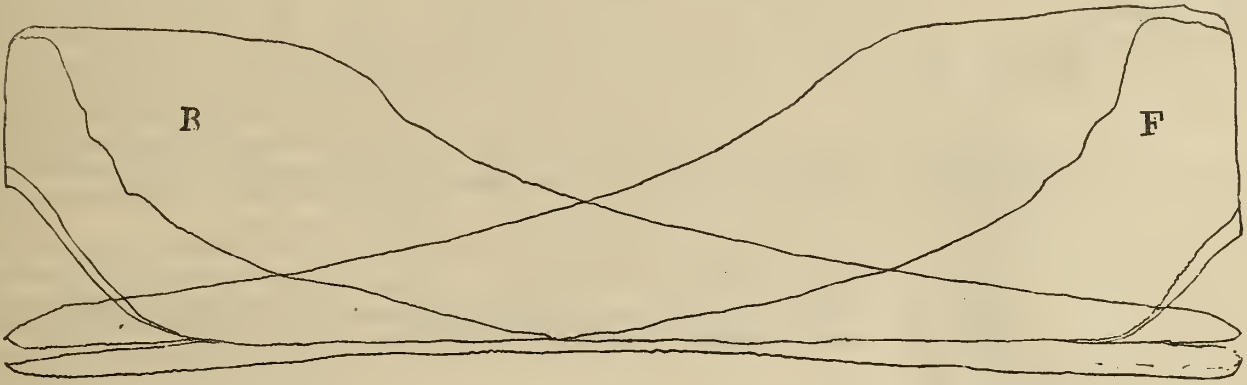
The opposing cut-off is worked on the back of a plain *D* valve. The cut-off valves are of the grid-iron type, and are hung from a pendulum worked from a cam on a small shaft running in time with the main shaft of the engine.

Another advantage the Tremper governor over the one tested against it is this: The latter valve has to resist the boiler pressure after the point of the cut-off which, of course, makes a very heavy running valve. The Tremper cut-off has only to resist the mean effective pressure in the cylinder, or, in other words, the same as an ordinary throttle governor.

I will give you a list of the percentage of gain as per tables, the advantages, direct and indirect, being wholly in favor of the Tremper governor:

	Per cent.
Water	2·98
Temperature	·865
Height	8·27
Wood	11·73
Coal to raise steam	11·44
" from 7 A. M.	9·30
Total	9·04
Coal per square foot of grate	8·91
Ashes	23·98
Combustible	13·41
Evaporation per pound	12·08
" " " from 7 A. M.	6·28
Coal per square foot heating surface	2·21
" " " " grate	3·05
Revolutions	·62
Boiler Pressure	·63
Temperature of boiler house	5·51
" " outside	7·90
Maximum M. E. P.	7·53
Minimum " " "	23·6
Average " " "	3·43
Water per I. H. P.	6·44
Coal " " " "	11·99

No. 2.



TUESDAY, MAY 15TH, 1883.

Boiler.	Pres.	Water.	Water.					Coal.	
Time.	Pres.	Height.	Time,	Gross.	Tare.	Nett.	Temp,		
7	65	3½	7	1445	295	1150	161	200	
7.30	65	4	8	1445	295	1150	152	250	
8	65	2½	8.30	1443	253	1190	156	250	
8.30	64	2½	9.15	1440	271	1169	156	250	
9	65	3	9.50	1443	330	1113	153	250	
9.30	63	3	10.30	1435	294	1141	161	250	
10	65	3½	11	1443	270	1173	158	250	
10.30	65	2	11.30	1445	300	1145	152	250	
11	66	2½	1 15	1455	264	1191	132	150	
11.30	68	3	1.40	1450	294	1156	154		
12	60	4	2.15	1450	287	1163	136	2100	
1	65	2½	3	1445	250	1195	156		
1.30	64	3	3.30	1452	285	1167	144	ASHES.	
2	65	3	4.10	1445	250	1195	142	348 lbs.	
2.30	65	3½	4.45	1450	288	1162	150		
3	64	2½	5.15	1484	300	1184	154	TEMP.	
3.30	63	2	5.45	1380	300	1080	154	B. H.	Outside
4	65	2½	....	....	....			66	55
4.30	58	2½	....	....	....	19724	2571	76	59
5	60	3	....	....	....			92	76
5.30	60	3	....	....	....	....	....	95	80
			....	....	....	....	AVE.	94	78
....	1340	61	....	....	....	....	151.23	423	348
....	AVE.	AVE.	....	....	....	....	....	AVE.	AVE.
....	63 80	2·90	....	....	....	....	....	84·6	69·6

Revolutions, 42,479. Average per min. 67·96.

(*Signed,*)
S. A GOODWIN,
N. W. WILLIAMES,
R. S. MILLER,

These percentages I have attached for you to compare. They are produced from the two columns of averages in the table. While the percentage is all on my side, I only claim as the result of the governor direct the percentage of revolution (which is ·62 of 1 per cent) 3·43 of 1 per cent. of horse power more work done, 6·44 per cent. less water to do more work, and 11·99 per cent. less coal to do more work. Considering the four items mentioned as percentage of gain for the governor performance alone would be 22·48 per cent. in favor of the Tremper cut off governor, I will present a transcript of the data of one day's test—Tuesday, May 15th. The tables above are the result of 12 of these cards (120 double indicated cards traced 68 times on each end). Signed by the other party, myself and R. S. Miller the engineer in charge.

I hope by an examination of the tables and data, and the reasoning of cause and effect, that you will find something of interest to you and your employers. In that case I shall feel amply paid for my trouble.

THE
Mechanical Engineer.
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 Nassau Street, New York.

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Entered at the New York Post Office as Second-Class Matter.

We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

EXPLANATORY.

The very large amount of live matter in this issue of THE MECHANICAL ENGINEER compels us to omit many engravings and the serial, "*Foundry Practice as Allied to Pattern Making.*" We need not direct our readers' attention especially to the articles; they will be seen readily enough. "*The Famous* 100" on this page is the first authentic account of a new steam yacht which is a marvel of speed. "*American Locomotives in English Colonies*" is by a well-known mechanical engineer. Mr. Goulding's paper read before the Chicago Society carries its own certificate. The report of N. W. Williames on cut-off governors, and B. F. Isherwood's lucid explanation of the difference between the weight of water vaporized in the boiler and that accounted for by the indicator, comprise a series of papers never before equalled in value in one issue by any technical journal.

SINCERE FLATTERY.

Imitation, says the proverb, is the sincerest flattery, and since this is supposed by some to be the homage mediocrity pays to talent, we should be grateful to the *Scientific American* for its efforts in this direction in our behalf. We are not responsible for the expression "mediocrity pays to talent," for it is not our own. Some sage originated it and it floated on to our pen, just as our contemporaries' views upon lathes floated out of our columns into its own, without, however, any acknowledgment on its part that its inspiration was derived from that source. There is too much of this sort of thing extant. Some scribe short of brains and topics cons his neighbors columns and steals his ideas, putting them into his own language, but often so distorted as to fact that the grossest errors are made. Simple, transparent, commercial honesty, of the every day kind, provides a remedy for this, and it is so easy to put in practice that it should be, universally. We subjoin an example of what we refer to; our readers can judge for themselves whether our charges are warranted or not:

From The Mechanical Engineer of Feb. 3d, 1883.

THE UNIVERSAL TOOL.

If one had to carry on the machine business with small means, he could get along very well with a lathe and vice bench only. That is to say, there are few jobs in a shop that cannot be done with these simple tools. The lathe will not only turn work, but it will supplant the planer, the milling machine, the bolt cutter and the gear cutter, for many of the jobs usually done in these several machines, can be done in the lathe. Where work can be held in a chuck it can be faced off to a flat surface much quicker, and quite as accurately, in a lathe as on a planer. Take a slide valve for example, and where it can be gripped readily the lathe will face it up true before the planer will, for equal surfaces. This, for the reason that the valve can be set more quickly in the lathe, is constantly under the cutting tool, and can be run at a higher speed. A lathe may be called a circular planer, with the advantage that it can do other work that the planer cannot. When it comes to cutting gears, if a lathe is provided with simple fixtures having an index plate, (such as the centers used on a planer for instance) the finest work in this class can be done. A gear cutter is nothing more than a special machine, with a revolving spindle, and a wider range of capacity than the lathe.

* * * * * *

From the Scientific American, July 21, 1883.

THE LATHE.

* * * * * *

Take a single instance of its capabilities, the production of a screw tap. The lathe will cut a piece from the steel bar; it will drill its centers and countersink them; turn the tap, whether straight or taper; cut the thread on it; score the tap, either by a cutter in the tool post while the tap is suspended on the centers of the spindles, or by means of a rotary cutter or milling tool on the spindle centers while the tap is held on temporary centers on the tool carriage. Even the top end of the tap can be squared, by similar means, for the reception of the tap wrench.

Now, all this work represents the cutting-off machine, the drilling lathe, the turning lathe, the screw cutting lathe, the planer, or the milling machine. And unlike many combination tools, the lathe can be made to do all this work well.

With a cheap attachment the lathe can be made to cut gears, making the teeth with practical accuracy, and the lathe itself can be used to produce the index plate that insures this accuracy. A job of planing—or surfacing—where the work will swing in the lathe, can frequently be better and quicker done on the lathe chuck than on the planer platen. The rapidity is much greater because the surface to be worked is continually under the action of the tool, instead of having more than one-third of the time wasted in the running back of the platen for the return chip.

In short, all the other machine tools, either of a rotary or reciprocating character, are simply modifications of the lathe; and with the lathe and its convenient appliances and necessary tools, the mechanic can by the exercise of his taste and skill perform almost any ordinary job in the working of metals possible on machine tools. The possession of a screw-cutting slide-rest foot lathe and a common bench vise, with their accompanying hand tools, is an excellent outfit for the amateur.

Our contemporary is quite welcome to take our ideas and use them in this way if it approves of them, but unless we are prejudiced we do not think it has bettered them. If it had copied our article entire, with the proper credit of course, it would have given its readers as much information in a more honorable fashion.

SIGNALS.

There can be no question but that the average locomotive engineer views with apprehension any signal which depends upon machinery, in whole or in part, for its action. As one recently said to us: "Relying upon the fidelity and watchfulness of a man is bad enough, but when to this is added the possible failure of some machinery or automatic device to work, we have grounds for anxiety. A man with a flag of any color is a positive certainty, for if he is not present something is wrong. If he displays the wrong signal the responsibility is his; but the probabilities are that the man will do the right thing in ninety-nine cases out of a hundred." This view is from the driver's standpoint, which is, without doubt, a good one to consider the matter from.

THE FAMOUS "100."

THE HERRESHOFF MANUFACTURING COMPANY'S LATEST ACHIEVEMENT.

The steam yacht "100," built by the Herreshoff Manufacturing Company, of Bristol, R. I., has won for herself, in the two months which she has been afloat, a reputation for marvelous speed, such as has not been enjoyed by any steam yacht that has preceded her, whether built by the Herreshoff's or any other builder.

The "100" is not a launch, torpedo-boat, or anything that could be styled a simple speed-machine. She is a yacht, in the fullest sense, and can make an ocean voyage as long as her fuel will carry her. The steam yachts *Atalanta, Radha, Stranger* and *Corsair*, and a number of smaller and unimportant pleasure craft, have been met and beaten by the subject of this article.

The steamer *Mary Powell* is the only vessel that can boast of a victory over the "100," and that was dearly bought, only four minutes in a run of twenty miles, and we understand from Mr. Herreshoff that he has exceeded the conditions which existed when he was in trial with the *Mary Powell*, and were the two boats to meet again the result would probably be different. But the *Mary Powell* is a river steamer over 250 feet long and having a 76″ × 12′ stroke beam engine, so that the odds against the "100" in a competition like this are very great. The "100," be it observed, ran mile for mile against a vessel very many times larger and more powerful. In time allowance for difference in tonnage she beat the *Mary Powell* out of sight.

The attention attracted by this swift "100" is widespread, and as many of her equipments have special interest to critical readers, we have been at great pains to lay before them a full and correct description of her.

The "100" (that being the number of steam vessels built by the Herreshoff Manufacturing Company) was launched in the early part of June last, and for three weeks was used by a Board of Naval Engineers, headed by B. F. Isherwood, Esq., to determine the economy of her machinery, and test her speed and general qualities. By a carefully conducted series of experiments it was found that a horse's power developed for one hour, required only twenty pounds of water, and the consumption of $2\frac{1}{4}$ pounds of coal, and that the maximum speed was 19·27 miles per hour.

The dimensions of the "100" are as follows: Length on deck, 100 feet; on the water, 94 feet; width, $12\frac{1}{2}$ feet, and depth 5 feet. Her frame is of bent white oak, set 15 inches from centers; the skin is double, the inner being $\frac{5}{8}$ths inch thick, arranged diagonally, the outer planking is $\frac{7}{8}$ths of an inch thick, and laid in the usual direction. The deck is of pine, above which the deck-house, or trunk, is raised two feet.

She has a schooner rig with setgaffs. There are four complete bulk-heads of iron, which divide the vessel into five water-tight compartments, rendering her as safe as possible in the event of a collision or other accident, where the skin may have received "a solution of continuity." The main saloon is reached from aft, and is 18 feet long, with transoms and berths at the sides. Forward of the saloon are two state-rooms, with a dressing-room opening into each. The entire saloon, with state-rooms, is finished with mahogany, polished and highly varnished. The upholstering work is of the best material, and is specially selected with respect to durability and comfort.

The all-important machinery is situated more forward than is usual in yachts, and has points of interest which are new, and for which letters patent have been issued to the inventor, N. G. Herreshoff, Esq. The engine is of the compound, condensing type, and has cylinders 12 and 21 inches in diameter, each 12 inches stroke of piston. The cylinders are wholly surrounded by the steam-chests, which serve also as jackets. The valves, which are annular in form and completely surround the cylinders, allow very large port-opening through which the full boiler pressure passes with perfect freedom to the piston. Motion is given to the valves by a peculiar arrangement, by which perfect distribution of power is imparted to all parts of the valve. The Stephenson link is used in reversing.

The cylinders, with their enveloping steam-chests, are supported by steel standards, 4 to each, giving the engine the general appearance of those used in torpedo-boats, which are intended to give a maximum of available power with a minimum of weight.

The two air and four feed-pumps are connected directly with the engine and receive their motion through a side lever. The condenser is inside, and has 500 ½ inch brass tubes 30 inches long. The refrigerating water is driven through the condenser by novel means, there being an adjustible scoop outside which catches the water as the yacht acquires motion and forces it through the condenser, escaping by means of a second scoop when it has done its work.

The engine weighs complete forty-five hundred pounds, and exerts, at a maximum speed, about 350 horse power. The shaft is of compressed steel, 3 inches in diameter; the screw is of bronze, having a diameter of 45 inches with a pitch of 100 inches; it is turned at a rate of 320 per minute when the yacht is at full speed.

The boiler is one of the Herreshoff coil, with a grate 62 inches in diameter. With natural draught 60 pounds of boiler pressure can be maintained, giving a speed of 15 miles an hour, but when it is wished to exceed that figure the blower is brought into requisition, the engine room closed, and an air pressure equivalent to 2 inches of water is maintained.

Altogether the "100" presents a new departure in marine construction, each and every part of which has been the subject of special study by the builders. The hull and machinery alike are the direct outgrowth of years of carefully conducted experiment to determine the best form and distribution of material. Such is the science now employed in the construction of these steam vessels, that the Herreshoff Company are about to contract to build a yacht that will make 23 miles an hour, or 100 miles in 5 hours. It is to be hoped that this speed will be realized. The builders fully merit all the successes they have won.

CONDENSATION AND RE-EVAPORATION.

When live steam is let into a cylinder of a steam engine at work its pressure is expended in moving the piston, but in so doing it loses heat which in a measure is absorbed by the water of the cylinder and the piston itself. In parting with heat it condenses and deposits on the walls of the cylinder a certain amount of moisture, this is afterwards, to some extent, re-evaporated by the heat of the cylinder. A most interesting paper on this subject will be found in another part of this issue and should be carefully read by all engineers, as it makes the matter very plain, and will be useful to many who have not been able to grasp it previously.

THE MODERN STATIONARY ENGINEER.

The stationary engineer of to-day is a great advance upon his prototype of a quarter of a century ago. He reads and thinks, and demands the reasons for certain effects. He will not tolerate mysteries, for he has learned the connection between cause and effect. The result is to the advantage of all concerned. The employer is better served, and the engineer's standing and individuality is raised infinitely; or just in proportion to his efforts to rise. A spirit of inquiry is aroused, and the truism that knowledge is power has some meaning.

Years ago a man who was conversant with the indicator and its uses ranked but little lower than the great teachers of our profession, now the instrument is a familiar friend in every well ordered engine-room. It is the arbiter of questions that before were answered by guesses.

Moreover, the stationary engineer has changed his reading, and instead of blood and thunder tales, and literature of a baser sort, he is familiar with the poets, and can quote appositely, as Mr. Gouldings thoughtful paper in this issue shows. "Who would be free himself must strike the blow," and the new dispensation which just now attracts all thoughtful men of our trade is to acquire freedom through greater knowledge of all things affecting us as men.

> "The wish to know, that endless thirst
> Which were by quenching is awak'd,
> And which becomes, or blest or curst,
> As is the fount whereat 'tis slak'd,
> Still urged me onward, with desire
> Insatiate, to explore, inquire."

Thus said the poet Moore, and his sentiment is to-day echoed in many shops and engine-rooms. What limit shall we put to the progress we may make? There is no limit. So long as the present desire for more light continues we shall continue to rise.

BOOK NOTICES.

Dio Lewis's Monthly, New York: Clarke Bros., 69 Bible House.

We have read carefully the first issue of this new venture in periodical literature, and it gives us pleasure to say that it is exceedingly promising. Dio Lewis is well known as a writer and a physician, and though he sometimes seems a little tinctured with egotism, and prone to look upon his efforts to do what he can for the benefit of his fellow men as entitled to special mention, he is sincere in his convictions, direct in his dealing, and lucid in his explanations of the ills mankind suffer. Dio Lewis's monthly is a popular magazine treating chiefly of the human body, whether mentally, morally or physically ill; it is far removed from the pragmatical, you-must-do-as-I-tell-you style common to many such ventures. It discourses in a readable vein of the sources of ill health and tells the reader what he must do to preserve good health; on these points it will undoubtedly be an authority, and we hope to see it meet with a wide support. It is handsomely printed on uncalendered paper, in bold type, and contains a large amount of reading matter. We should like to have our readers send 25 cents for a sample copy; they will get fully the worth of their money.

* * *

Dynamo-Electric Machinery. A series of lectures by Sylvanus P. Thompson, B. A. D. Sc., M. S. T. E., Professor of Experimental Physics in Universal College, Bristol. With an introduction by Frank L. Pope, M. S. T. E. New York: D. Van Nostrand, Publisher, 23 Murray and 27 Warren Street. Price, 50 cents.

In noticing this work we cannot do better than quote a portion of Mr. Pope's introduction, for he has put the matter very tersely and clearly. He says:

"While the Dynamo-Electro machine has, within a comparatively short period, achieved a most wonderful development in connection with the rapidly increasing application of electricity to the useful arts, yet the essential principles of its construction and operation appear to be but imperfectly understood, even by otherwise well-informed electricians.

"The great value of Professor Thompson's work, especially to the student and investigator, is mainly due to his masterly power of analysis, as shown in his method of logically grouping the various dynamos in connection with certain typical forms, each possessing characteristic individual elements, which are readily comprehended, and when once fixed in the mind, are instantly recognized wherever found. Hence, any existing machine, or any new machine which may hereafter appear, may be at once referred to its proper type, and the essential features of its organization compared with those of its rivals or predecessors.

"The present series of lectures, like all the productions of its eminent author, are characterized not only by a thorough mastery of the subject, both in its theoretical and practical aspects, but by a felicity of classification, and a conciseness and clearness of statement and illustration, which literally leaves nothing to be desired. It forms a work which will be found alike indispensable to the educated electrician, the student, the inventor, and the intelligent mechanic or apprentice."

THE PROFESSOR IN THE MACHINE SHOP.

NO. XXXIX.

It is high noon of the year, and business is rather at a low ebb. Beyond the necessary repairs which are always coming in in large and small lots, there is nothing going on, and I do not know that I am particularly sorry that it is so. Men cannot drive and rush about with the mercury in the nineties, and it is a good thing that with us, at least, there is no occasion to. This is the time of slow speeds and fine feeds, and Jacob is conveniently blind. He has the happy faculty of not seeing things there is no occasion to see, and if a planer-man runs three or four inches over his work on both ends, and takes only one tooth at a time on the feed, he makes no remarks. It is too hot, and there is no hurry. A man cannot do any more than there is to be done, and Jacob and I both think that if work is slack there is no occasion to put what we have through, might and main, and then sit down and wait for, or try to drum up, business out of season.

The boys fall in with these views with great alacrity, and nurse their jobs beyond all belief. If a man wants to see the infinite minuteness in cut and feed a lathe is capable of he should visit a country machine-shop in hot weather, when there is little work on hand.

I cannot say that we arrived at this philosophical state of mind—that is, taking things easy—without some tribulation by the way. Foreseeing that work would be slack during the summer, we talked the matter over, and took counsel as to what we should do. Jacob had an idea that if we advertised for work we should get it. He said that there was always something going on in large places; that we were in an eddy, and out of the current; that if we wanted business we must stir it up. I assented to this, but put in the remark that in the large cities there were probably a good many in the same condition with ourselves, who were on the spot and would be able to pick up all that was going. There were doubtless some enterprises on foot, but they were snapped up quickly by persons on the watch for them; and, lastly, that I did not believe we should catch any fish at this season by advertising for them. He overruled me, however, and I consented to put an advertisement in a New York daily paper to the effect that we would build new machines on royalty, or for cash, at reasonable rates; but I did not expect it would result in anything. In fact, I did not believe it would be noticed. In this I was at fault. We had many inquiries by the very next mail after the appearance of the advertisement. Some of these were curious epistles, and I copy a few of them to illustrate some phases of human nature. There are some men who are so fearfully and wonderfully made that they cannot understand that any one can see through their shallow devices. I don't blame a man for being sharp and driving the best bargain he can—that is business; but that a stranger, whom I have never set eyes on or heard of before, should take me for a natural idiot is unreasonable, to put it mildly. Here is a sample of the chap referred to:

New York, July 7th, 1883.

Messrs. Moulton & Hess,
Bungtown :

Gentlemen:—Seeing your advertisement in the New York ——— of the 20th ult. that you would make small machinery on royalty, I have to advise you that I have patented an improved dog's muzzle, (?) which is very saleable, and will be very popular. This is just the season for it, and I would like to have you put in hand four thousand dozen at once. The sample sent by this mail will give an idea how they should be made, but it is not exactly right in some places. I want the bridle that goes over the jaw made out of No. 18 wire, so that it will cut the dog's jaw if he goes to open it too far, and I want the side lappets made out of red leather, so as to look somewhat ornamental. If you will undertake this job I will give you twenty per cent royalty on all sales of goods as fast as made, and ten per cent. additional if you will act as local agent in your county, on such sales as you may personally make. All cash to be forwarded me at once, less your commission. Your respectfully,

Isaac Littlewit.

When I had read this curious epistle I laughed some and handed it to Jake, saying: "There's your advertising scheme."

Jake read it and said: "Oh! he's a crank. Of course, we will get some such answers. What do the others say ?"

"I haven't read them yet," said I. "Here are some. Read and see."

He opened one at random, and read out loud as follows:

NEW YORK, July 10, 1883.

Moulton & Hess,
Bungtown :

GENTLEMEN:—We have seen your ad. in the ——, asking for machines on royalty. We have a new patent cut-off for steam engines, which we want built and introduced. Supposing you to be acquainted with steam engine work, we make you the following offer:

We will give you twenty-five per cent. commission on all engines you may fit with our cut-off, we to find patterns, drawings, cost of material, labor, and all necessary and useful expenses to introduce the same. Understanding that you are in the center of a manufacturing district where there are vast numbers of steam engines employed, you will see at once that this affords an opportunity for a speedy return, as well as employment through the dull season. Yours truly,

WEASEL & CO.

"What's the matter with that ?" said Jake. "It looks like business."

"It don't to me," said I. "It makes me vexed to receive such a letter as that."

"How so ?" said Jake.

"Why, what do 'Weasel & Co.' take us for ? Who are they, anyway ? Their letter-head is simply printed, with no indication of who they are or what their business is, or anything about them. They talk as if we had some interest in their cut-off, and as though we had simply to go out and collar the first steam user we met, and say: 'Here; we are going to put this cut-off on your engine to-morrow, and don't you forget it!' We repeat this all over the county, and in a year we have put in fifty cut-offs—perhaps made twenty-five per cent. commission and cost of labor beside. That looks very probable, don't it ?"

"No, it don't," said Jake.

"Further, these men give no references, offer no guarantee of payment, or say the first word respecting their status. It looks very likely, don't it, that we would go into any such scheme as that ?"

"Well, we must take some chances in trade," said Jake. "We can't get something for nothing."

"We take ordinary business risks, no more and no less; every concern must do that. But this is not a business risk—it is the scheme of an adventurer who throws out his little bait for fools to bite at. An ordinary business risk is when a man, or a firm, is in good standing, doing a good business, and by general report and common knowledge able to pay for what he or they order. No firm in good standing would write such a letter as Weasel & Co. do. They would have more courtesy—which last is a mighty scarce article in some quarters. Read another letter, Jacob."

NEW YORK, July 12th.

Messrs. Moulton & Hess,
Bungtown :

GENTLEMEN:—Seeing your advertisement in the —— —— of the 20th, I have to advise you that I wish to have a machine of a certain description built at once. I will order one dozen to begin with, and if it turns out as I expect, will order 500 more at once. I have not much money, but I will pay for the first order on delivery at railroad in your place, on receipt of bill of lading, stating that same is on the way. My references are Messrs. Cash & Credit, Slagtown, whom you may know. Yours, etc.,

JOHN SMALLCASH.

Jake looked rather dubious over this, and laid it away without any remarks. I made some, however, as follows:

"This is evidently an honest, straightforward man, who means what he says, but we can't do anything with him, for all that. He is evidently a person who is flying a patent for all it is worth, and with no money or means to back it up. He fancies, with thousands of others, that he has only to conceive an idea, put it into the form of a machine, and turn it loose on the market, when all the world will fall over things in their haste to buy it. He does not know whether there are one, or one hundred machines just like it, perhaps far better, now; but, simply because the idea is new, and good to him, he thinks his fortune is made. If he could only get a few machines in use all would be plain sailing. They would demonstrate their advantages themselves, and he would be unable to supply the demand. Men of this class deserve sincere sympathy, for they are sure to be disappointed. They go into a transaction on the strength of their dreams, their hopes, and they risk all they have in the world upon a delusion. I say delusion, because, in most cases, it is just that. A poor man is in no condition to undertake the introduction of new devices. He does not understand the methods of business men, for one thing, and he lacks pecuniary resources to forward them. The only thing he can do is to put it into the hands of some reputable man, or firm, who have all the facilities needed, and there are many such people everywhere."

"Well, you were right about the advertising, anyway," said Jake. "These letters are all humbugs, every one of them. We can't get any business in that way."

"Not in times like the present. When there is more work going than there are shops to do it we might; but when there ain't enough to go round we catch only the drift that floats up and down with every tide. There are times and seasons in trade, as there are in the productions of the soil, and we can no more get business in slack times than we can hasten the coming of the fall."

WANT OF CARE DOES MORE HARM THAN WANT OF KNOWLEDGE.

BY H. J. GOULDING, ESQ., C. E. CHICAGO CABLE R.R.

A Paper read before the Brotherhood of Stationary Engineers, No. 1, Chicago, Ill., July 16th. 1883.

MR. PRESIDENT AND GENTLEMEN:

In a city just a thousand miles from here is a manufacturing establishment which, could you visit and inspect its mechanisms and rules of order, you would pronounce perfection. Across the end of the largest room is a sign 50 feet long, with these words in large letters upon it—"WANT OF CARE COSTS US MORE THAN WANT OF KNOWLEDGE." This is true everywhere. Every broken rod, every exploded boiler, almost all disasters of every kind, can be traced to want of care one hundred times to want of knowledge once.

One of the objects of this Association is mutual improvement and instruction. Our best friends are those who tell us of our faults. The best preacher is he who shows us and rebukes our sins. Our object this evening is to try to improve ourselves, as a class of men engaged in a business that demands, and ought to have, earnest thought, constant care and diligent study. These requirements can be found only in a man of sound mind, good morals and good health.

These qualities in their turn are the outcome of good habits, pure air, the proper amount of work and rest, mentally and physically, and total abstinence from all that can injure the noblest work of God—man.

Our subject for this evening then, instead of being strictly confined to steam engines, might be entitled, "*Ourselves and Our Engines.*"

1st. To ourselves, permit me to say that while many of us are careful, thoughtful and attentive to all the needs of the machinery in our charge, we are not so careful of ourselves. That wonderful piece of mechanism called man, is "Fearfully and wonderfully made." In view of this fact, how dare we do any violence to such valuable machines?

An examination of many of the engine and boiler rooms of this city would reveal to us much that is uncomfortable and positively unhealthy, yet we find many men compelled to spend the working hours of their life in these places, while the owners of them would not let his horse, or cow, stay one day, for fear of damage to them. To resist this damaging influence, we need to fortify on every side and appeal, as often as we can consistently, to the owners to better our condition.

In doing so, we must always be sure we are in the right. We should be careful to be known as doing all in our power to preserve our health and prolong our days, so that when we ask for improvements in our engine and fire rooms, for health's sake, the charge of inconsistency cannot be made, in that we are injuring ourselves more by the use of narcotics and stimulants than the location of our engine room is doing.

Regularity in all our habits of life is essential to us as a class. It surprises people from the east to see how little sleep many men take in this western country, especially engineers—mostly on railroads—but as well in all branches of steam engineering. This is shortening the days of many valuable men, and we should use our influence to prevent those men going on duty in such responsible places who have not had a proper amount of sleep and rest.

It is said that our insane asylums are being filled more rapidly than ever before in the history of the world, by the noise in large cities. The incessant roar and rumble of commerce over the pavements, the jingle of bells on locomotives and street cars, and above all the incessant and *infernal* blowing of steam whistles on shops, factories, steamers, tugs and locomotives, gives no rest, day or night, to at least three hundred thousand of the tired and worn-out people of this city. Is it any wonder that some die or go crazy?

Picture to yourself a poor woman who has worked hard all day, and finds herself at night with a sick child or perhaps a husband. The doctor has just called, and his last words were, "He *must be* kept quiet or he cannot live." The weary wife tries her best to have perfect stillness. Teams are off the street now, the noisy children have quitted the sidewalks, and she hopes and prays that sleep may come. At last he rests, and her hopes are bright that he, who is her support and comfort, may be spared to her yet. Just then some bridge-tender or switchman is needed, and the man on the tug or locomotive cannot wait one instant; he opens his whistle, and blows a blast long and loud and oft-repeated. The sick one is startled, wakened, frightened, and sleep will no more visit his eyes that night, nor health his body.

It is not exaggeration to say that hundreds are sent prematurely to the cemeteries, and asylums are being filled by the *needless* use of steam whistles.

As engineers, having those noisy, useless, aye! worse than useless, things in charge, let us think and care for the sick and the dying, and use them as little as possible.

WANT OF CARE IS EXPENSIVE.

After years of trial and much expense in efforts to make a smoke-burner (so-called), we find that the best of them need, and must have, good care which, by the way, can be had at a fair price. Just here is where want of care is costing more than want of knowledge. We all know what is right, but how many care to do it?

There is nothing more annoying to engineers and steam users than the smoke-consuming subject. It is a very important one also, and to shirk it is a want of care; to attend to it involves care, close application, study, thought, and experiment. Engineers should do all this and they can and will develop some means of ridding the city of a nuisance and themselves of annoyance. The exercise of care leads to a better knowledge of how to do whatever we have in hand.

Of our engines I hardly need speak, nor do I feel competent to do so. Experience teaches us we must exercise great care, or we have great trouble. There is one point I will speak of: There is a tendency among us, brought on by a desire to be very economical, to cheat our engines, especially the cylinders and valves. There are no doubt as many cylinder oilers to-day as there are smoke-burners, and the great object of them all is to save. It is a question with many whether the oil saved in all cases compensates for the power lost, and the increased repairs made necessary by too close economy. In this investigation, thought, study and care will be found valuable.

CARE IN THE SELECTION OF MACHINERY.

Almost always when works are to be erected where steam power is to be used, engineers are consulted as to the engine and boilers to be required. Great care, much study, experience and great *integrity* are needed in giving advice upon that subject. We are of those who do not admire complications, but believe in simplicity. That engine or boiler which does the most and is the least in all the parts, joints and pieces to be looked after and repaired is our choice. Taste and beauty are not to be lost sight of, other things being equal. A noted preacher of this city once said that in all our rules of conduct and acts of life, we should ask the question: "How will this act of mine, or this rule of conduct affect me or mine twenty years from now?" How important it is then in the selection of engines, boilers or any kind of steam machinery to ask ourselves the same question. Especially so in advising others, for those of us whose advice is followed are never forgotten. Let us be careful in such matters so that we may be remembered in a satisfactory way. I know the tendency of the times is to advise this or that device, according as the party can make the most money by so doing. This is not the highest or best motive that can inspire a man. Steam machinery is in the nature of edge-tools to very many, and great circumspection should be used in its selection. Let us strive to be so careful in this matter that our advice may be profitable to owners, and safely followed; faith in it felt and practiced. Thus shall we become masters of the situation.

Want of care costs many engineers their situations, and their employers much loss. "Lookout for the dimes; the dollars will take care of themselves," is true in a large sense in the use of steam as a motive power. It is not so much whether the parts of our engines are too large or too small (leave that with the builder), but whether two pounds of coal are consumed where one would suffice if the ash-pit opening was right, or the chimney damper properly adjusted. It is not so much whether the fly-wheel is too heavy, or too light, as it is whether the dirt on the flues, outside as well as in, is too thick.

It is well enough to know the first, but not to know the last and remedy it, is a fault of ours, and a loss to our employers, who are entitled to our best efforts and abilities.

Want of care in our speech and actions may not cost our employers money, but how very often are we judged in all our qualifications by our manners and treatment of others! How often opportunities for getting information from others are cut off by neglect on our part to be courteous, and put ourselves out a little to make things pleasant for others. Much, very much, can be learned in conversation with others, but to get them into that line whereby we may profit requires care. Improved opportunities for culture in engineering, by books and papers, have become numerous now, and much that is valuable may be had cheaply. But care is to be exercised in this, even, for we can see by the daily press that paper will not refuse ink, and an untruth, or a false theory, is as easily printed as the truth.

IMPROVEMENT OF TIME, OUT OF, AS WELL AS IN, WORKING HOURS.

To do this to the best advantage requires great care, and the want of it is very expensive to us.

"Could a man be secure,
That his days would endure
As of old, for a thousand long years,
What things might he know?
What deeds might he do?
And all without hurry or care."

"But we that have but span-long lives, must ever bear in mind our limited time for acquisition. And remembering how limited this time is, not only by the shortness of life, but still more by the business of life, we ought to be solicitous to employ what time we have to the greatest advantage."

"Care for the moments, the hours will care for themselves!"

There are so many short intervals of time each of us have that go unimproved because they are so short! A little *care* will utilize these short intervals, so that each one of them may bring to us some new light, or better thoughts than we had before. Ideas are not floating in the air but are the products of the brain. Thoughts, reading, conversations, meditations, are the activities by which the brain is made productive of ideas.

Were I to outline a course of thought for others, it would be somewhat after this line:

1st. Ourselves; because "self-preservation is the first law of nature." The proper amount of care and thought for self, to provide all needed comforts and means of preserving and prolonging this life in this world, for this is the best world we have ever seen.

2d. Our thoughts should go out spontaneously and loyally to Him who made us and this beautiful world He has placed us in. Grateful for all His love and mercies to us, let us give space in the hours for thought on this subject.

3d. Our business, or our employer's interest. On this I need not dwell. Did I need to prove that you are faithful to your trusts, I would cite the long years many of you have been in the service of the same parties.

4th. Our fellow-men. How *best* to show affection for and do good to our fellow-men is beyond me to answer.

I believe that a man has a right to follow his inclination just so far as he means to do right—*no farther*. I also indorse the sentiments of our National Preamble, that "all men have a right to life, liberty and the pursuit of happiness." The right to life with us means to work for it, and the right to liberty means to work when, where, for whom, and for what compensation we choose. Therefore, to interfere with that right is to go back upon the fundamental principles of a republican form of government. So, if any man, or body of men, says to you or to me, you may or you may not work for this or for that, my reply will be: Hands off! There are a few things in this life that come strictly under the head of my own business, and that is one of them.

Associations for mutual benefit, improvement and instruction, such as the church, schools, colleges, Odd Fellows, Masons, etc.—to all such I say God-speed! But when any of these undertake to control those acts of life by which a man is to obtain sustenance for self and loved ones, he himself must be free to act, so far as is consistent with the laws of government and society, according to his own judgment and without any interference from others. This is true, also, in the distribution of capital, or its employment by its owners.

So I can express this whole matter in no way so briefly as by saying, "Do unto others as you would that they should do to you." This applies to capitalists as well as laboring men.

Our fellow-men can be served and benefitted by us, by our being good citizens. To be a good citizen of any community is commendable, but to be such in this city is needed much. The duties of a good citizen are many, and to discharge them rightly at all times is to be ever on the watch, and to have the Golden Rule ever in mind. It is to be hoped that in the future some of the professions, businesses, trades and industries that make this city great may be represented in the different branches of the city government, where one influence only is now felt, and that the most baneful and destructive of all. If that day should ever come, we should be prepared to assume the duties and responsibilities of good citizens, and do what we can to make this city great in more and better ways than it now is. We must rise above *self* to do this.

I believe it was Henry Clay who said he would rather be right than be President. So let *us* say we had rather be right than be rich. The eagerness to be rich, which is consuming our manhood, is not good for any community. Let us get above that, and in our efforts to serve our God, ourselves, and our fellow-men, remember, "*It is not all of life to live, nor all of death to die.*"

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SOME THOUGHTS ABOUT STEAM BOILERS.

A query of much importance is, how shall we construct steam boilers to get the highest evaporative results from a pound of coal, and what elements in the setting and management will contribute to their life and safety? Many, in order to procure more economical results, have added some dangerous features in their setting and designs of boilers, which conduce to shorten the life or time they will need repairs, explosions being considered by many occurrences to be expected rather than prevented.

Perhaps no type of boiler is absolutely exempt from mishap, however well designed or constructed, even when mounted with all modern appliances for safety. Many appendages we find on boilers detract from the object intended.

Some assert that there is an increase in the number of boiler explosions. If this were true it would be a disgrace to American engineers. No doubt explosions are more frequent now than formerly; but, when the number of boilers in use are taken into consideration, the percentage is on the decrease.

Can we not transfer more of the heat given out from coal (during combustion) into the water and retain this heat better by giving more attention to losses which occur at the boiler, namely, condensation and radiation? Our furnace walls are not made of non-conducting materials, and combustible gases escape to the chimney unburned.

Years of practice with steam boilers have demonstrated that poor circulation has been the cause of many serious disasters, and the ruination of innumerable boilers; yet to-day we see many with cramped water spaces and tubes so near together as to prevent even an approximation to free circulation. It is expensive to run such boilers, and the results are wet steam and extra expense for repairs.

There are many boilers in daily use that consume from ten to twelve pounds of coal upwards to evaporate one cubic foot of water. This loss, however, cannot be wholly attributed to dirty boilers, poor circulation, or imperfect combustion, but the general construction of the plant is at fault.

Rapid changes in temperature are probably the most significant injuries that boilers receive (excepting unequal expansion). Consequently no boiler should be blown out with pressure, but should be allowed to cool gradually for several hours until there is no pressure within. Then allow the water to run out, and no serious effects will ensue.

Locomotive or portable boilers, are less liable to injury by blowing out than by pressure immediately after the fires are drawn, but the results are rapid and unequal cooling of the boiler, whilst boilers set in masonry are liable to serious injury from hot masonry. Much has been written on this subject, yet in many instances it has not been heeded.

If boilers are not equipped with surface-blows or other mechanical arrangements for removing the surface scum, it will pay in dollars and cents to add such fixtures, as it is an efficacious method for keeping boilers clean internally, saving coal and expensive repairs; it also renders a mud-drum undesirable, obviating the danger and inconvenience which would be incurred by its use, and a too-frequent use of the blow-off cock.

I believe no flame should extend higher than the normal water line, as that part of the shell not protected by water and exposed to the action of the flame must become highly heated (when firing up cold boilers) before steam is formed, while the lower portion of the shell is comparatively cold. Moreover, no steam is generated by applying heat above the water line—it is only superheated. Would it not be better to close in the side walls on a line with the lower gauge-cock, and cover the top of boiler with some non-conductor, leaving a dead air-space between the covering and shell; also have the covering put on in sections, that it may be removed with dispatch in case of examination or repairs.

A man-hole in the front head under the tubes is convenient for examination or repairs, and for removing deposit from the fire-sheets; but there are objections against its general adoption. It would reduce the heating surface in an ordinary tubular boiler, which would render a larger shell necessary, and the cost of construction would be greater. The boiler would also occupy more space, which in many localities would be important.

Though there has been great advancement in the design and construction of machinery in general, yet it is universally conceded that in the steam boiler there is plenty of room for improvement. "SMOKE ARCH."

"IN THE ROUND HOUSE."—No. 7.

ERECTING LOCOMOTIVES.

By L. O. Danse.

As stated in a previous issue, the original author of this series, C. Burkeley Powell, M.M.C.S.R.R., had completed only that portion already published when he was called to his present post. This, unfortunately for us, resulted in his having to leave the matter where it now stands, and he has not yet found time to complete them.

The writer, whose name is at the head of this article, has undertaken to finish the series, and we ask for him a hearing. Naturally there will be a change in style and method of treatment apparent, though it was our intent to have the original schedule adhered to.

Mr. Danse will deal chiefly with erection and the management of engines on the road.

There are at present in general use in this country three general types of locomotives, all of which are modified in various ways to suit the individual tastes of designers, and the special conditions under which they are to be used. These types differ essentially in the number of their driving wheels.

The first and most common type, is that with two pair of driving wheels. The second embraces those locomotives having three pairs of drivers; and the third type those with four.

Of each of the three types, there are three modifications: 1. Engines with no trucks, or carrying wheels. 2. Engines with one pair of truck wheels; and 3. Those having two pairs of carrying wheels combined in one four-wheeled truck.

Engines without trucks are used almost exclusively for switching service. They are particularly adapted to this from the fact that the entire weight is on the drivers, so that they can readily start heavy trains. Their short wheel-base enables them to pass readily the sharp curves common in yards at low speeds. Those with trucks being able to round moderate curves safely at a higher speed, are better adapted for use on the high road.

All classes of locomotives are susceptible of modification in regard to the manner of carrying their water and fuel; some carrying them on the engine, and some on a separate "tender." The former are designated "tank engines," and the latter "tender engines." Tank engines are of two kinds: those with the tank on the boiler —which are very naturally designated "saddle-tanks;" and those having the tanks at the sides and rear of the fire-box, and known as "back tanks."

Having thus laid out our subject into general classes, we will proceed to take up the individuals as they occur most commonly in practice.

The "four-wheeled switcher" is used only for yard service, moving cars from one point to another, making up trains, etc. Having a very short wheel-base and all its weight on drivers it is well adapted to this purpose.

The "American," or "eight-wheeler," has two pairs of coupled drivers, with a four-wheeled truck in front. This locomotive, being comparatively simple, and very steady at high speed, is used principally for passenger service, and stands to-day practically without a rival for that use. The "Forney" is a modification of this pattern, in which the truck is behind, under the back tank, which is supported by the main frames of the engine. The "American" is also used for fast freight service.

The "pony American" has a two-wheeled truck, in place of the four-wheeled one of its larger type, which it resembles in other respects. The "back tank" engine stands in the same relation to it as the "Forney" to the "American." The "double-ender" is a modification, having pony-trucks both front and rear. Double-enders are also made with a four-wheeled truck under the tank and a pony truck in front. These engines are all used for shifting and for local passenger service.

The "six-wheel connected" engine is used for the same purpose as the "four-wheeled." Having three pairs of drivers it is less liable to derailment in case of a broken axle or wheel, and can be built heavier, so as to obtain increased adhesion, without danger of damaging the rails.

The "ten-wheeler" is to the "six-wheel connected," what the "eight-wheeler" is to the "four-wheel connected." It is used for freight and mixed service.

A modification of the ten-wheeler, in which the two-wheeled truck replaces the four-wheeled one, and the drivers are moved a little forward, constitutes the "Mogul." This engine, having for the same total weight half a ton more on the drivers, has greater adhesion and hauling capacity. It is used for heavy freight traffic.

When greater adhesion is desired in a shifting engine, the "eight-wheel connected" engine is used. Owing to its complication it is seldom used, save on heavy grades, and it is entirely unfitted for high speed.

In order to adapt this engine to use on the road, it was modified by the addition of a two-wheeled truck, thus producing the "consolidation," an engine admirably adapted to heavy freight traffic on steep mountain grades, but not well suited to ordinary train service on light or moderate grades.

Quite recently a "twelve-wheeler" or "Mastodon," has been introduced which is similar to the "consolidation," except in having a four-wheeled truck instead of a "pony."

In classifying locomotives, not only the wheels are regarded, but also the cylinders. Different systems are used on different roads for classifying engines, but probably the most comprehensive and convenient system is that of the Baldwin Locomotive Works which has been adopted in several other manufactories. In this system, letters are used to designate the number of drivers, preceded by a number designating the whole number of wheels, and one chosen for certain reasons to represent the size of the cylinders.

A is used to signify that the locomotive has only one pair of drivers. As this is quite an unusual construction we will proceed to *C*, which is used for those having two pairs of drivers connected. *D* is used where there are three pairs of drivers, and *E* where there are four pairs connected. Thus, 8-*C* means an engine with eight wheels, four of which are drivers; and 10-*D* is a ten-wheeler. The fraction ¼ indicates a two-wheeled truck at each end; and ⅓ represents a Forney engine.

12	means cylind.	9″	diam.	24	means	15″	cylind.
14	" "	10″	"	26	"	16″	"
16	" "	11″	"	28	"	17″	"
18	" "	12″	"	30	"	18″	"
20	" "	13″	"	32	"	19″	"
22	" "	14″	"	34	"	20″	"

36 means cylinders 21 inches diameter. 8-26-*C*, would then mean, an American with 16″ cylinders; and 8-26-*D*, a mogul with 16″ cylinders; while 8-26¼-*C* would be a Forney with the same sized cylinders. 10-34-*E* would represent a consolidation with cylinders twenty inches in diameter.

AMERICAN LOCOMOTIVES IN ENGLISH COLONIES.

In the *Railroad Gazette* of July 13th, is a communication relative to American locomotives in Australia. It is well understood by everyone acquainted with the use of American locomotives in English colonies, that they have been the subject of systematically dishonest handling, and the victims of the greatest and most dishonorable partiality for the poorer English engines for years. This is so well understood that it is unnecessary to enlarge on it, nor would I, unless the letter of "William Thow, Locomotive Engineer" (?) carried on its face the proof of my charges and his own incapacity, as well as that of his "drivers" or engineers. We have recorded the failure (?) (see reports of this road in this article) of a Baldwin engine because of the burning out of a set of grate bars. With the same justice might it be charged to the engine that she failed because the driver was drunk, because the builders of the engine are as much to blame for the drunkenness of an engineer as the burning out of a set of grate bars. In other words, every railroad man knows that grate bars don't burn out if they are intelligently used. On many American roads the burning out of a set of grate bars would get for the engineer and fireman a 30 day lay-off, because it is the neglect to shake the grates, and to keep the ash pan clean, which, by clogging up the grates, melts and destroys them. And it is clear that either through ignorance or dishonesty, probably a due proportion of both, that the best engine in Australia was "sand bagged." What kind of men, may I ask, does England send to her colonies to take *charge* of the locomotive departments who will ride on an engine *six miles* and allow her grate bars to become so clogged with ashes as to burn out? In the first place it is clear that the ash pan was filled up before the engine started, for otherwise it would have been impossible for it to fill in six miles, unless, as is not improbable, the live coal in the fire box was purposely shaken into the ash pan until it was full of burning coal. The only remarkable thing about the whole matter is, that with such an amount of ignorance on the engine she wasn't "burned."

The Baldwin Locomotive Works built in 1880 four locomotives for the Adelaide & Nairne Railway, of South Australia, the line on which the "break-down" occurred. Two of these were of the "consolidation" type, with cylinders 20″ × 24″, driving wheels 48½″ diameter, and weighing in working order about 102,000 pounds, with say 88,000 pounds on the driving wheels. The other two were of the "ten-wheeled" type, with cylinders 19″ × 24″ driving wheels 60″ in diameter, and weighing in working order about 84,000 pounds; and with, say 64,000 pounds on the driving wheels, the weights of the engines being, in both cases, exclusive of the tenders. Without knowing which type the engine was which proved so inefficient as to burn out its grate bars, (?) we may assume that it was the lighter of the two classes. Calculating the tractive power of the locomotive by the usual method, the boiler pressure being, say 135 pounds, and the effective pressure in the cylinders say 100 pounds, we get $\frac{19^2 \times 24}{60} \times 100 = 14{,}400$ pounds tractive force. Ascending a gradient of 1 in 45 (118 feet per mile), at a speed of 25 miles per hour, we may estimate the total resistance due to the gradient, friction and speed at 61 pounds per gross ton, which divided into the tractive force, and deducting the weight of the engine and tender, say 61 tons, gives 175 gross tons as the calculated capacity of the locomotive, with American cars, under the conditions named. There is abundant evidence, however, that properly proportioned locomotives, when working under favorable conditions, will largely exceed the performance indicated by calculations on this basis.

And with these facts in view, Mr. Thow, the "*Locomotive Engineer*" (?) of this Australian road and his "drivers," knew so little about handling an engine that they allowed her to stall with 98 tons as a load! If Mr. Thow ever wants a certificate of incompetency, his letter setting forth these facts ought to satisfy the most critical.

In this letter mentioned Mr. Thow condemns this engine, but the heaviest or largest English engine he has on his road is a 16½ × 20 inch cylinder, with 48 inch wheel, with a tractive force of 113 pounds for each effective pound on the piston. How can Mr. Thow, if he is the merest tyro in railroad business, hope to do work with an engine whose tractive force is—using same effective pressure of 60 pounds per square inch—only 6,780 pounds, when he asserts that an engine with 14,000 pounds tractive force fails?

It is well known that English cars for want of proper design, haul heavier than American cars, but if an American engine with 14,400 pounds pulling force wont haul 98 tons of English cars, it is equally clear that no English engine will, and that the Australian Railroad authorities need the services of an American car builder. It also appears that Messrs. J. W. Downer, J. G. Ramsay and J. L. Parsons, members of the Australian government who made a report on the tests of this road (the Nairne Railway) are as ignorant of their duties as Mr. Thow is of his.

I was informed by an English railway official not long since that English locomotive engineers (or drivers) and other officials in the locomotive department below the Chief Locomotive Superintendent, were much more ignorant than American engineers, and similar officials. He said he had found in England that the failure of the Westinghouse brake was due to this ignorance, while in America he seldom found a locomotive fireman even, who was not thoroughly conversant with it in all its details. This fact at once accounts for Mr. W. Thow's decision that the Westinghouse brake was "too complicated" and it also accounts for the burning out of an engine's grate bars in six miles. With all this in view it appears that an average American locomotive fireman would give better and more intelligent satisfaction in Mr. Thow's position than that gentleman has.

The intelligent English railroad official, such as Mr. Higginbotham, and the Engineer in Chief of this road, appear to be in demand on English colonial roads, for they appreciate the fact that the best engines and cars for any road outside of England are of American build. How obtuse such petty officials on English colonial roads are to their company's interests is clearly shown by the monthly report of this road. The cost of the American engine, it appears, was £2,700, and the English build £2,000, but the American engine is capable of doing, in the hands of an engineer of ordinary intelligence, *twice* the work, in tons hauled, of the English engine; that is it would require £4,000 worth of English engines to do what £2,700 worth of American engines will do.

From this report it further appears that in January of this year the American engine ran 2,781 miles; coal per mile, 54 pounds; cost of 100 tons per mile, 1·86 pence. It may be mentioned here that as the partiality for English engines is so great in Australia, that as the report was made in Mr. Thow's office, and his want of fair play is so conspicuous, the result is probably the *worst* possible average, and want of care in Mr. Thow's power to see the American engine could receive. In other words, if the engine had had fair treatment and intelligent handling she would probably have shown a better record by 25 per cent.

In the same report it appears that the work for the English engine was but 240 tons, with a consumption of 32 pounds of coal per mile, and the cost per 100 tons hauled per mile, was 2·73 pence. It may also be mentioned here that although the American engine hauled tons, comparatively speaking, where the English engine hauled pounds, at a cost of but 1·86 pence per 100 tons per mile, against 2·73 pence for the English engine for the same service, that Mr. Thow's favoritism came strongly to the help of his English engines, and that the actual cost per mile was nearer 3½ or 4 pence than 2.73 pence. The train men's wages also show greatly in favor of the Baldwin engine; as for the Baldwin it was: load, 418 tons; coal, 54 lbs.; cost of fuel, 1·86d.; wages, 0·7d.; total cost, 2·56d. per 100 tons per mile. The English engine shows 181 tons load; coal, 32 pounds; cost of fuel, 2·73d.; wages, 1·6d.; total, 4·33d. per 100 tons per mile, or a better showing of probably 100 per cent. if the American engine had had fair attention. The whole matter settles itself. It has been well known for years that the American engine is the best by 100 per cent. This has been shown on every portion of the earth—South America, Queensland, New Zealand, Canada (where American engines are exclusively used), and where a locomotive building concern has been started with English money, but fitted with American tools, and with an American superintendent. Even on this Australian road, with the most *dishonest* treatment, the American engine shows that, if running with but one cylinder, she would do as good, as much and as cheap work as the best built and most tenderly nursed English engine in the best possible condition; while with two cylinders she shows herself to be the better engine by 100 per cent. Unless the owners of this road allow their prejudices and that of their incapable officials (like Mr. Thow) to stand in the way of financial success of the road, as shown by their own report, the motive power will be nothing but American engines.—WAYNE.

DIFFERENCE BETWEEN THE WEIGHT OF WATER VAPORIZED IN THE BOILER AND THE WEIGHT OF THE STEAM ACCOUNTED FOR IN THE CYLINDER BY THE INDICATOR.

B. F. ISHERWOOD'S REPORT OF STEAM YACHT SIESTA.

Were there no cylinder condensation due to other causes than the production of the power, the differences named above would not exist. Supposing the absence of priming or foaming in the boiler, the weight of water and the weight of steam would be equal. Among these other causes is the action of the metal of the cylinder, which alternately takes up heat from the steam and gives out heat to the resulting water of condensation, the former quantity of heat appearing to be greater than the latter as shown by the indicator, but equal in fact when the heat is included which re-vaporizes that portion of the water of condensation which is present in the cylinder at the end of the stroke of its piston when the exhaust valve opens, the resulting steam of which passes to the condenser during the exhaust stroke of the piston, and thus escapes detection by the indicator. This re-vaporization is due to the contained heat in the water of condensation, and to the heat of the metal of the cylinder over which this water is spread, and to the less pressure in the condenser than in the cylinder, the interiors of these two vessels being in common as long as the exhaust port is open.

There is also a condensation of steam in the cylinder, due to the heat transmuted into the work of expulsion of the exhaust steam by its own pressure at the end of the stroke of the piston. This heat reappears in the condenser (and likewise in the receiver of a compound engine whose large cylinder is fitted with a cut-off valve) when the inrushing steam comes to a state of rest; the live motion communicated to this steam in the cylinder, at the expense of heat, reproducing the same quantity of heat when extinguished in the condenser (or receiver). But as regards the cylinder, such heat is lost, and escapes detection by the indicator.

Furthermore, there is a condensation of steam in the cylinder when the steam is used expansively, owing to the expansion, *per se*, and is due wholly to the transmutation of heat into interior work on the steam molecules, this transmutation being independent of any mechanical work done on the piston. The heat thus disappearing is not measurable by the indicator.

The water of condensation due to the transmutation of heat into work when expanding steam is employed as the heat carrier, be that work of what nature it may, internal or external, is not deposited upon the surface of the metal of the cylinder, but remains suspended in the steam and perfectly diffused throughout the mass in the form of infinitesmal particles which give a cloudy or fog-like appearance to the expanded steam, whereas non-expanded steam, when employed as the heat carrier in doing work, remains transparent, no such water of condensation being present in it. The time of making a stroke of the piston is so short, and the watery particles of condensation are so excessively small and so intimately mixed with the very much greater mass of steam, that both are swept into the condenser together before any separation by gravity can take place.

The water of condensation due to the varying temperature of the metal of the cylinder during a double stroke of its piston, and composing by far the greater portion of the cylinder condensation, is mainly deposited previous to the closing of the cut-off valve, and is spread uniformly in the form of dew over the inner surfaces of the cylinder and its steam passages, whence it is re-vaporized partly during the expansion portion of the stroke of the piston, and the remainder during the exhaust stroke, so that when the cylinder again takes steam these surfaces are dry and comparatively cool. Thus the cylinder acts alternately as a condenser and a boiler, but the re-evaported steam so obtained in the cylinder produces but little dynamic effect in comparison to its heat cost. It is used upon the piston almost without expansion, and its entire effect from the point of the stroke of the piston at which the re-evaporation takes place, back to the valve face, is lost. Of all the components of loss in a steam engine, this cylinder condensation is the greatest, and the economic advantages of steam jacketing and steam superheating are derivable directly from its prevention.

As regards the enormous influence on the economic production of the power exercised by the metal of which the cylinder is made, an answer may here be properly given to the questions: How, during the exceedingly short time required for a double stroke of the piston, even in the case of the slowest working engines, can the transfer of so much heat be effected, first from the steam to the metal of the cylinder, whereby a considerable portion of the former is condensed, and then from the metal of the cylinder to the water of condensation; whereby the whole of the latter is re-vaporized, as is experimentally shown to be the fact? Indeed, does not the exceeding brevity of the time in which these effects are supposed to be produced, furnish a sufficient negative to the possibility of such energetic action by the metal of the cylinder?

The answer is, that the weight of metal composing the cylinder is so much greater than the weight of steam or of water within it per single stroke of piston, and the extent of interior cylinder surface exposed in connection therewith is so large comparatively, that no difficulty need be experienced in accepting the fact of the rapidity with which the heat is transferred, notwithstanding that the specific heat of iron at the ordinary temperatures of working cylinders is about 0·115, while that of water at the same temperatures is about 1·015. The heat conductibility of iron is about forty times greater than that of water, and its density about 7·2 times greater.

Taking for illustration the case of a small cylinder in which the maximum weight of feed-water per hour was vaporized in the boiler, the weight of steam entering the cylinder per single stroke of piston was only 0·12825 pound. The interior surface of the cylinder was 1,200 square inches, and the weight of cast iron in direct connection therewith was about 220 pounds; consequently, not only did the weight of iron exceed the weight of steam 1,716 times, but the latter if reduced to water and spread evenly over the former would form a coating only 0·0031 inch thick. So far from there being any difficulty in conceiving that a considerable percentage of this weight of steam could be condensed to water by the metal of the cylinder having a disposable cooling power represented by its weight, its specific heat, and the difference of temperature in the cylinder during a double stroke of its piston acting through the comparatively large extent of surface within the cylinder, the real difficulty would be in conceiving the reverse. Besides which, experiments have shown that pure saturated steam in contact with a cooler metallic body condenses almost instantaneously until heat enough is transferred to equalize the temperature of the two bodies. The same considerations show that the water of condensation thus deposited upon the inner surfaces of the cylinder will be re-vaporized therefrom with exceeding rapidity when the pressure under which it was deposited is reduced, by the disposal heat of the metal of the cylinder and by the contained heat of the water of condensation, the latter being measured by the difference between the total heats of vaporization due to the difference of pressure. The cylinder acts as a condenser during the period of steam admission, as a condenser and boiler during the period of expansion, and as a boiler during the period of the exhaust.

WATER FOR STEAM BOILERS.

Among the many useful features of railway management introduced on the southwestern lines, is one which provides for the careful qualitative analysis of waters intended for the locomotives. No tank is built till it is first ascertained that the water to supply it is fit for boiler use. For instance, there is a long stretch of line from Fort Worth to Sierra Blanca, on the Texas & Pacific, where the management is seeking to erect water stations at suitable intervals. Springs are tapped or wells are dug, and samples of water thus obtained are forwarded to Mr. Regis Chauvenet for analysis and report. If the report is favorable up goes the tank.

"You see," said Mr. Chauvenet, "all water won't do for railroad purposes. The virtue of a water for boiler uses depends upon the small percentage of solid matters which it contains. The water that has the lowest per cent of solids to the gallon is considered best. Whatever solids a water holds in solution will be deposited as sediment as the water is evaporated. Not that all sediments are equally injurious. That depends upon the quality. Sulphate of lime and carbonate of lime are about the most injurious, because they are insoluble, precipitate rapidly, and the 'scale' which the first forms adheres so closely to the iron that the iron becomes a sulphate of iron, and the 'scale' cannot be removed without taking away some of the iron. Some other solids, such as chloride of sodium (common salt) are not so injurious, because they are easily broken up and being soluble in water are easily washed out.

"My first object in analyzing a sample of water is to determine the percentage of solids. I measure so much water by a centimeter scale—which also give its weight—and evaporate it in a platinum dish of known weight. A simple process of subtraction gives the weight of the residuum of solids and the per cent. is easily figured out. Then I proceed to test for qualitative analysis. I pour a little acid on the residuum, and if it effervesces violently, that shows there are carbonates. Next I fill seven or eight little beakers with samples of water and put a drop or two of nitric acid in each to 'warm' them. To the first I add chloride of barium, which throws down sulphate of barium. To the next I add ammonia till it becomes alkaline, and then add oxalate of ammonia. This throws down oxalate of lime. To the third I add phosphate of soda, which gives me magnesia. This salt is usually combined with sulphates of lime and magnesia. I take another beaker and add nitrate of silver. This gives me chlorine, and throws down the silver as chloride. I don't say it is chloride of lime, but I know that the chlorine is liable to combine with sodium, and that it prefers sodium to lime. To still another beaker I add ferrocyanide of potash. If the water assumes a deep blue color I know there is iron present; and if iron is present in great excess, ammonia will throw down a red precipitate. And in this way I get a fair idea of what substances are held in solution in the water sent for analysis. Let's see: sulphate of lime, carbonate of lime, phosphate of lime, phosphate of magnesia, chloride of sodium and carbonate of iron.

"The analysis of this water from Pyote—from the railroad stockyards on the Rio Grande division of the Texas and Pacific, 379 miles west of Port Worth—shows 44·7 grains of solid matter to the gallon, composed chiefly of sulphate of lime. It also contains carbonate of lime, chloride of sodium, and a very faint trace of carbonate of iron. My report reads: 'Though the amount of solid matter in this water is not large, yet it is of such a nature that we cannot recommend it for boiler use.' Whenever you get up to 25 grains to the gallon, the per cent. of solids begins to get too heavy.

"Here is a bad one from a bored well at Gordon, about 100 miles west of Fort Worth: Solids, per gallon, 2·267 grains; chloride of sodium, largest in amount; chlorides of lime and magnesia and carbonates of lime and magnesia, largely present; sulphate of lime and carbonate of iron, small in amount. 'We condemn this water as quite unfit for use in boilers.'

"It is not alone the trouble of cleaning out sediment and scale that makes such analysis useful. Sulphate of lime forms a scale that is a very bad conductor of heat. But in boilers this scale frequently forms to such an extent as to require a largely increased consumption of fuel to make steam. How often do we hear some engineer say his boiler doesn't make steam as she used to. When you hear that you can guess the cause. Absence of scale means a light consumption of coal, and so the use of non-scaling water saves money to the railroad and trouble to the engineer".—*Louisville Globe Democrat.*

◆

SOME NEW ENGLISH MACHINES.

Llewellin's Patent Machine Company, Bristol, exhibit lathes and polishing machines specially designed for brass finishing, workshop tables and vises, and a time checking machine; is worth attention. It consists of a cast-iron casing, the top part of which holds the clock and mechanism which actuates the checking arrangement. Near the middle is a slotted band, over which fits another movable slotted band which opens or closes the inside slots at pleasure. As the workman comes he drops his check through any of these slots. From them the checks fall into different hoppers, and are directed into various compartments according to the time the men arrive. When the apparatus is opened the checks are found assorted, so that it can be ascertained beyond dispute whether a man entered late, and how long after the proper time it was when he arrived.

* * * * *

A little instrument has been designed for automatically sounding the whistles of steamers in foggy weather. It consists of a brass case, containing clockwork, and which, by means of gear, works a valve, admitting steam below a piston connected to the whistle cock. Each rise and fall of the piston gives one blow of the whistle, the sound occurring after stated intervals, the duration of which is regulated by a governor in connection with the clockwork. After once starting by hand, the instrument is self-winding, each stroke of the piston acting on the drum of the main spring by a rack and pawl motion, so as to entirely obviate all chance of failure to sound the whistle through inattention.

* * * * *

It is well known that when an ordinary stop valve begins to leak much inconvenience is suffered before an opportunity can be found for its renewal, while the valve itself is not seldom thrown away, although every part, except the seat, is as good as the day it was made. A recent invention is designed to remedy this, and to provide for the insertion of a new valve and seat at any time, without waiting for the pressure to be blown off. To this end the inventor interposes between the inlet and the outlet of the casing a conical plug fitting in a corresponding seat. This plug is hollow, and carries at its upper end a removable valve seat, and a valve which opens into the outlet. There is a hole through the plug seat, and a corresponding hole in the plug itself, communicating with the inlet of the casing, and so ordinarily the pressure flows into the plug and up under the valve at its top, and so away to the outlet. But should the valve grow leaky, the plug is loosened by slackening the nut at the bottom, and is then rotated 180 degrees, so that all communication between its inlet and the inlet of the casing is cut off. In that position the gland and spindle can be removed and the valve and seating replaced by a new one, whereupon the fitting is again perfectly good.

◆

In spite of all modifications of its rate of burning that have been so far accomplished, gunpowder occasionally behaves eccentrically, and guns sometimes go to pieces in an unaccountable manner. In English practice there is a record of a simultaneous reading of sixty tons and thirty tons pressure per square inch in two gauges placed within two inches of each other. In our own practice a single pressure disk has been known to show a double record, an indication that a first effort upon the gauge piston was followed by a sort of reflex action, which disturbed the position of the disk, and which was in turn succeeded by a second direct pressure. Artillerists call these curious effects the results of "wave action" and "local pressures," and have usually modestly abstained from particularizing as to the cause.

It may, however, be briefly stated that what is demanded in powder for large guns is, first, that its rate of combustion shall be uniformly constant, with constant weights of charge and projectile and equal conditions of projectile band. Second, that this rate of burning, at first slow to assure a safe and gentle start of the projectile, shall have a progressively increasing development, in order that the point of maximum pressure may be reached with the projectile as far down the muzzle toward the bore as possible.—*Washington Correspondence N. Y. Herald.*

◆

DURABILITY OF CAST IRON CAR WHEELS.

J. S. W. writes to the *Railroad Gazette* as follows:

"One word as to the alleged average rate of fracture among American car wheels: Recent articles convey an impression that it is about 4 per cent. per annum.

"The most complete recent returns that I have (for the whole of the last two years) from one of the largest northern roads; using a large proportion of heavy cars, running at high speed on unusually heavy grades (where the use of the brake heats and cracks the wheel), are as follows:

"Fractured wheels removed from cars and engines on Pennsylvania road, viz.: main line, Philadelphia and Erie Railroad and United Railroads of New Jersey:

				No. 0 wheels	Percentage.		
Year.	Cracked.	Broken.	Total.	on Jan. 1.	Cracked.	Brkn.	Total.
1881.	2,034	454	2.488	353,496	0·57	0·13	0·70
1882.....	2,197	380	2,577	397,280	0·55	0·10	0 65

"As the accidents are caused by *broken* wheels, it is important to note the low percentage of these, which certainly compares well with that of English wheels run under much more favorable conditions.

"If we allow that these wheels were exceptionally soft, yet they can hardly be less durable than steel tires, which cannot be harder on the surface than throughout. And if the steel tire can be turned, the chilled wheel can be ground to a new true circle, and used again.

"But the test of the *capability* of an article, after all, should not be made from the average product, but from the best. On this basis, the present indications seem to be, that under equal conditions, steel-tired or cast wheels, of equal rank in their manufacture, will give essentially equal results as to fracture. "J. S. W."

◆

If about to build send to Palliser, Palliser & Co., architects, New York city, and get a sheet of plans gratuitously. They give all details of construction of low-priced and other dwellings.

◆

Boiler tubes, that are short from being cut out, are stretched to length in England by a special machine, very simple in character. It is merely a long screw run through the tube and clamped fast at both ends. The tube is then heated in the fire and the screw turned until the tube is of the right length. This is much simpler than swedging and less injurious. The screw need not be cut the whole length, a few inches on the end is enough.

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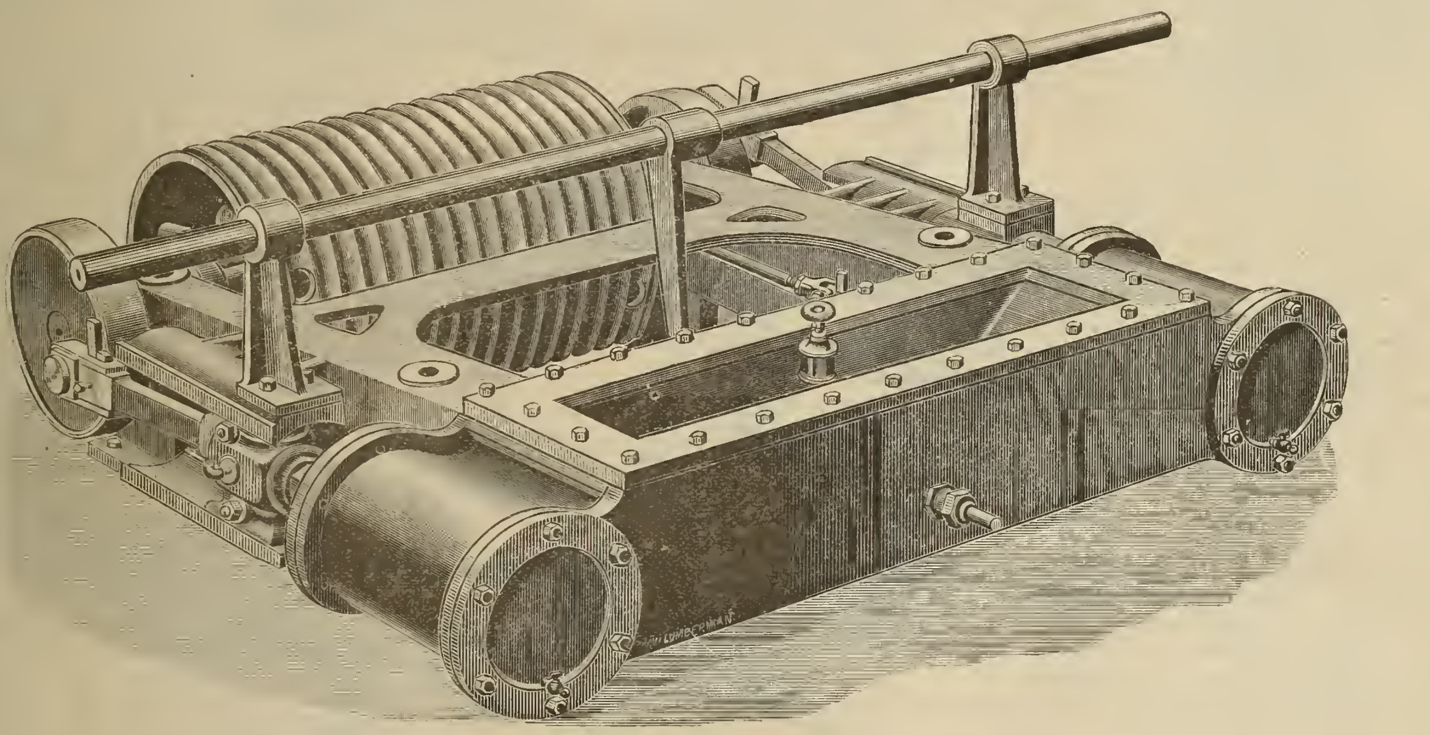
Single Copies 8 Cents. $2.00 per Annum.

INDEPENDENT STEAM-FEED FOR SAW MILLS.

The engraving represents a novel and ingenious method of feeding saw logs to the saw which will be readily understood at a glance by all mechanics. It consists simply of a pair of engines directly connected to a drum or "spool," upon which a rope attached to the carriage runs. The spool is 24″ diameter by 36″ face, and grooved for 2″ rope. It will run the carriage ninety feet. The engines 10″ cylinder by 12″ stroke. In order that this machine may be perfectly under control of the sawyer, a peculiar arrangement is necessary. This consists of a balanced throttle worked by a rock shaft, which can be set to suit either a right or left hand carriage. One wrought iron arm connects the rock shaft and sawyer's valve, and another wrought iron arm or lever, not shown in the engraving, is attached to the end of the rock shaft, and in line with the sawyer's lever. The stand for the latter is bolted to the floor, the lower part passing below the floor timbers, and having two sheaves at its lower end. A small rope with a weight hung to it passes between these sheaves, and connects with the lower end of the sawyer's lever. Should the sawyer, through carelessness or for other reason, let go of the lever while the engines are in motion, this weight will bring the valve to the center, and cut the steam off from both cylinders. The lever-stand also extends about two feet above the floor, and has a guard on either side to prevent the lever from being thrown over too far in either direction, and from giving too much movement to the valve. For further security, when the sawyer leaves his position, there is a lock or fork connected with the top of the lever stand, which is turned over against the lever, making it impossible to start the engines by accident, or until the lock is turned back again, away from the lever.



INDEPENDENT STEAM-FEED FOR SAW MILLS, BY E. P. ALLIS & CO., MILWAUKEE, WIS.

Price lists and circulars can be had by addressing E. P. Allis & Co., Milwaukee, Wis.

* * *

It is far better where an adjustable or trip cut-off is used on marine engines, to connect the governor to the trip direct rather than to the throttle as usual. The "trip" works much lighter and is more easily handled, and the action of the governor is absolute on the engine. Between the throttle and the steam chest there is always considerable clearance space which is full of steam, and the engine may make several turns before the action of the governor is felt to any great extent.

An engineer in the Southwest says:

"I would be pleased to see The Mechanical Engineer a weekly, and pay a weekly price for it. I take six technical papers, so-called; some of them remind me of a last year's bird's nest—there is nothing in them. Others are like the early Church at Sardis; they have a name, they live, but are dead. I turn with pleasure from them to devour The Mechanical Engineer."

The early Church at Sardis was in a bad way!

* * *

The American Miller says:

"The 'pumpernickel' is a variety of bread made of coarse rye-meal. It seems to the uninitiated very indigestible and stone-like, but it is a fact that no variety of bread is easier digested than this unsightly black pumpernickel."

We are inclined to add that "easily digested" is an elastic term. We have a vivid recollection of pumpernickel, and it seemed to us as though we had swallowed a lot of cast iron borings.

* * *

A new steam yacht built of steel is now in hand by the Harlan & Hollingsworth Company, of Wilmington, Del. The vessel is for William B. Astor, of this city, and is 227 feet long, 30 feet wide, and 18 feet deep. She has a plate keel and keelson combined, 32 inches deep by 8 inches wide, the plates being 10-16ths thick. The engines are compound, of 1,400 horse-power, having cylinders 30 inches and 60 inches by 36 inches stroke, driving a wheel 11 feet diameter 17 feet pitch. The vessel will be capable of steaming 12 knots per hour under moderate pressure, and 14 knots as a maximum. The fittings of the cabin and the appointments generally are magnificent.

* * *

The torpedo boat is an excellent example of the advance towards high speeds, and shows what can be accomplished by studying lightness and strength in combination. In running at at $22\frac{1}{2}$ knots an hour an engine with cylinders of 16 in. stroke will make 480 revolutions per minute, which gives 1280 ft. per minute for piston speed; and it is remarked that engines running at that high rate work much more smoothly than at lower speeds, and that the difficulty of lubrication diminishes as the speed increases.

* * *

A Baldwin locomotive and one car on the New Jersey Central Railroad recently made $11\frac{1}{2}$ miles in 9 minutes; this is at the rate of 80 miles per hour.

In a recent railway collision at night, whereby many lives were lost, the engineer testified that just before it occurred the fireman opened the furnace door and threw a blinding flash of light in his face, which destroyed his sight for the time being. When it came to him again he was right on the danger. This contains a hint for thoughtful men.

* * *

Bad smells are unnecessary, and when they exist in the household are evidence of neglect which may be injurious to health. In hot weather kitchen sinks are apt to become foul; they can be readily and cheaply cleansed by common copperas dissolved in hot water, in the proportion of half a pound to a pail full of water. This is also useful for cess-pools, but for the latter there is nothing equal to *crude* carbolic acid. Five cents worth will last a long time, and render the most offensive place harmless.

* * *

The blow struck by a locomotive on a bridge, crossing at high speed, can be better estimated in the cab than anywhere else. The sensation is peculiar; there is first a sinking, as though the bottom was falling out of things, and subsequently a palpable blow, as though the engine had run into a hay stack, or something yielding. This is caused, doubtless, by the structure actually giving way under the first tremendous onset of 40 tons hurled upon it, and immediately recovering its elasticity. This refers to iron and wooden bridges.

* * *

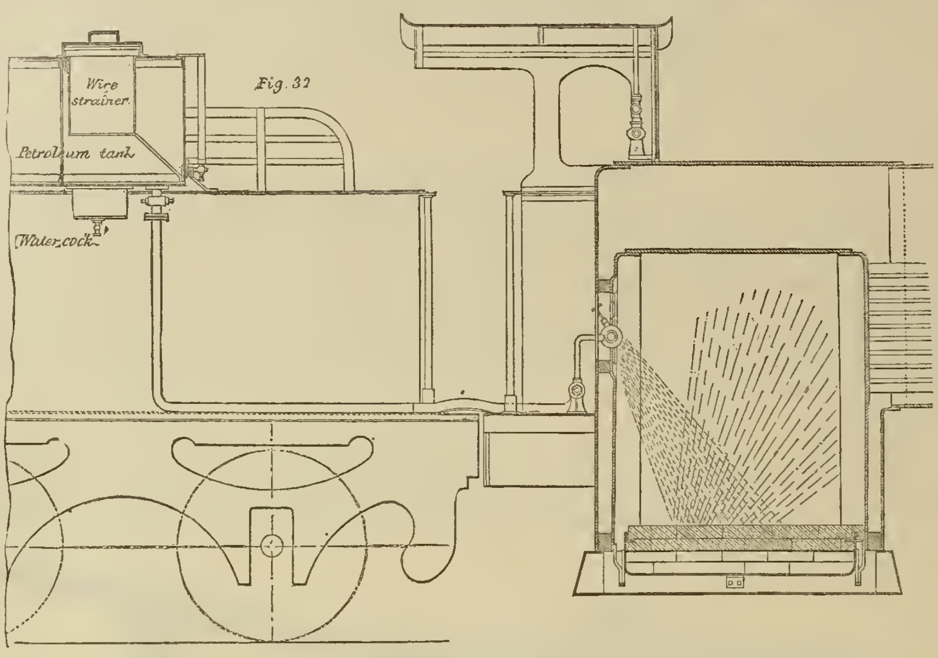
It is well enough at times when bowling along in the cars at 45 miles an hour to recall who it is that is doing it. The locomotive is credited with the performance but, of itself, it could not roll one foot, it is as helpless as a drunken man and as dangerous. The man at the throttle is the moving spirit. Quiet, cool under all circumstances, always doing the right thing at the right time, never for one moment relaxing his vigilance, always facing the arch enemy, Death, and rushing towards him, often conquered by him that others may live, the engineer on the locomotive is a type of the highest qualities in human nature. It is seldom he gets credit for them. When the train is on time travelers alight from it without comment or remark, feeling that the locomotive has found its way alone by virtue of its mechanism, but let some pin drop out, or a box get hot, and half the passengers in the train will get out, scowl at the engineer, and tell him what to do.

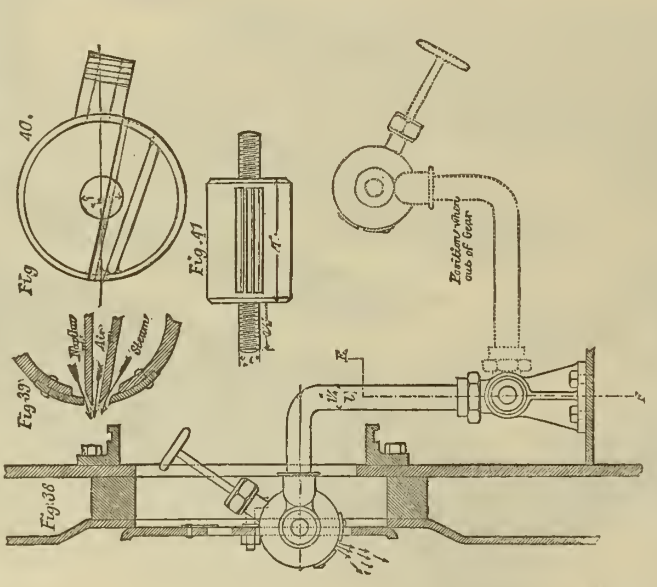
DEVICE FOR BURNING PETROLEUM IN LOCOMOTIVES.

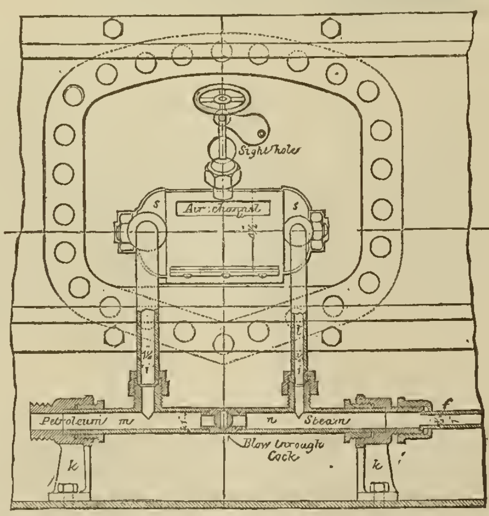
The engravings herewith represent an arrangement for burning petroleum in locomotive furnaces. It has been found to answer the purpose well, and works as efficiently as any petroleum burner can.

Fig. 32 shows the general arrangement, whereby the petroleum is carried and injected into the furnaces, and Figs. 37, 38, 39, 40 and 41, represent the details. Briefly, a jet of combined air and petroleum is blown into the furnace through the chamber shown in Fig 33. where it is ignited. The direction of the jet, is downward, with the intention of striking the fire-brick at the bottom, which are supposed to become in time red-hot, and act as a regenerator or conservator of heat, as also to maintain a uniform temperature by thoroughly igniting the volatilized petroleum, producing theoretically perfect combustion.

It is stated in *Engineering*, from whence these engravings are taken, that this arrangement is found to answer the purpose well, though it does not say what purpose, beyond making steam in a locomotive boiler. Whether the duty is passenger or freight is not stated.







INCENDIARY OILS.

We have lately been called upon to record a number of accidents which could have been prevented. Some of these were due to purchasing the lowest priced oils where one of better quality would prove the cheapest, beside giving better satisfaction. Lubricating oils are generally supposed to be entirely safe. Oils of this class, after they leave the hands of the manufacturer, are apt to lose their identity by reason of various mixing processes supposed to improve them. In the cheaper grades the object sought is the cheaper production of an oil that has the appearance of a good lubricant. In the case of a recent fire in a Western flour mill, the cause was plainly the use of one of these cheap oils. The oils known as the black mineral oils, when of good quality, are adapted for heavy bearings and may be safely used for such purposes, but they are very frequently mixed with light oils of a volatile nature, and there is danger.

In the case of the flour mill cited, an oil of low price had evidently been "compounded" by ignorant or unscrupulous dealers, and the vapors given off, mingling with the dust in the mill, required only ordinarily favorable conditions to cause ignition. In the endeavor to secure lubricating oils at a low cost, consumers do not take into consideration that there may be danger in their use. Mineral oils of good quality, adapted to the work expected of them, are admittedly the safest lubricants that can be produced, but care needs to be taken that those of the best quality are selected. An oil with a low fire test is not fit for lubricating purposes, but such oils are being sold. Some low grades of black summer oils, but little better than tar, have been sold at five and a half cents per gallon, and these, when mixed with light oils to improve their appearance, are sold to the consumer at a price that seems to him low for the quality, while in reality the oil is dear and unsafe. What we have said of the black oils applies equally as well to all the other lubricating oils.—*Oil, Paint and Drug Reporter.*

There are some brands of Havana cigars which sell for $400 per thousand, that is $4 each cigar; so an importer of them recently stated in this city. They are probably made for publishers of milling journals, who alone can afford them.

SOME ELECTRIC-LIGHT ENGINE ROOMS IN ENGLAND.

The *Mechanical World* gives the following astonishing account of how some electric-light engine rooms are kept in England. Such a state of things cannot be found in this country.

"We have had to inspect many electrical installations, and have been impressed with the wide difference between them. In a few, a very few, instances there existed prominent evidence of special knowledge and ability. The boilers were of the best construction and of high efficiency, the engines using steam economically, and having a sensitive governor operating a cut-off valve; the belting free from lap joints and cover pieces, the machine carefully insulated and in a perfectly dry position, the leading wires for the most part invisible, but, where obvious, carefully protected and insulated—everything about the place clean and orderly, an inspection of the brushes and commutator showing no undue friction or sparking.

"On the other hand, we have had evidence before us of the grossest and most culpable ignorance in installations, where any boiler and engine that could be obtained were put down, the only condition being cheapness; the engine with an old-fashioned pendulum governor and single slide valve, greasy, rusty, and rheumatic, knocking at every joint, and leaking steam till the atmosphere of the room was saturated; old style leather belts, clumsily laced, with as many joints as could conveniently be got in the length, the commutators ploughed into deep grooves with a little heap of copper dust and oil below it, the brushes sparkling as if the efficiency of the machine was denoted by the brilliancy of the local fireworks, the leading wires in graceless festoons, and in many places bare of insulation, and having simply looped and twisted joints; while the circuits and lamps were clumsily arranged, and maintained with the apparent idea that it was desirable to get "earth" both to the wires and on and in the lamps.

"In every case we have endeavored to obtain the qualifications of the party responsible for the installation, and almost without exception we have found that the first cited were under the control of men who had training as mechanical engineers, while the other examples were in charge of men who had been plumbers, joiners, linemen, stokers, laborers, warehousemen, auctioneers, clerks, or electricians."

Science says in regard to the Holland hydrogen gas burning locomotive:

"The inventor proposes to raise steam by means of the combustion of decomposed water. The heat evolved by burning naphtha is used to separate the oxygen and hydrogen in superheated steam; and the carbon of the naphtha kindly uniting with the oxygen thus set free, the hydrogen is burnt by means of oxygen obtained from atmospheric air. The inventor states that the only products of this combustion are carbonic acid and water, the nitrogen disappearing in some mysterious manner not yet fully understood.

"The old fallacy that water can be decomposed and then reunited, with a positive advantage as regards heat, is here again illustrated; while the strong smell of burning naphtha during the trial of the engine in the exposition indicated that this convenient auxiliary was used to a considerable and probably wasteful extent.

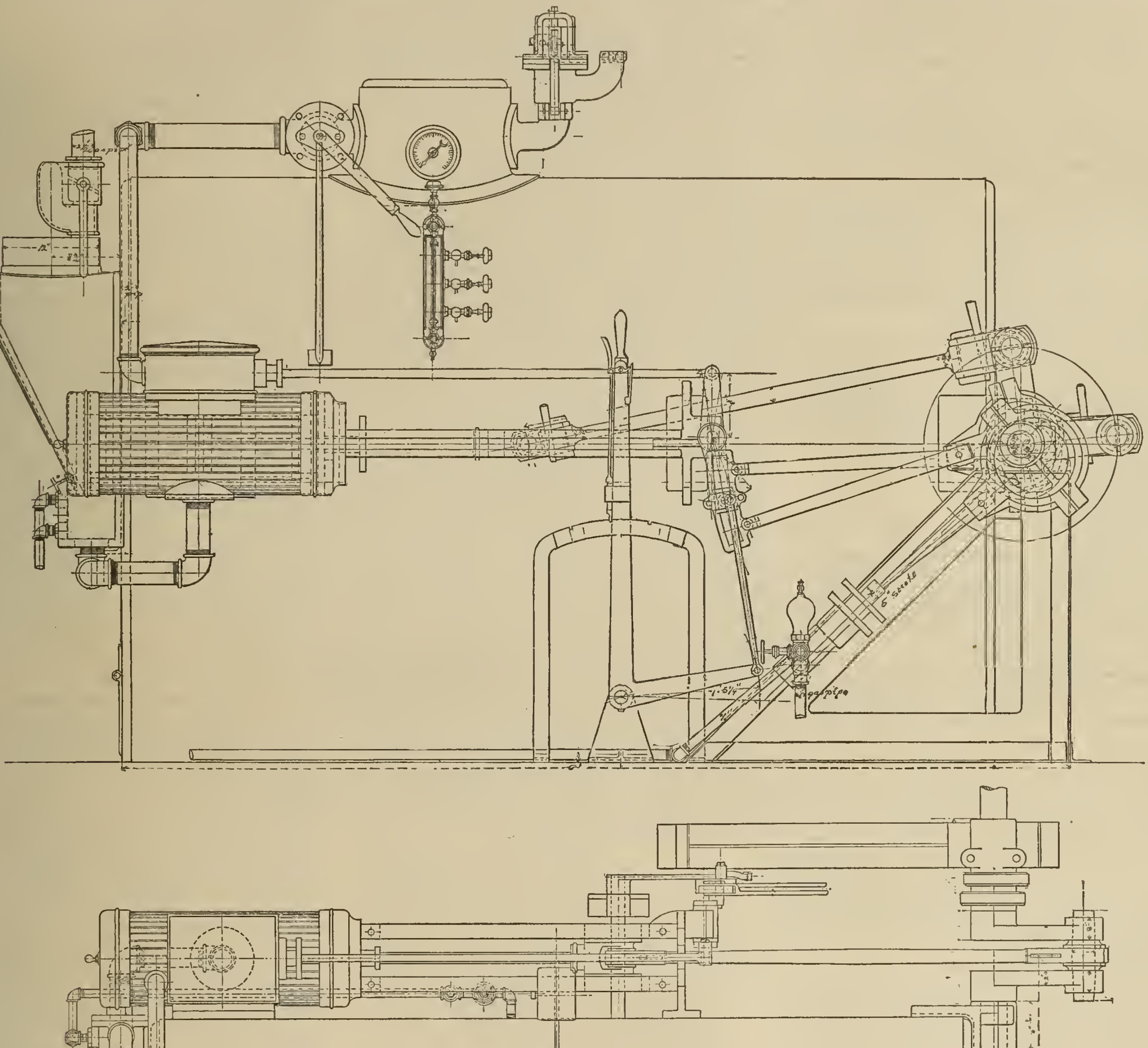
"The main tendency of locomotive design seems to run rather in the direction of larger bearing surfaces and stronger working parts than in any novel methods of construction; while sound and accurate workmanship, and plenty of good material judiciously distributed, are relied on to make a locomotive durable, hard-working, and trustworthy under trying conditions."

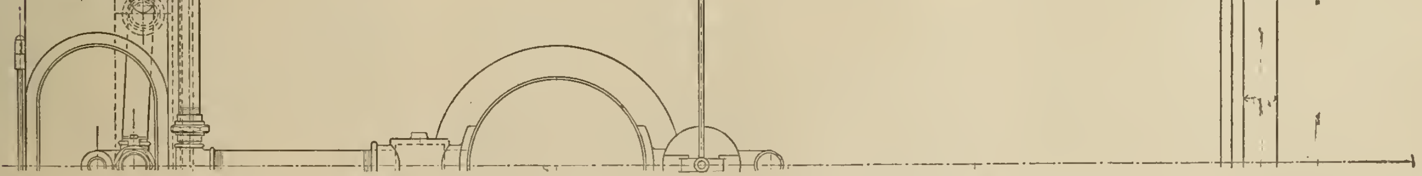
An important experiment in high speed in light vessels, which will doubtless be watched with much interest, is now being carried out. Mr. Loftus Perkins is building a steel vessel with a screw at each end. She is 150 ft. long; her boiler pressure will be about 800 lb. per square inch, and she has a four-cylinder compound condensing engine of 800 horse-power working on to a single crank, and making from 400 to 500 revolutions per minute. When this vessel is laden with 300 passengers, her total weight will not much exceed 150 tons. Should this experiment be successful, it will materially advance the solution of the problem, how to put the largest possible amount of propelling power into a vessel, and so to drive her at the highest possible speed.—*Engineering.*

A new compound beam engine will be illustrated by a two page engraving in the next issue.

THE STEAM YACHT "TWILIGHT."

The Globe Iron Works, of Cleveland, Ohio, have recently built a small iron steam yacht complete throughout, for Mr. S. V. Harkness. She is a side-wheel, light draught vessel, called the "Twilight," and is 75 feet long over all, by 12 feet beam, and 3 feet 10 inches depth of hold. She draws only 16 inches, and has a cabin the full length of the vessel. The wheels are feathering, and all working joints in them are bushed with brass. The engines are two in number, 7 inches diameter of cylinder by 24 inches stroke, and are attached as shown in the engraving herewith. They have link motion, and are very handsomely fitted up. The boiler is steel, 44 inch shell by 9 feet long, and has been tested to carry 115 pounds of steam. The vessel was launched with steam up, and immediately ran out into the lake, behaving very satisfactorily.





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A PECULIAR "DRAWING PAPER" has been introduced in France. This paper is covered with several layers of different colors, and when these are artistically "scratched" by pen or pencil, variegated effects may be obtained. Very fine drawings of uncommon clearness may be made on a paper with three layers—gray, white and blue—and sized with insoluble gelatine so that there will be no "running" from pen or pencil. The colors are prepared from a zinc basis, and are not affected by the atmosphere.

IF STATIONARY ENGINEERS' ASSOCIATIONS can accomplish no other end than merely bringing men together, they would be doing a great deal. The mere interchange of experiences is of incalculable advantage, as every engineer knows who has attended a general "confab." Old hands in the trade drop hints about details and management which are entirely new to a great many and are invaluable. Engineers come to this office frequently and talk over their experience, and we have gained many points in that way ourselves. No one is too old to learn, and though in thirty-five years in the highways and byways of steam engineering we may have seen as much as others, there is a vast amount yet to be seen, and we can fully realize the benefits to engineers of mutual associations.

BLAST FURNACE SLAG is a silicate mixed with various metallic substances, derived from the ores melted. Slag from iron ore is of all colors, ranging from opaque green to bluish green and black. It is sometimes translucent, and in structure it is very strong. When black or green, it is due to iron and manganese; if purple, manganese only, and when blue, sulphur is combined with it.

* * *

A NEW GOVERNOR for steam engines recently invented in England is thus described: It consists of two balls sliding on a transverse rod. The balls are prevented from flying off the rod when the engine is at work by two steel springs which pass over pulleys and down to the governor sleeve. When the balls fly out, they pull on the tapes which lift the sleeve against a spiral spring keeping it down. This governor is compact, and extremely efficient.

* * *

THE CUNARD COMPANY are building two new steamers for the Atlantic mail and passenger service. They are to be vessels of 8,000 tons burthen, and are to have engines of 13,000 horse-power indicated, their dimensions being 500 ft. long by 57 ft. in breadth of beam by 40 ft. depth of hold. They are guaranteed to steam at the rate of nineteen knots per hour, thus crossing the Atlantic in less than six days. The cost of each vessel is about $3,000,000.

* * *

HOW EASILY the mechanic is known by his work. He needs no certificate of capacity, for the labor of his hands and his head testify in his favor. The silent evidence of a fine piece of work speaks louder than a printed page, and in some situations it lives longer. The mechanic is not only a workman, he is a designer also, and many a monument of mechanical skill is executed by men who have never touched a tool.

* * *

E. L. RICHARDS & CO., 52 Broad Street, N. Y., patent brokers, have made arrangements to represent inventors and manufacturers at the American Institute Fair, to be held in this city October 3d. They will exhibit models and make sales. Circulars of their terms can be had by addressing them as above.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

FROM AN OBSERVANT ENGINEER.

Editors Mechanical Engineer:

I have just completed a tour of the Eastern States, mainly for the purpose of ascertaining where all the coal goes to, and how economically it is used. I visited the largest manufactories, where the coal consumption will range from ten to two hundred tons a day, and I will tell you that some things I saw were really shameful.

The first place happened to be about thirty miles from Boston, where the coal bills had actually caused failure; but lately it has fallen into the hands of a skillful engineer, who, although the production had increased forty per cent., reduced the coal consumption from 280 tons a week to 126 tons!

How did he do so?

He was one of those men whose first object is to get the good-will of everybody by gentlemanly behavior and kindness to those under him. He said to me when he came there: "One man and a helper were firing six boilers in a battery of eighteen. This man cleaned his fires four times a day, running with his damper wide open, and the gases going into the chimney at a temperature of from 480° to 500°."

He informed the fireman that the next day he would have to get along without his helper, and fire *ten* boilers. Down went the shovel and off started the man for his coat. After some persuasion he was induced to try it before he left, and see the result. The engineer afterward told me to ask the fireman if his work was hard, which I did, in the following manner:

"Good-morning, my friend. Hot day!"

"Yes."

"Working pretty hard?"

"Not very."

"Ten boilers are rather a large number for one man to fire, are they not?"

"I don't find it so. I used to fire six before the new man came, and had a helper. When he came he wanted me to fire ten without a helper. I thought him a fool, but how he has shown me where I have been one for twenty years. Why, sir, I could fire sixteen boilers as these are now!"

How did all this come about?

Why, by adding more boilers he stopped off on his draught, thus enabling him to send the gases through the chimney at from 350° to 400°, and also by not cleaning his fires until he banked them at night. The old way was to let them go entirely out and start fresh in the morning.

I am sure that if most of the Eastern, and in fact all manufacturers could (if they only *would* look into the matter) save from ten to sixty per cent. of their fuel bills. Slower combustion is what is wanted. That involves plenty of boiler power. Take as an example two men. One buys a stove too small for his house, while another buys one that seems too large. The first man rushes his all winter, and it's—"Charles, we are out of coal," about every week, while the man who has the stove which was assumed to be too large keeps a slow fire; his house is warmer and his coal bills much lighter than the first man's.

It is the same with steam users.

One will put in a boiler, or a set of boilers, that will just figure up to his capacity, and the consequence is that his coal bills are large, his boilers over driven, and he requires an army to handle them. If the boiler power was increased, he could run with less help and burn considerably less coal.

Go to a boiler that is forced and put a pine stick in one of the top-tubes and another in the bottom. In the course of a few days if you examine them you will find that the bottom will be charred while the top one will be, comparatively speaking, in a good state of preservation. On the other hand, if the boiler is working under slow combustion, the sticks will present about the same appearance.

The reason is this: in quick combustion in a tubular boiler, the gases, after passing under the boiler, turn immediately and shoot through the nearest tubes—that is, through the bottom ones, while with slow combustion they have time to rise, thus distributing the heat more evenly through all the tubes.

Some other places that I visited, besides losing through forced combustion, were using steam pumps that took 120 pounds of steam per horse power, while a power pump would have done the same work with 25 to 30 pounds of steam.

I found leaky blow-off pipes, steam-pipes to engine too small, and engines getting about 20 pounds less initial pressure than boiler pressure.

In one place I saw a 6″ pipe on a 24″ cylinder making 80 revolutions per minute, and getting only 16″ vacuum. A good dose of thick paint around the pipes and joints would have improved it materially. Invariably in such places I found men that were not honest to themselves or their employers. All they cared for was Saturday night and pay-day. When spoken to about it they would reply:

"What interest do you suppose a man takes when he gets such low pay?"

I wonder how such men think their employers can afford to pay more when their bills are so high for coal and oil!

Let engineers take more interest in their calling, skip dime novels, reading instead some good engineering paper, get all the books they can pertaining to the business, use a slate and pencil oftener, and let Saturday night and pay-day take care of themselves. Let them study the engine and indicate it, get the firemen interested in their work, and when success comes, and it is sure to come, they need have no hesitation in asking for a rise. A. M. Z.

Brooklyn, N. Y.

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LETTER FROM AN ENGLISH ENGINE DRIVER ON ENGLISH LOCOMOTIVES.

Editors Mechanical Engineer:

In your issue for the 23d of June (No. 13, Vol. V.) on the above subject, you quote from the *London Engineer*. Having had 19 years' experience with English engines, built by Trevethic, Ramsbottom, & Webb, for the L. N. W. Railway Service, and for the last 15 months on American engines, the subject is very interesting to me. I should like to see a good discussion by able writers on each side of the Atlantic on the merits of their respective locomotives.

For myself, I have formed my opinion, but for want of scholarship I dare not attempt the subject. With your kind help, if you think it worth the trouble, I will, as a disinterested party, give you some of my experience with F. W. Webb's side-tank passenger engine, and with J. Ramsbottom's freight engines. In my last capacity in England I was running a passenger train on the branch lines from Carnarvon to Afonwen, Llanberis and Bangor. In Wales, from Carnarvon to Afonwen, Llanberis, it is 18¾ miles, 9 miles of which is up a grade varying from 1 in 50 to 1 in 67. The other part descends at the same grade, so the disadvantage going is an advantage coming back, and vice versa. Our ordinary train consisted of 6 coaches; on exceptional days, (such as market days and pay days, etc.) we had to haul 12 coaches. To give your readers some idea of an English coach I will try to describe a 3d class one. It is about 32 feet long with 6 compartments across; each compartment will carry 10 passengers (5 on each side.) It has no trucks but 3 pair of wheels, one at each end and one in the middle. Think of these going round a 10 or 15 chain curve! The ordinary train was made up thus: 1st, Guards van (that is a baggage car); 2d, 3d class coach; 3d, composite; 4th, first-class; 5th, 3d class; 6th, guards van. All extras would be thirds. Including Carnarvon and Afonwen, there are 11 stations, which makes 10 starts and 10 stops. Time allowed for the run, 65 minutes. Engines, 4 coupled wheels, 4 ft. 6 in., 17×22 cylinder, about 1,000 square feet heating surface in flues, and 90 in fire box. Pressure 145 lb. to square inch. I have seen my fireman filling the fire-box before leaving Carnarvon at 2.15 P. M., arriving at A. W. at 3.20 P. M., standing there until 4.20 P. M.; arrive at Carnarvon 5.25 P. M.; before leaving at 7.15 P. M. he would fill the box again and lock his scoop shovel up; that being the last trip he would have no more use for it that day. To make two round trips he would fill the box twice, using 10 cwt. of coal each time; running 75 miles, starting 20 times on heavy grades, and not ½ a mile straight track on it. I happen to have a copy of the consumption sheet for October, 1881, which I enclose:

Engine No.	Miles Run.	Cwts. of Coal.	Coal—lbs. per mile.	Standard Consumption per mile—lbs	Reduced Consumption per No. lbs.	Premium.	Oil used—Quarts.	Oil per 100 miles.	Tallow—lbs.	Lbs. per 100 miles.	Cost per 100 miles for fuel, oil tallow engine men and firemen's wages.		
											L.	S.	D.
2283	2070	550	30·9	35	4	8s.	51	2·4	13	·6	1	3	1
1178	2179	620	33·3		2	4s.	45	2·1	28	1·3	1	3	9
2280	2047	600	34·0		1	2s.	69	3·3	35	1·7	1	4	11

L. N. W. Railway, Oct. 1881.

To the above I can testify from self-experience for years.

These engines give great satisfaction in their work, some ran for 3 years without going to the shops for general repairs. I kept mine out for 2 years and nine months, and then went in to have the wheels turned. The wheels are not run down in England to the condition they are here.

The lightest locomotives on fuel are considered to be those of J. Ramsbottom's "Lady of the Lake" class. They have 7 ft. 7 in. driving wheels, 17 in. by 24 in. cylinder. Copper fire box 4 ft. 1½ in. long, 3 ft. 6 in. wide, 5 ft. 4½ in. high. The copper stay-bolts uniting the shell of the copper fire-box are 4 in apart, center to center; 192 tubes 1⅞ in., ¾ in. apart, 1,013 square feet heating surface; fire-box 85 square feet and 14·9 square feet grate area. By experience they have always been found remarkably good "steamers." They will take a moderate load at express speed with a consumption of 22 lbs. of coal per mile. Ramsbottom's engines are fitted with air dampers for burning the smoke. Webb, his successor, abandoned the air-hole system and fixed the fire hole door inside the fire-box, working upwards by a lever and a notched quadrant to regulate the door. Both systems are good, but the first is the cheapest, most comfortable, and has less nonsense about it. What I mean by nonsense is this: It stands to common sense and reason that a cast iron door inside of a fire-box won't last long without burning out, and when it is, fire has burnt it. Well, when an engine wants a new door the engineer has to explain what became of the old door, etc., and unless he is smart at good excuses he will be fined.

What would an American engineer think of that?

There is a great waste of fuel in every locomotive in any country that has no appliances controled by the engineer to burn the smoke. A clear flame in the flues creates more heat than smoke, besides the gases escape before they are burned. In order to get a reduction in the consumption of coal on American engines they must be altered at both ends, in my opinion; and by practice and closer observation on part of the American engineer. The admission of too much air does injury. From a want of sufficient air the combustible gases are not ignited; they escape, wasted from the chimney. In some cases they take fire on coming in contact with the atmosphere at the top of the stack. Oxygen is then clearly necessary. Suppose we look into a fire-box with a smouldering fire, without light about it, it is all smoke. The gases that are escaping are all inflammable, but their calorific value is lost, owing to that supporter of combustion, oxygen, being stinted. Assume that a better supply of air is admitted above and below the fire! As soon as the oxygen in the air comes in contact with the incandescent fuel it combines with the gases and takes fire instantly. Oxygen then governs combustion entirely, and is capable of being controlled both in quantity and in the direction of its action.

The actual consumption of coal by English engines is not an easy matter to get at, as the premium system makes rogues out of honest men. For instance: there was a man running opposite to us from Llanberis. His standard was 29 lbs. per mile, and he used to make 10s. and 18s. per month, coal money, while we could hardly keep up to the standard at 35 lbs. per mile!

I guess you are at a loss to know how this was! Well, here it goes.

Once we were on quite a different standard. Ours was 27 lbs. per mile and his 29 lbs. Ours was so unreasonably high that we could not get near it. It would be useless to try for a premium, though we were bothered every month, for years, for explanations. At last they altered it, and it was all we could do to play about the mark at 55 lbs. per mile, while the other man was running on 15 lbs. per mile less than us.

Of course he was a better man or had a better engine! Neither. He burnt more coal than any of us! The cause was this: He was stationed one end, where there was but himself, and had charge and account of his own coal; as a rule the trucks contain more coal than was charged to them. He had a car of coal per month for the use of the shed, that was enough for 12 months. He would have his engine in for repairs often, and working an extra. The extra engine would have to suffer. If an extra engine would take coal there it would be charged double. He could for 12 cents get a ton at our end from the coal-man now and then. In fact he paid his way, and was, what is the ruin of the old country, "a favorite" briber. E. R.

E. St. Paul, Minn.

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LICENSED ENGINEERS.

Editors Mechanical Engineer:

Several of us have been talking about licensed engineers on lakes and rivers. We say to each other: "I should like to get a license, but do not know how to go about it."

Perhaps you could help us through. We are working a few hundred miles from any place, where engineers are examined for licenses, but I think there are plenty of engineers who are capable and desirous of getting certificates if they only knew how to proceed. I do not mean "hand-behind the back" work! It is obvious that an engineer hundreds of miles from the place of examination would not put himself up for a candidate unless he was competent. If the authorities want good engineers why not publish the examination (say through the Mechanical Engineer), take the names of those who would like to apply for a license, notifying date and place. I hope the time will come early when licenses will be required everywhere.

Ohio. An Engineer.

[Licenses for engineers are required only in a few States in the Union, but it would be much better for the trade, and the public, if they were demanded all over. There are not lists of questions to be asked, the examination being generally informal and in no wise searching. When the National Association of Stationary Engineers get to work in earnest we think this matter will be heard from.—Eds.]

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EQUALIZING PRESSURES IN BATTERIES OF BOILERS.

Editors Mechanical Engineer:

Your issue of August 4th contains a communication from "*Tramp*," Nashville, Tenn., to which I desire to reply. It is relative to the water level in batteries of steam boilers. Without referring to any particular cases that have come under my observation in handling boilers and engines since 1850, I will state that I long ago found a perfectly reliable remedy for the difficulty named, viz: the flowing of the water from boiler to another owing to varying pressure. I connect all the boilers together on top by a steam pipe that has nothing to do but maintain equilibrium of pressure. With feed pipe of sufficient size, and free from obstruction by scale or otherwise, this will never fail. It never has for me, and I have given it many trials. I have often drawn the fire from one of a battery of three boilers that were working at their full capacity with a hundred foot stack, throttles and checks in the feed pipes between them, and water gauges in all. The throttles were always wide open, and the buttons or valves out of the checks, and I never had any trouble about the water level. A shut-off both for water and steam to each boiler is very convenient in case of accident or injury to the boiler. When I took charge of these boilers I put up the independent steam pipe for convenience and *safety*. I maintain that this method is much safer than the use of stops and checks between the boilers, for reasons that I need not state They are readily seen.

Troy, N. Y. Blowoff.

PROTEST FROM A BOILER MAKER.

Editors Mechanical Engineer:

I notice in No. 3. current volume, a communication from "*Tramp.*" He says it is the custom where he is for *boiler makers* to set their boilers with mud drums running across the whole width of the setting. He don't say whether there was a steam drum running across with opening to each boiler. It looks to me as if the boiler makers had to father all faults in setting boilers. Now I always thought when a firm got boilers to build they had to do it according to specifications furnished by the buyer, both in material, construction and setting. I have been a good many years connected with shops, both as foreman and otherwise, and that is as I always found it.

N. Y. Boiler Maker.

WOMEN AS INVENTORS.

Women sometimes originate clever devices, but not often; the instances are not so numerous that she can be classed as an inventive animal, as somebody says man is. A Western woman has invented over again a device for burning petroleum, an invention for which there is no place, and never can be, until the heating value of petroleum is equal to coal or the market price of petroleum so much less than coal that it can compete. Devices for burning petroleum are like the sands on the sea shore in numbers; one is illustrated in this issue. They have been tried carefully and persistently for the past thirty years, but in no single instance have they proven commercially available in competition with coal.

In noticing this invention, our esteemed contemporary, the *Trade Review*, remarks:

> "Just why it is that practical men have an aversion to accepting the results of woman's thought and application it is difficult to see."

We do not think practical men have this feeling. The obstacle to success on the part of women as inventors lies in the fact that they generally get hold of some obsolete and worked-out vein and fancy that the mere possession of a patent will unlock all doors to wealth. We do not mean to read our friends a sermon on their text, but it is not the disability of sex so much, as the want of usefulness in their inventions, that bars the door to woman as an inventor.

POWER ACTUALLY UTILIZED IN PROPELLING A VESSEL.

Speaking broadly, all the power of an engine is applied to the propulsion of a vessel, but the distribution of it, the absorption so to speak, by the various members and details, varies greatly. The power which actually goes through the crank pin is expressed by the pressure per square inch and the number of revolutions, but in the list appended it will be seen that the available power is only a small portion of the actual power. The demonstration is by B. F. Isherwood, in his report of the steam yacht *Siesta*, whose engines are compound, $10\frac{1}{2}''$ and $18''$ by $18''$ stroke.

	Horse-power.	Per cent. of the net h. p.
Indicated horses-power developed by the engine	140·336508	
Horses-power expended in working the engine, *per se*	11·943764	
Net horses-power applied to the crank pins	128·329744	100·00
Horses-power absorbed by the friction of the load	9·629456	7·50
Horses-power expended in overcoming the resistance of the water to the surface of the screw blades	11·055100	8·61
Horses-power expended in the slip of the screw	30·188774	23·51
Horses-power expended in the propulsion of a vessel	77·519414	60·38
Totals	128·392744	100·00

Smoke Box Extensions, it is claimed by some engineers, improve the draft on locomotives; an engineer of many years experience on the New Jersey Central division of the Philadelphia and Reading R. R. informed us that the result above mentioned followed in one case to his knowledge. It would seem as though the reverse would be true with most engineers.

THE QUICK WIT OF TWO ENGINEERS.

An instance showing how necessary it is for an engineer to have eyes all over his head, and brains to realize what is passing before, behind and on all sides of him, is thus related in the *Hornellsville Times:*

"Passengers who were on Erie train No. 4, last Thursday night, are probably not aware how near they came to a terrible disaster. As is generally known, all way-trains are obliged to take side tracks in time to leave the main road clear for the 'flyer.' On the night referred to, trains 36 and 49 were ordered to take the switch near Friendship, to let the express pass. Train 36, coming east, arrived first and entered the switch from the west end. Train 49 arrived soon after, and started in on the same switch from the east end. Before the train had been drawn in far enough to clear the main track, the engineer, seeing the headlight of train 36 ahead, and not knowing whether it was standing still or pulling toward him, reversed his engine and stopped. For some reason unknown, no flag was sent out by the latter train to stop No. 4, which soon came thundering along at terrific speed. The engineer of train 36 heard the 'flyer' approach, and seized with fear, turned to a brakeman who happened to be in the engine and exclaimed, 'For God's sake flag that train!' although he was not certain at the time that the train at the east end had not cleared the track. The brakeman ran to the front of the locomotive, where he seized one of the signal lamps, and by bringing all his strength to bear upon it, succeeded in pulling it from its fastening. He ran to the side of the track and in attempting to swing the lamp the light went out, and the 'flyer' dashed by like a gush of wind. The ever-watchful engineer, Mr. J. K. Chapman, had observed the movement of the lamp, and fearing danger, immediately applied the air-brakes, reversed his engine, and worked her hard in the back gear. He stopped so quick that the passengers were lifted clean from their seats. It was the quickest stop ever made on the division, but it was no better than the occasion required. After the stop had been made it was found that the 'flyer' lacked only a couple of lengths of crashing into the side of train 49.

"When train 4 passed the Friendship depot it was running at the rate of nearly a mile a minute, being a little late, and there is no telling what the consequences would have been only for the sudden action taken by engineer Boyden of train 36. It is said that as the 'flyer' dashed by his engine he became so paralyzed that he could not move for some time."

Reports of new engines and trial trips of steamers, in the daily press, read like jokes, and not very funny ones at that. In a recent trial of a new steam yacht, we read in the *New York Times* that the engines have four cylinders $7'' \times 10''$ stroke, "*giving a combined stroke of* 40," also that the inventor's arrangements for "keeping the steam moist" are perfect. In the *Sun* we find that "the cylinders are placed on the top of four towers, one steam chest serving two cylinders; under this arrangement there is a perfect balance of the valves, etc."

The vessel, it appears, has a screw 6′ diameter by 7′ pitch. She is credited with making over 18 miles an hour. The screw made 176 turns with 100 lbs. of steam, and therefore only run 14 miles an hour without any allowance for slips; how it happens that the boat got four miles per hour ahead of the screw is not stated.

It requires great moral courage for one to write upon a subject he is not conversant with, but the reporters on the daily press never hesitates when a steam engine has to be written up.

Complaint has become frequent that the various employés of the Post-Office Deparment throughout the country are negligent in forwarding newspapers as directed, and, that there may be greater care given to such mail matter, the following order has been issued from the Post-Office Department: "Complaint has been made to this Department that second-class mail matter (newspapers and periodicals sent to regular subscribers) is not in all cases promptly forwarded to the addresses. Such matter is of at least equal importance with the letter mail, and it should be treated with equal care by postal clerks. If it is necessary to withdraw second-class matter from its wrapper in order to ascertain its destination it may be done, but this will not be allowed for any other purpose. The Postmaster-General desires that the practice of reading newspapers and periodicals passing through the mails be discontinued wherever it exists." Another matter of annoyance for which postmasters are responsible occurs in the delivery of newspapers at offices. Unless one rents a box he does not get the papers waiting for delivery to him when he inquires for mail, unless he specially asks for papers. Most people do not know that it is the custom of postmasters to look only at the letters in the "general delivery" upon request for mail, and there is often long delay in the delivery of valued papers. A paper is of no account, thinks the postmaster, and hence his indifference to its delivery.—*Paper World.*

An English invention for stopping large engines promptly is comprised in an electric connection, by which the stop valve is closed in case of accident to the governor; but as this alone—closing the valve—would not stop an engine moving at high speed, on account of the momentum of the parts, a connection with the condenser is made, for low pressure engines, whereby air is let into it through a large pipe, not only destroying the vacuum but forming a cushion for the piston to back up against.

The effect of a sudden rush of air into the condenser is equivalent to putting a brake on the engine, and as this takes place at the same time that the steam is shut off, the engine, no matter how large, can be brought to a standstill in about thirty seconds. This apparatus has been applied to a large number of engines and of all sizes up to 1,000 horse-power with success. In several cases serious accidents have been prevented.

Mr. Chas. E. Dyer, President of Brotherhood of Stationary Engineers, of Owosso, Mich., has the right idea of the objects of such associations, and in a letter to his local paper writes as follows:

> "It is the first step ever taken toward elevation, and to discountenance all and every strike or trade unionism. It works in perfect harmony between employee and employer. We mean to deal with the subjects of every day happenings in and about our engine rooms, to exchange experience so as to fit us better to command our situations. In return, the employer of an engineer from our association receives as much benefit from it as the engineer himself, as it has been shown in some of the cities where there exists a Brotherhood of Engineers, by the employers making gifts of $50 and more to them.
>
> "We feel the need of more intelligence in our occupation, which we think will bring about a better standard of wages. We know rioting and striking will never advance us nor will it raise us in the estimation of the people at large. Our motto is, Every man judged by his value, and the higher the value the better the judgment. Knowing the responsibilities and lives in the care of the engineer, we mean to place ourselves in a position to make employers want our work.
>
> "We want every good, steady and sober engineer in Shiawasse county and those of neighboring towns in adjacent counties to unite with us."

This sounds about right.

Recently invented vertical boilers in England appear to be so contrived as to get the greatest possible number of angles, crooks and bends in the water spaces and fire surfaces. Their designers seem to think that a quantity of fire surface atones for every other defect, and that if they only have it—fire surface—coefficiency is secured; circulation and facility for repair and cleaning out appear to be ignored wholly.

A writer in the *Railroad Gazette* says that Phineas Davis was the first engineer to build a locomotive burning anthracite. This was fifty years ago.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

RETROSPECTIVE.

The engineer of a third of a century ago had no such opportunities for education as the present day affords. There were no text books, for the profession itself was comparatively new and but little known. It abounded in superstitions and catch "rules," and "the blind lead the blind" whenever any new scheme, or plan of engine, was proposed. Much was assumed, and more was guessed at, as to the action of steam in the cylinder. The indicator of course existed, but it was looked upon in the light of a curious toy by many, and its value decried or overlooked through want of comprehension. A lavish use of fuel, wholly disproportioned to the work done, was apparent everywhere, the only recognized agent or force being the absolute pressure of steam on the piston as long as it could be made to follow and get out again before the next stroke. Engines were cumbrous and ungainly in form, and ran hard, from mistaken ideas as to their construction, and their coadjutors, the boilers, were similar.

In the fullness of time a great change has taken place. Not, indeed, in the twinkling of an eye, for progress in the mechanic arts is slow, but through the facilities afforded for better knowledge. By the efforts of individuals, and the endowment of schools, the engineer of the period has obtained incalculable advantages. He has the mistakes of the past to warn him, and he may profit by the blind leads of the pioneers. Beyond all, he has theory and practice side by side.

The results of these opportunities will be more apparent in the next quarter of a century than they are at present, though the advance made now is by no means small. The steam engine of to-day runs with but a tithe of the coal, per horse-power, that it required a third of a century ago, and is a better and more durable machine. The steam boiler evaporates more water, as a rule, and is practically free from explosion. Its functions, and the regution of them economically, are better understood, and where it was a magazine of mysteries, and looked upon with dread, it is now known to be a faithful servant when well treated.

Many who live in the present only, and cannot recall the engineer and his works a third of a century ago, do not appreciate what has been done. Still greater efficiency is demanded, and the sources of closer economy are carefully investigated. It is well for the age that this spirit is manifested, but to us who look back, to the graybeards who remember what was then and what is now, the advance is wonderful. Banish all the compound engines, go back to the methods of long ago of boiler setting and coal burning, throw out surface condensers, and ignore the indicator, and that giant, steam—the master of the world—would be as helpless again as Samson shorn of his locks.

The subject is inexhaustible if traced out through all its bearings, socially and politically, but this brief retrospect, this glance backward, must suffice. It shows feebly what engineers have accomplished so far; what they may not do in the future is beyond prediction.

GRADUATES OF TECHNICAL SCHOOLS.

A contemporary has been looking at this subject through the big end of the glass, and as a result graduates of technical schools appear very small in its eyes. Its views are of little importance on any topic of interest to engineers, still less upon this, for from the tenor of its remarks, it is evidently pandering to that small class who profess to believe that technical schools turn out finished workmen capable of earning wages at the moment of graduation. If it really understood the object of technical institutes it would not have so bemuddled the subject, for every mechanic who has investigated the matter knows that technical institutes do not attempt to make workmen. They fit young men to follow mechanical pursuits, and the course of technical instruction simply gives them a clear insight into the principles, and grounds them in the laws that underlie the callings they intend to follow.

Manufacturers generally, in our line of trade, are fully alive to the importance of this, and many of them have sent their sons to these despised technical schools to graduate. Railroad companies, bridge builders, large machine works, steam engine builders, etc., etc., are glad enough to obtain the services of young men who have followed the course, not simply to work in the shops, but to contribute what they have been taught in philosophy and the laws of mechanics. It is too late in the day to decry the influence of the technical school upon the future mechanical engineer.

TWO NEW SERIALS.

Two new serial articles, one of which we have seen advance sheets of, will appear in the new volume (number VII) of The Mechanical Engineer. It is of great promise, being entitled "*How I Served my Apprenticeship*;" narrating in an easy, fluent style, the routine of a young man learning the trade of a machinist. It is a bona fide experience; not a collection of stale shop tricks and jokes about grinding surface plates together, or giving lead-taps to the tool-dresser to harden. It will introduce the why and wherefore of familiar processes, and, above all, thoroughly ground the reader in the simple mathematical rules which every mechanic should understand. In a word this admirable serial will prove of incalculable benefit to all whose early advantages have not been great, and who wish to make up for lost time.

The writer is "George Slocum," a piece of information which we fear is not so definite as it might be!

George is at this moment, and will be for some time to come, doubtless, at work in the shop, and knowing whereof he affirms, and how to lead others over the thorny path of "shop arithmetic," his articles will be invaluable. They are written in an easy gossiping vein that will hold the reader's interest to the end.

The other serial alluded to will be entitled, "*The Management of Steam Boilers*," and will be valuable to engineers.

A MILD OBJECTION.

The *American Miller* criticises happily in its August issue the fashion some contemporaries in its line have of saying silly things in a solemn way, and it gives these example:

> "I hear that Billy Smith is getting up a new mill pick.
>
> "It is an ingenious combination of a piece of steel and a sharp edge. Mill picks have been used in England since 1757.
>
> "The man who tends the smutter cannot be too careful in the discharge of his duties. Smutters have been known to strike fire on a nail or other hard substance, and start a disastrous conflagration."

We invite the attention of our brilliant contemporary to similar abuses of patience in some alleged technical papers which sport an engineers' column. What does the *American Miller* think of this admonition?

> "Never set steam packing, cotton waste, tops of oil cups, or anything whatever that is to be used around the cylinder, valve, piston rod or bearing of steam engines on the floor, as they will invariably pick up sand or grit, which injures the rubbing and revolving surfaces with which it comes in contact."

Or this:

> "The setting of boilers is a very important matter, and upon this, in a great measure, depends their efficiency. It will pay the steam user to employ men of ability and integrity to build their boilers."

Will it pass judgment on this?

> "It is claimed that the criticisms which are raised against wrought iron and steel boilers are mainly due to the boiler-makers themselves. Competition is pretty sharp, and the temptation to use poor material and do cheap work is very great. But it tells against the man in the long run. It becomes a matter of importance then to boiler-makers that their products be first-class in every particular. The steam user is not entirely free from criticism. His desire to drive a close bargain will often tell against his interests. Men generally get about what they pay for."

What this means no engineer can tell. It is hard to criticise such twaddle, but when an engineer reads it he prays for fire from heaven to fall upon the writer and disseminator, and consume them.

A POPULAR ERROR.

It is not uncommon to hear the assertion quoted below, but that it is erroneous scarcely needs demonstration. We quote from the New York *Sun*:

"There is something beyond calculation in the speed of steamers, according to one of John Roach's experts. Two boats may be built simultaneously from the same model, with every effort to make them precise duplicates as to shape and machinery, and yet one will prove faster than the other. Why this is so no man can tell. The *Mary Powell* has for fifteen years been the swiftest on the Hudson River. During all that time she never has been beaten. Time and again an exact counterpart has been built, with everything copied as nearly as the best mechanics and facilities could do it, but none of these has turned out as good as the original. As the reputation of unrivaled speediness is a valuable advertisement for a passenger boat, you can see the object in trying to build a second *Mary Powell*. Experience has been the same with yachtsmen. They order copies of the swiftest craft, or combine the supposed good points of several, and nine times out of ten are disappointed in the result."

It is easy to see why. The reason is simply that the copies of originals are not correct. In order to compete in speed with each other, or to attain the same speed when built from the same lines the vessels must be exact counterparts of one another. They must have the same lines exactly, and the same engine and boiler power. Even with engines of the same dimensions the end is not attained for mere dimensions amount to nothing. They must be of the same efficiency. Each must indicate exactly the same number of horse-power. This latter is always assumed, for it is thought that two engines exactly alike, as regards cylinder and stroke, will be of the same power. This is quite wide of the fact. One may be many times more efficient than the other.

Two vessels of exactly the same displacement and model, with engines of the same power, run in the same waters, will have equal velocities. Failures result in not having the same conditions. A very small matter—apparently—will take a mile or two an hour off of a boat's speed. She has only to lose 88 feet per minute to fall behind one mile per hour.

WHAT IS A STEAM BOILER?

Judging from popular impressions, many hold the idea that a steam boiler is, in the nature of things, a peculiarly dangerous structure, and that it is liable to—nay, probably will—at no distant day, give out somewhere. Good care and watchfulness may put off the danger, but cannot prevent it. Not a small part of the community regard steam boilers as necessary evils, to be endured only because nothing has been found that will stand the same amount of abuse.

Suppose this matter is looked at in the light of common sense? In that case, we find that a steam boiler is merely a magazine to restrain a certain force, and that if it is constructed intelligently and with reference to its peculiar functions, it is just as safe against disaster as a house is against falling down spontaneously, if we may employ such a phrase.

Steam boilers are costly affairs, and to make them perfectly safe is far more expensive than to take some chances in that direction. Expense is supposed to lie in the first cost of them, whereas, in the case of defectively constructed boilers, it only commences. A steam boiler is not made by exact workmanship. It is rough work, mechanically considered. It is made by blows and violent effort, not by nice adjustment and exact measurement. If it would not make steam unless built in a certain way, and that the best, it would be practically inexplosive.

The point of our article is that it should be made in the best manner and of the best materials, for on no one appurtenance or belonging of steam engineering does so much depend. Boiler makers are aware of this, and of their own will would never scamp their work or allow anything unworthy to enter into the construction of them; but they are only human, and it requires much more moral force than the average man possesses to see a job go past one's door by reason of a little compunction on his part.

As regards construction, the cylinder is the perfect form for a boiler, for in it the strains are equal in all directions. So soon as that form is changed a conflict of strains begins, and one part or another has to be made doubly strong to resist it. This shape (the cylinder) is the one now used universally on shipboard, but there are serious objections to it.

An engineer of over forty years' experience in all parts of the world said to us recently that the time is close at hand when we shall have to get some different form of boiler for marine purposes if we are to keep on using the same pressures, for we have got to about the limit of thickness in shell. Iron one inch thick is about as heavy as can be worked with any sort of economy, and the enormous weight entailed by such thickness is a most serious objection, to say nothing of the mechanical difficulties incident to working.

Since our friend is now superintending engineer of a large steamship line in this port, saying nothing of years spent in building engines and boilers and steam vessels of all classes, his views are entitled to respectful attention, the subject being of very great interest to all engineers. With the fresh water now obtainable, very many difficulties are overcome. Those which marine engineers of the past had to deal with are unknown.

ANOTHER AMBITIOUS PROJECT.

A contemporary announces that another "unprecedented steamship" has been designed, and that it is to have enormously high speed. This is the end desired, for no one announces an intention to build a steamship of very moderate speed, there being enough such already. It somehow happens—too frequently of late—that the steamship which was to go very fast, in reality goes very slow, an example that amateur steamship designers should profit by in their announcements. This ship is to be no less than 500 feet long and 60 feet wide, and is to carry engines of 20,000 H. P. on a displacement of 5,200 tons. She is all cut up with bulkheads, both fore and aft, and has a propeller at both ends. Notwithstanding this she is to carry "light freight," bullion, and passengers. The designer is a sea captain, and success is inferred, apparently, from this fact.

There does not seem to be any connection between the two businesses, or professions, to warrant such an inference, for the designing of steamships and navigating them are quite different, as persons generally find out who attempt building with no training for it.

The dimensions of this projected vessel, it will be seen, are surpassed by several vessels now afloat, but none of them have anything like the amount of power. The *City of Rome* is a larger vessel and has all the power she can carry, and that is only 13,000 H. P. In itself this is enormous, but the new vessel is to surpass this by 50 per cent. How it happens that a sea captain can put in 20,000 H. P. where experienced engineers can only get 13,000 we are unable to say.

In reading the announcement of this vessel we observed these lines:

> "The first cabin is elevated above the main deck ten feet, and eighteen feet above the water line, thus placing it beyond the reach of seas that can in any way affect it. In addition to the cabin protection, the sides are eight feet inboard from the outer sides of the ship, increasing the distance of the cabin from heavy seas. The elevation of the cabin will allow seas, in a gale of wind, to pass over her main deck unobstructed."

Nothing is said about spirit levels in the cabins to keep the ship on an even keel, but there will doubtless be some.

A POINT AGAINST STEAM LEAD.

Recently the *Stranger*, a large iron steam yacht owned in this port, was at the Delamater Works for some repairs, when one of the men employed at the shops reported to an engineer of one of the large steamship lines that the main valve on the high pressure cylinder had $\frac{3}{16}$ths lead, and $\frac{5}{8}$ths of an inch exhaust lead. The engineer's advice was to take this lead off, make the valve late a little, and leave the exhaust as it was. This was done, and the result was, with the same steam pressure, that the revolutions were increased by ten, with a measurable advantage in speed. We do not know the exact size of the high pressure cylinder, but it is in the vicinity of 30 inches.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XL.

Bill Young was a man six feet two in height, with an arm like the piston rod of a three hundred horse engine, and a thigh like its shaft. He had a clear, blue eye that looked a man square in the face when he spoke to him, and light hair that stuck up all over his head in short tufts. He worked at the vise, and when he stood up in front of it he was a sight to behold. The dumbest and least observing man in the shop could see there was a difference between him and the others. With shoulders square and chest thrown out, he drove a sixteen-inch bastard file with those massive arms as easily as I could a twelve-inch, and his stroke was just as vigorous and as steady at six o'clock as it was when he started. Whatever he did was well done. No man could make a closer fit or a better finish with so little fuss. Withal, he was as good natured as the day was long. No man ever went to him for advice or for consultation on a hard job that he did not give it willingly and promptly. Jealousy of others was left out of his mix when he was cast; he didn't know what the word meant. His magnificent physical proportions attracted the eye, and his temperament made everyone a friend for life.

I can see him now, as he stood many years ago, fitting up a pair of side rods; he was draw-filing them in the vise, and he had one end fast in it by the stub end, the other being supported by usual device for that purpose. When he changed ends or sides, he would take that rod out and turn it around as easy as a boy would a cane, and it almost seemed as though he could take it by one end and brandish it like a club.

Poor Bill! he had hard luck, as I shall proceed to show. If any man who reads this thinks it is a romance, he is under a wild delusion he had better get rid of. It is a record of actual fact, so far as the facts can be told, of an episode in the life of a comrade. My object in relating it in these columns will be sufficiently obvious, I hope, to the most careless reader who reads to the end.

I was passing Bill's vise one day, when he reached out, caught me by the slack of my overshirt, and dragged me back as easily as I would a boy, and I am no chicken myself, nor a light weight.

"Look at that," said Bill, and he pointed to a common brass door-key hanging on the wall.

"What of it?" said I.

"Do you see that key swinging back and forth as if it was alive?" said Bill.

"Yes," said I.

"Well, its been going that way ever since I hung it up there an hour ago. It's the key of my house. The old woman has gone away for a holiday, and I locked the door and brought it along. It swings just the same now as it did when it started, and it would swing that way forever if was rightly balanced; it's too heavy on one end."

I looked at him to see if he was joking, but it was hard to say whether he was or not; he had one of those imperturbable faces which express nothing, or can be easily masked, so that it was impossible to say whether he was fooling or in earnest.

"What of it, if it has been swinging that way?" said I.

"You'll see what of it. I have got an idea that will make my fortune and no mistake. You come along here at this time to-morrow, and I'll show you something. I laughed at him and went on about my business.

I had forgotten all about the incident above related, but as I was going through the shop Bill called me over and said:

"Look here!" taking down a newspaper that hung over a brass model like a double clock-hand, or a scale beam with a hole in the center. "I hung this up over it so the boys would not see it," and he pointed to the model which was swinging away at a great rate. "That thing has been a jumping like that ever since I hung it up."

"Bill, what are you trying to get through you, anyway?"

"I want you to tell me why that thing moves without anything to drive it, and keeps going when it ought to stop," said he.

I looked at him again; he was in dead earnest, and no mistake, so I said: "It's easy enough to see why it goes. You have it hung on a knife edge, and it is perfectly balanced. Put your hand on the partition; it is vibrating back and forth all the while, from the shake of the lathes and planers. That is the power that keeps your model going. Take it off and put it on a frame where it can't get any external jar and you will see that it will obey the laws of gravity, and come to a stop the same as any other insensate object, as soon as the impulse which gave it motion is spent."

"Don't you believe I can make a perpetual motion out of that?" said Bill.

"No, sir; neither you nor any other man can ever make a perpetual motion. It is a mechanical impossibility. Bill! I hope to goodness you ain't going to get struck with that idea," said I, earnestly.

He laughed. "Well," said he, "I ain't going into it very deep, but there is an idea in that thing, and I believe I can make something out of it. I will make a small model, and if it goes all right I will make a larger one. If that is O. K. good-by Mr. Vise."

"Bill," said I, "don't you spend a cent on it, nor a minute's time. What's the use of fooling with an impossibility?"

"That's a big word, young man. All things are possible to him who wills; didn't I hear you say that one day?"

"All things are possible that are practicable; but those that are contrary to natural laws are as far off as ever, and never will be any nearer, but I don't suppose you are in earnest," and so I left him."

A job of setting up took me out of the shop for some weeks after that, and I forgot Bill and his notions. When I returned and had a chance to look around I noticed a great change in him. He was abstracted and preoccupied, and always in a brown study over something. He would stop in his work and stare at the wall, or away off, out of the window, and was as different a man as it is possible to conceive. His very nature had changed. Once he was as sociable and even tempered a man as you would wish to meet; now he was curt, sharp spoken, sometimes surly, and many times irritable. The men used to be afraid of him, for he was a giant in stature and strength, and if aroused there was no saying what he might not do. The boys said he had taken to drink, but no one ever smelt liquor about him, or saw the outward signs of it. He took to losing time. Often he would come in at half-past nine, and sometimes quit at twelve o'clock. Such a thing was never known before. He was as regular as the clock itself. No man was more steady, and by that, and through getting the best wages in the shop, and having a good wife he had managed to lay up, as he once told me, about $1,500, with which he intended to build him a house in a year or so. He was always tinkering and fussing away with some little trap he held in his hand and filed, and he had a lot of small gears, about an inch and a half diameter, very fine in pitch, that he used to be puzzling over. Once I caught sight of a small frame with a lot of traps on it, and then the murder was out; it flashed across me suddenly what he had said some time ago about a perpetual motion, and that was the cause of all the trouble.

I wasn't going to let an old friend and a comrade go to the dogs without a protest or a struggle, and where others held aloof from Bill and gave him the cold shoulder I forced myself on him, and put up with all his cross ways and surliness. Once in a while he would regain his old time disposition, and then he was confidential. He knew that I was aware, by this time, of his infatuation and he would try to get advice from me on some trouble that he had run against, but I steadily and in all cases endeavored to discourage him from doing anything more to his machine. Sometimes he would listen to me and say that there wasn't any use in fooling with it any more, but the very next day he would be tinkering away and say, exultantly, 'I have got it now. I ran her last night for three hours and only that part of the bearings were only half finished she would be running now. I am going to put on another gear instead of a pinion and then she will start from the word go, and never stop until the world ends, or I stop her."

Seeing that his infatuation was complete I gave up remonstrating, thinking that time would effect a cure, and that when he became convinced of the hopelessness of his efforts he would rally and take his place again.

Shortly after, I had to go out of the shop on another outside job, and when I returned a stranger was at Bill's vise. I asked the boys how long Bill had been gone, and they said some weeks. Inquiring what caused him to leave, they said that he had an idea that he was just on the point of discovering perpetual motion, and wanted to give his whole time to it. He had bought a small lathe, set it up in his front room, and was working night and day. No one had ever seen the machine, but from the quantity of castings he had bought and put into it the boys said it must weigh about a ton. Determined to make one more effort, I called at his house one night to see if I could not dissuade him from going further. I thought that possibly he might feel that it was indeed contrary to natural laws for such a thing as perpetual motion to exist.

When I reached the place his wife came to the door, opened it only a little way, and then, seeing me, opened it wider, and said: "Oh! Mr. Moulton, I am so glad you came. I think Bill is out of his head. He scarcely takes time to eat or sleep, but is always at work on that dreadful machine. It don't seem to me that it is any nearer going than it was a year ago; but he is putting more time and money into it than ever before. He has drawn I don't know how much out of the bank, and keeps drawing it all the while. What to do I don't know. I wish you would tell me. He won't listen to me nor any one else. He says he is going to be rich, and have his name in all the papers, and that in a month this house won't hold the people that will come to see his wonderful machine. I have seen it lots of times, and it's a beautiful thing; but I think it will drive me crazy. Mr. Moulton, it looks to me like some awful monster. There it goes, tick-tick, tick-tick, all day long. Sometimes it runs three or four days, and then Bill begins to laugh and sing, and it seems like old times; but all of a sudden it stops, and then he is like a wild man; but he never loses heart nor hope. He says it is on account of wanting a spring here or a pin there. Then he pulls it all down and goes to working at it again.

"Mr. Moulton, that thing has swallowed up more than dollars. My husband's life and hopes have gone into it. It has changed him into iron like itself. He is as hard as it is. His children, that he used to love so much, he cannot bear the sight of; he says they fret him. As for me—but I won't complain. Maybe, if you were to go and speak to him, you could call him back to life, for he is just as dead to it as if he was under ground. He used to have a great opinion of you, and maybe if you was to talk kindly to him you could get us out of this scrape."

The poor woman threw her apron over her head and cried in a low, pitiful way that was more than I could bear.

Suddenly the door opened and Bill came in. Seeing me sitting there in the half light, and not recognizing me at first, he turned on the woman and roared out:

"I thought I told you not to let any one in the house!"

"Bill," said I, "it's only me—Moulton; but I will go if you don't want me here."

He looked relieved when he saw who it was, and said:

"You scared me. I thought you was a stranger sneaking around to steal my ideas, but seeing you are here, you shall see what no other man but me ever saw. Come in and have a look at her. I will trust you with anything."

I followed him, and somehow—I can't explain it—the sight of that machine affected me as only one other thing ever did in this world, and that was an automaton flute-player—a devilish thing of life size, with a face like a corpse and motions like one galvanized. It rose to its feet, cast its sinister eyes around, raised its flute and played dirge-like tunes. It was blood curdling.

So this machine, as we stood before it, filled me with a feeling I am unable to express. It was about four feet square, and so complicated you could not see through it. The work on it was marvelous, as might have been expected from the maker of it. Every bearing was hung on centers where it could be, like lathe centers: every gear meshed perfectly, and beyond the slow, mathematical tick-tick of an escapement on it there was no sound. Something came up in my throat and choked me, and I no longer wondered at the poor wife's feelings in the presence of this concrete infatuation and delusion. I could not speak, and didn't attempt to.

"What do you think of it?" said Bill, at length.

"How long has it been running?" said I, evasively.

"Since last Tuesday," said Bill. "That is a week."

"And it is all honest?—no secret power anywhere, no coiled springs, no nigger in the fence?"

"As God is my judge, it is what you see. I think I have got her now."

Even as he spoke there was a perceptible lagging in the movement, and while we stood watching it she stopped.

Neither of us spoke.

In a moment, Bill jumped for a sledge that stood in the corner, and raised it over his head with a fearful oath.

"I'll put an end to this now and forever," said he; but before he could strike I grabbed his arm and stopped him.

"Wait," said I; and for this I have never ceased to blame myself.

What followed will have to remain until the next issue.

"IN THE ROUND HOUSE."—No. 8.

FIRING.

By L. O. Danse.

When a young man wishes to become a fireman, he will do well to think twice before he makes his application to the master mechanic. Certain mental and physical qualities are requisite to make him successful as a fireman, and these qualities, heightened and improved by experience, are imperatively necessary in a runner.

Good general health and plenty of muscle are necessary, as there is considerable work in keeping up the fire and cleaning up. Perfect vision is requisite in order that he may readily see all signals. Endurance is needed to enable him to stand the long hours of double runs or extra trips. Quick perception he must have to see what is to be done, and to do it without needing to be told constantly. Good hearing is indispensable, for many reasons. He must be able to read and write, and to "figure" readily.

On most roads firemen are put on "extra" at first, taking the place of any "regulars" that may be unable to go out. If they give satisfaction they are put on a regular freight run, and afterwards on a "passenger," from which they will be promoted to third-class engineers. Some roads put men on shifters first, and then promote them to road engineers. It takes a man from three to four years to become a runner. No two engines fire precisely alike, but there are a few general rules that apply to all.

In the first place it is well to keep in mind the fact that there are two ways of setting grates in common use—horizontally and inclined. Also, that some grates rock and others do not. Fuels, also vary greatly. In the South many roads burn wood. In the East, anthracite, and in the West bituminous coal.

Firing with wood is rather difficult and very laborious. The difficulty lies in keeping wood enough in the fire-box to "keep her hot" without having the whole fire-box full and the draught impeded. The wood must be fed a stick at a time and frequently. Engines for burning anthracite usually have very large fire-boxes and water-grates. This fuel must be fired "spreading;" that is, the coal must be distributed over the whole grate. The fire must be rather thick and even. Bituminous coal is the most common fuel for locomotives. In general, the fire should be about nine inches thick and most of the coal fed near the fire-door, and afterwards poked or shaken forward. Fire often and not much at a time. Coke requires a heavy fire eighteen to twenty inches thick, and need not be fed so often. No matter what the fuel, the fire must be kept even, with no thin spots for cold air to come through. The appended method is that generally followed.

When approaching a heavy grade make up a good fire, so that there may be a large body of incandescent coke (for all coal becomes coke after the smoke is burned off), and when pulling hard up the grade feed the fire often, but do not pile in a whole fire-box full at once. When going down grade with the engine "shut off," if there is a good fire, close the ash-pan dampers; but if the steam is down and another ascending grade is at hand, make up the fire and put the blower on. Never throw coal on the fire just before going into a station, as the smoke is objectionable.

In approaching a station, the fireman must act so soon as the runner shuts off steam. If he has a good fire and plenty of steam, he must close his damper and open his fire-door register; or if he has no register, the door may be opened slightly. Opening it wide is objectionable, as it cools down the boiler too rapidly and too much; all that is wanted is to keep it from getting hotter than it is. If, on the contrary, the steam is down pretty low, the fireman must put on the blower and stir up his fire, coaling it so soon as he leaves the station. Firemen must keep their ash-pans empty, or their fires will not burn satisfactorily.

"I had a little Dutchman firing for me once on a construction train," said a driver recently. "One morning he couldn't keep his fire up at all, although our work wasn't very heavy. I didn't know what was the matter, for the dampers were right and Jacob said the grate was clean, and yet he had great trouble in making his fire burn. After a while I got down to oil and happened to notice that the ash-pan was full of ashes. Jacob had forgotten to rake it out, or had been too lazy to do so, and it was choked up just as though the damper were shut. I made him rake it out, and that ended the trouble with the fire."

Firemen must remember that it is their duty to keep the steam regular. Watch the gauge closely. Don't keep the pressure up to the blowing-off point. Every time the "pop" blows off a certain amount of coal is wasted, and water, too. If you can keep the pressure regular, at say ten pounds lower than the popping point, the engine will do her work much better than if the steam goes alternately "way up" and then way down. If you want to get the coal premium never let her pop. There is a great difference in firemen in this respect.

One day I was riding with Bill J——, who hauls the through freight with a ten-wheeler. We had a pretty good train, and it took pretty hard firing to keep the steam up; but the little Irishman who wielded the shovel was so much afraid of running out of steam that he kept her pop blowing off all the time. He was very much offended when I told him he had wasted lots of coal.

Last week I was with John F——, who pulls the morning accommodation. I sat in that cab for two hours and watched the gauge constantly, and I am sure that it did not vary five pounds either way from 130 lb. The fireman fired often and very little at a time, and every time the runner "shut her off" the fireman would close his damper and open the register in the door.

If there are no hollow staybolts in the side of the fire-box, always keep the door register open for a while after coaling the fire, as that will assist in burning the smoke.

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WEIGHT is the natural enemy of speed, for weight means load, and load means extra work for every extra ounce carried beyond absolute need.

TESTING BOILERS BY HYDRAULIC PRESSURE.

Carefully and intelligently conducted, with the weaker parts closely examined and gauged before, during, and after the test, the hydraulic test may be made of the highest value, and prove useful in assisting to form a judgment as to the safe working pressure of a boiler weakened by long usage, whose real strength, owing to the existence of various defects developed in the course of long service, cannot be determined by any of the ordinary methods of arithmetical calculations, commonly adopted in determining the strength of new boilers. It requires, however, that any one making such a test should have had considerable experience in such matters, and he can only be able to form a sound judgment by having had opportunities of watching the behavior of boilers working under different and varying conditions.

To illustrate by an example: Let us take the case of a boiler which has been resting for some time on broad seatings of damp brickwork, and in which the plates have become seriously reduced in thickness by external corrosion where in contact with the seatings; inspection would discover the dampness and lead to the detection of the corrosion, but the mere application of the hydraulic test, without any examination, would in 99 cases out of 100 reveal nothing which could lead anyone to suspect the dangerous condition of the boiler in the parts not exposed to view.

We remember some time ago a boiler being taken from its seat on a broad midfeather wall, where the plates were so much corroded that portions of the boiler bottom remained on the wall, leaving holes in the bottom of the shell. The support afforded to the attenuated plates by the brickwork seating only had prevented the shell from giving way at the bottom. And more recently still, a boiler owner, after considerable difficulty, was persuaded to raise his boiler from its seat, and when the manager came to examine the part which had rested on the brickwork he could bend the plates with very little effort by pressure with his fingers. The hydrostatic test in both of these cases would in all probability have revealed nothing which could lead to the discovery of the defective state of the shell, because, unless the parts most seriously affected had been exposed to view any bulging or yielding could not have been seen, and the brickwork would have prevented the plates from giving way. While, therefore, we agree with the recommendations usually made to test all new boilers by water pressure, and also to apply the test after any considerable repairs to old boilers, in order to see the quality of the work and the staunchness of the seams of rivets before being covered up, we maintain that careful inspection should always go along with all tests, and no amount of testing can supersede the necessity of this.

It is, we believe, mischievous to contend that inspection can be dispensed with, if a water test is regularly applied. Many accidents, we believe, have been directly attributable to this notion being held by those responsible for the boiler's safety. It is a common practice, especially in testing new boilers, to submit them to a test pressure double that to which the boilers are intended to work. This we scarcely consider judicious, especially in view of the high pressure now being carried, because a pressure of 50 per cent. higher than the working pressure would be quite adequate to establish the tightness of the work, and to show any indications of weakness, whereas the application of an excessive pressure tends to develop undue strains, and may induce incipient fractures and other defects, which, in course of time and working, may further extend and ultimately lead to disaster. The practice of the Admiralty, we believe, is to apply hydraulic pressure to double the working pressure, and to continue the test at half-yearly intervals so long as a boiler is in use. When the test is applied, however, the boiler is closely examined over all parts. Careful gauges are taken at different places, and as soon as any indications of weakness are shown at any part, the test is stopped, and the working pressure afterwards limited to about one-third the pressure at which weakness was observed. Under such conditions—that is, where the test is accompanied by intelligent and careful examination—testing by hydrostatic pressure may prove of value; but this is a very different operation to the ignorant "pumping up" of boilers to a pressure some 50 or 100 per cent. in excess of the working pressure required. Such is too frequently understood to constitute a "hydraulic test," and if it does not "burst" it is pronounced, without any examination whatever, to be in perfectly sound and safe condition to work at the pressure required.—*World.*

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BELTS GO WHERE THEY ARE CARRIED.

In the estimation of the general public, belts are always good servants, speeding along quietly in the even tenor of their way, doing man's will and pleasure as if they were sentient beings, and took delight in good behavior. But there are people who could "another tale unfold" of belts creeping and crawling, turning and twisting, climbing and slipping with as much "won't-go-ativeness" as if they were made of a mule's hide with the mule left in.

A belt will go just wherever it is carried, and this is at once its vice and its virtue. A belt runs to the high part of the pulley, not because it is tighter there, but because it is carried there by the greater circumference of that part of the pulley. A well-turned crowning pulley has more circumference and therefore more motion at the middle than at the edges. The difference is slight, but that difference is a mighty agent in producing results. The rule of proof in mathematics is to reverse positions, and let the operator be operated upon. We have seen the belt moving over the surface of the pulley; let us in imagination see the pulley moving over the surface of the belt.

Stretch out a 6″ belt flat on a level floor; take a 6″ crowning face pulley that is turned a straight taper from each edge to the middle and place the middle of the rim, say at the left edge of the belt, and tip the pulley to the right so as get a bearing on the belt just half of its width, and also on just half of the width of the pulley. Now roll the pulley forward, keeping its inclined surface in contact with the belt, and the middle of the pulley will soon get across the width of the belt and reach its right edge. Now tip the pulley to the left until it has a bearing on that side and roll forward, and it will traverse the belt to its left edge. Tip again to the right and roll again, and when the middle of the pulley and the middle of the belt meet, set the pulley straight up and raise the edges of the belt its entire length so as to conform to the surface of the pulley, and then roll the pulley forward, and it will keep on the belt to the end, like a keg ot nails on skids. Now, in this case we can readily see that it is the greater and the less circumference of the double cone-shaped surface of the pulley that governs its action when the pulley is on the belt. Now, when we put the belt on the pulley, as at work, the same circumstances of greater circumference and greater travel remain, but the pulley is fastened to the shaft and cannot move sidewise, but the belt is free to move and be carried to the high part and beyond it, until an equilibrium is established between the carrying forces of the two cones of the pulley, and then it will run; not because of any greater tension, but for a reason that I have tried to make plain, and that is, that a belt goes just wherever it is carried.—F. J. MASTEN, in *American Miller.*

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SAYS A FOREIGN CONTEMPORARY:

"It may be questioned whether the world does not owe more to George Stephenson as the founder of the modern system of speedy transport than to any of the great public men she has produced."

It is about time George had a rest. There are a good many others who have done quite as much as he did, who have had no chance at all.

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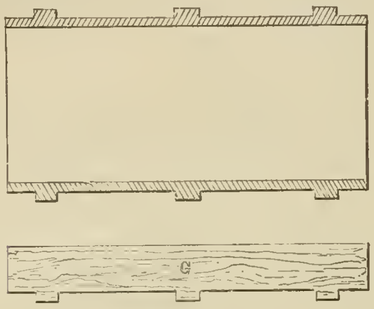
We do not suppose many of our readers are ever afflicted with "black eyes" of a disreputable sort, but supposing them to get one by accident they may remove it by applying starch made into paste and bound on for a few hours.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. VIII.

By J. P. Mullin.

CASTING LARGE CYLINDERS IN LOAM.

No other method of making castings requires so little pattern-making as loam work. In fact, we can almost say that in this branch of the business the regular pattern-maker is dispensed with entirely.



Figs. 52 and 53.

Fig. 52 is a sectional elevation of a large cylinder, intended to be cast in loam, and in this case all that is wanted from the pattern-shop is the loam-board, *G*, shown in Fig. 53. It might be called a templet for forming the outside of the casting required.

MOULDING.

Having made the proper excavation in the floor and set the spindle step, *A*, Fig. 54, get a sufficient number of stands, such as are shown at *B*, *B*, and set them quite solid and level, in the bottom of the mould. Upon these place the strong cast-iron plate, *C*, *C*. The outside diameter of this plate should be equal to that of the brick wall required for the mould, and the hole in the center about 6″ or 8″ smaller than the inside diameter of the cylinder. The inside edge should have an angle of about 45°, as shown at *D*.

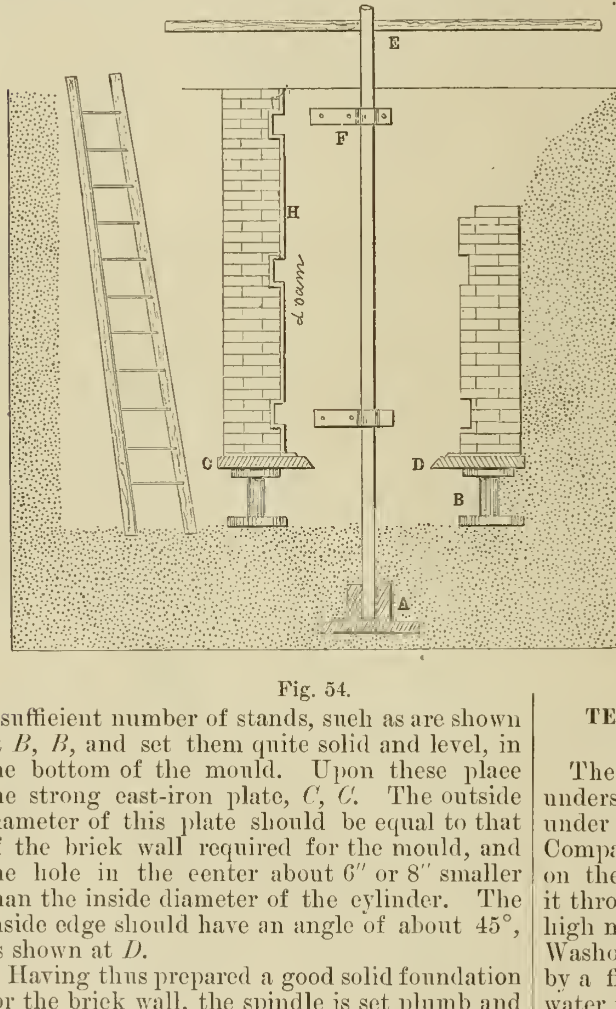


Fig. 54.

Having thus prepared a good solid foundation for the brick wall, the spindle is set plumb and held in position by the brace, *E*, and the loam-board, *G*, Fig. 53, bolted to the arms, *F*, *F*. We are now ready to build the brick wall, using the loam-board for a guide as to plumb, inside diameter, shape, etc. When the wall has been completed it is then lined with a coating of loam, shown at *H*, *H*, the board, *G*, being again used for the purposes mentioned above.

When this has been done, and the loam-board and spindle removed, we are ready to dry the mould. A good place to do this is shown at Fig. 55, and requires very little explanation. The heat dries the mould, as it rises from the fire, which has been kindled in the temporary furnace shown in the figure.

The method of making core-irons is shown at Fig. 56. The bottom plate, *J*, is made to fit the hole in the center of the foundation-plate, *C*, *C*, Fig. 54. The center or lifting-bar, *K*, is made fast to the plate, *J*, and the side wings, *L*, *L*, are held in position by the hinged arms, *M*, *M*. The side wings, *L*, *L*, should be about ¾″ thick, and any convenient width. When the brick-core has been made, and coated with loam, as shown at Fig. 57, it is ready for drying.

When the core and mould are both thoroughly dried, the fire is taken out of the bottom of the mould, the core is set in position, and the mould closed.

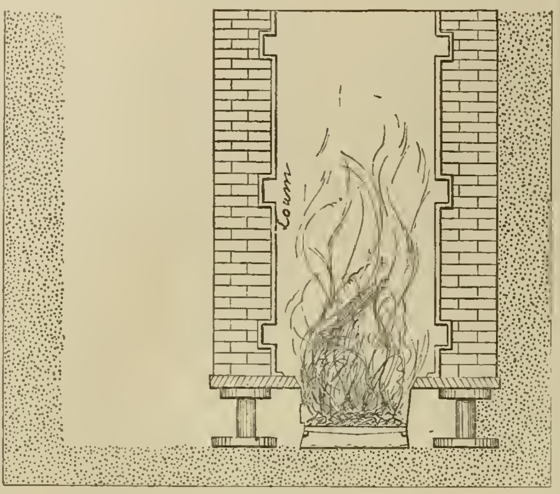
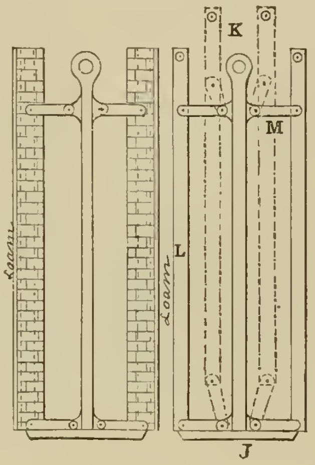


Fig. 55.



Figs. 56 and 57.

Now, when the cylinder has been cast and the metal just set, the side wings, *L*, *L*, may be drawn out of the brick-work of the core up into the position shown by the dotted lines, Fig. 56. This allows the core to be pressed in by the shrinkage of the metal, and thus avoids the danger of breaking the casting.

TERRIBLE FORCE OF WATER UNDER PRESSURE.

The properties of water are only partially understood by those who have never seen it under high pressure. The Virginia City Water Company gets its supply from Marlette Lake, on the Tahoe side of the mountain. It gets it through by a long tunnel on the crest of a high mountain opposite Mount Davidson, with Washoe Valley between. To cross this valley by a flume would be almost impossible, so the water is carried down the mountain side to the bottom, and crosses under the railroad track, then up again to the required height in iron pipes. The depression created in the line of carriage is 1,720 feet, and the pressure on the pipes is 800 pounds to the square inch. One pipe is eleven inches in diameter, and is quarter-inch iron, lap-welded, and eighteen feet long, with screw joints. There is little trouble from it; but the other, which is twelve inches in diameter and is riveted pipe, makes more or less trouble all the time. The pipe is laid with the seam down, and whenever a crack is made by the frost or sun warping it, or from any other cause, a stream pours forth with tremendous force. If the joint is broken, of course the whole stream is loose and goes tearing down the mountain, but usually the escape is very small.

The break last week was less than five-eighths of an inch in diameter, and yet the water in the flume was lowered an inch and a half by it, and the pressure went down fifteen or twenty pounds. It has been probably a year in cutting out, and was made by a little stream hardly visible to the naked eye that escaped through a joint and struck the pipe two or three feet off, eating away the iron until the pressure inside broke it through. When such a break occurs the noise can be heard for half a mile, and the earth shakes for hundreds of feet around. A break the size of a knitting needle will cut a hole in the pipe in half an hour. Such breaks are repaired by putting a band around the pipe, pouring in molten lead, and tamping it in. Such a stream bores through a rock like a sand blast. The flying water is as hard as iron, and feels rough like a file to the touch. It is impossible to turn it with the hand, as it tears the flesh off the bones, and if the fingers are stuck into the stream, with the point up, the nails are instantly turned back and sometimes torn loose from the flesh.—*Reno Gazette.*

INVENTORS AND INVENTIONS.

The number of successful inventors is large, but the number of unsuccessful ones is much larger. Only the other day 17,000 models of rejected inventions were sold for old junk. There is always somebody working at the unsalable problem of perpetual motion or making a flying machine. It not infrequently happens that, after a patent has been refused to an inventor a subsequent application is granted by a different examiner.

It sometimes happens that a patent is granted to one man after somebody else has failed to receive a patent for the same invention. This is a fruitful source of litigation. Indeed, litigation about patent rights is so common that in the introduction of any valuable patent the legal expenses of defending it are a large part of the capital required. Immense sums were spent in defending Morse's patents for telegraphing, and the various patents for sewing machines, India rubber manufacture, and of the inventions that have revolutionized industrial processes. But, when rights are once established by law, the profits are enormous. It was shown in a recent case before the United States Court that for royalties alone on the manufacture of barbed fence wire more than $1,000,000 a year were paid.

Inventors are now chiefly busy with electricity, and the Patent Office is deluged with devices for making new uses of the modern marvel, or for using it with new appliances. Many of these inventions run in the direction of motors. The opinion has gained some ground lately that storage batteries of electricity are not as successful as was at first expected. It is asserted by some that no storage battery ever gives out as much electricity as it receives, and that every moment decreases the amount yielded. Edison says the best storage battery is a ton of coke, which can be used at any time to drive a dynamo machine. Others, however, still think that the storage battery will produce wonderful results.

Inventors have always sought to utilize the forces of nature for the conservation of power. A good deal of time and money has been spent on efforts to utilize the force of the rise and fall of the tide. According to some plans the water is to be stored in a reservoir at high tide, and used to turn a water wheel when the tide falls. Another plan is to get the power from the rise and fall of a float. There used to be a tidal mill at Astoria and another at Charleston, S. C. The large amount of land required to get the requisite area of water surface is considered an insuperable objection to tidal mills.

A good deal of money has been expended on solar engines, in the hope of getting power out of the sun's rays. John Ericsson, the inventor of the monitor, has made some beautiful solar engines, and not long ago an inventor had a model of a solar engine on the top of the Cooper Union building, and managed to get up steam in a boiler. The trouble is, however, that the sun does not always shine, and the solar engine, to be of any practical use, must be accompanied with a storage reservoir of power that can be kept for a rainy day. After all, coal is nothing but the heat of the sun stored in past ages for present use.

Capital is never wanted to try even the most foolish inventions. Not long ago an inventor had an idea that he could by the use of a naked wire produce a return current and avoid electrical disturbances in cables. He could have got the capital to lay a long cable under ground to try his experiment. He was with difficulty dissuaded from doing this by a practical man, who saved him lots of money by wrapping several lines of cable about a barrel and arranging the naked wire as proposed by the inventor. The result was a complete failure, but the cost of the experiment was comparatively trifling. Men will work away at an idea with no knowledge of what has been done or what can be done, only to discover at the end what they should have known at the beginning.

A very good example of the eagerness with which capital can be secured to promote the most chimerical ideas may be seen in the story of the Keely motor. The stockholders have been pretty thoroughly bled already, but are compelled to bleed still more in the hope of saving what they have already expended. The varying fate of capital invested is seen in the contrasting results of the two steam heating companies in New York city, one of which has proved a most lamentable failure, while the other has had a measure of success.—*N. Y. Sun.*

QUALITY OF IRON FOR STEAM BOILERS.

There is so much discussion and controversy in regard to the real value of the different grades of iron offered in the market for boiler plates, that we have investigated the subject in order to ascertain what the brands used at present mean, and what quality of iron is indicated by them.

We find that the brands formerly used were: C. H. No. 1, flange, C. H. No. 1, shell, C. No. 1, Tank.

Some manufacturers were not satisfied with these brands because they did not indicate the true character of the iron, and boiler users were often deceived by having an inferior iron palmed off upon them, when they supposed they were securing a first-class article. The brands were subsequently changed, and the following are those used by most, if not all, the prominent iron manufacturers in the country.

C. H. No. 1, flange, C. H. No. 1, fire-box, Shell, Refined, Tank.

If these brands are honestly used the quality indicated is as follows, viz: C. H. No. 1, FLANGE, and C. H. No. 1, FIRE-BOX, are strictly charcoal iron. SHELL has only a thin cover or outer skin of charcoal iron. REFINED has no charcoal iron in it, but is simply refined from the pig. The pigs are selected with reference to the quantity of carbon which they contain. They are divided into *foundry* and *forge* pigs. Those containing the least carbon being selected for conversion into wrought iron. From the refinery the iron is usually run into large moulds and then broken up into what is technically distinguished as "*plate metal.*" Now the term "refined" iron is very indefinite, and means anything from "muck bar" to that which has been through several processes. The value of charcoal pig-iron and charcoal blooms is owing to their being produced with a fuel that is free from impurities; and while other irons can be purified it can only be done at expense and loss, and the danger is that in some cases at least it will be only purified sufficiently to "pass muster," and sell. The brand of "refined" iron in the market is often recommended as a superior article, because it is "refined," and the purchaser is led to believe that it is something unusually good.

Another test of quality is this: the price of refined iron at the time of our inquiry was $1\frac{1}{4}$ cents per pound less than the price of C. H. No. 1, Flange. The prices were, "*Refined,*" $3\frac{1}{4}$ cents per pound; *C. H. No.* 1, *Flange*, $4\frac{1}{2}$ cents per pound. Questions relative to the quality of boiler plate are frequently asked us, and we take this way of answering them. We believe in the best material for boilers and always recommend it. We know that there is sharp competition in the business, and that the margin of profit is often very narrow. But the purchaser should know what he is buying and be willing to pay a fair price for a first-class article. The purchaser is often as much at fault as the boiler-maker, by trying to get a first-class article for less than its cost. We know all reputable boiler-makers would prefer to use the best material and get a fair price for their work, and some will not make estimates if inferior material is called for.—*The Locomotive.*

FREIGHT TRAIN SPEED.

In experiments made with a heavy freight train on a western road by Mr. P. H. Dudley with his dynograph car, it was found that a speed of 18 miles an hour required less power and was more economical of fuel than a slower rate of speed, say 10 or 12 miles an hour. This was the result for the entire trip, including all the elements of resistance, frictional, atmospheric, grades, curves, etc. The track was in good condition and was laid with steel rails. The reduction in the amount of fuel consumed was very marked, owing to the fact that the engine developed its power at the higher speed much more economically that at a slower rate. It was found, however, that when trains were run at a rate much above 18 miles an hour, the atmospheric or wind resistance increased faster than the other elements of resistance decreased. These results, it is to be presumed, were realized upon tracks with moderate grades and curves. Upon long and heavy grades, in connection with sharp and frequent curves, the conditions would, of course, be very greatly changed.

The fact seems to have been established by Mr. Dudley that an average speed of 18 miles an hour for heavy freight trains upon roads as straight and level as the New York Central and its immediate western connections, is more economical than a slower speed. But whether this limit can be exceeded with like results is not so clear. There seems to be a point at which the atmospheric resistance is increased to such an extent as to neutralize the decrease of frictional resistance due to increased speed. If this point could be definitely ascertained as respects freight trains, it would go far toward settling the question as to whether these trains can be run to advantage at a speed of 25 or even 30 miles an hour. The old theory that train resistance increases as the square of the speed has been a good deal shattered by recent experiments with the dynograph. In regard to passenger trains, Mr. Dudley found, if our memory is not at fault, that the draught of a certain train at starting was 12,000 pounds, while at a speed of fifty miles an hour it was only 3,000 pounds. And yet, if reliance is to be placed on some other authorities, the atmospheric resistance to passenger trains moving at high speeds increases in a ratio much greater than the square of the velocity, however it may be with journal and flange friction, curves, and grades. That the maximum speed of passenger trains has not increased within the past thirty years, notwithstanding the efforts that have been made in the way of fast running, is an evidence that with them the practical limit has been reached, under existing conditions, at all events.—*Car Builder.*

REAMERS AND THEIR WORK.

At the recent meeting of Master Mechanics in Chicago Mr. Coleman Sellers made some interesting remarks upon reamers, a portion of which we copy from the *Railroad Gazette:*

"A reamer is intended to produce a straight hole, but having passed this reamer once through a hole, the reamer must be slightly worn. The next time you pass it through it is a little more dull, and each time it is worse, the hole made by it must become smaller. There have been many attempts to produce a reamer which will be adjustable. Thanks to the gentlemen who are now making such tools a specialty, there now has been added a very useful tool to the machine shop. Here is a reamer made by the Betts Machine Company, of Wilmington. In this the straight cutter blades are made wedge-shape on their back edge, and are seated in wedge-shaped or taper grooves, to match the taper of the blades; these blades can be set to fit a standard gauge.

"This will enable us to make and maintain a commercially uniform hole in our work. But the successful use of a reamer of this kind depends upon the drills that precede the reamer, being made as nearly right to size as possible: in other words, that the reamer has as little work given it to do as possible. The less you give a reamer to do the longer it will last and the longer it will maintain its size. The question of tapered bolts involves at once this difficulty, that we have to drill straight holes; then the tapered reamer is obliged to take out all the metal that must be removed in order to convert a straight into a tapered hole. The straight hole reamer is maintained to size longest by taking out the least amount of metal. Hence it follows that the tapered reamer would be the nearest right for durability, which also would take out the least amount of metal. A short reamer like that (see fig. 2) will answer for a hole of a very considerable depth. It is only necessary that the length of the reamer shall be three or four times its own diameter. The Pratt & Whitney Co. has furnished me with reamers made for the Baldwin Locomotive Works. These are reamers that are to do precisely the work that we now have under consideration. The straight $1\frac{1}{4}$ in. reamer is say 4 in. long in the blades, the taper reamer is say 20 in. long.

"Let us now consider the question of amount of the taper. No round piece of iron can go into a round hole in another piece of iron unless it is smaller than the hole into which it is intended to go. If it is in any degree larger it must compress the plug itself, or stretch the material that is around the hole. So if we adopt a tapered bolt we cannot fix upon a certain uniform distance that each and all bolts shall stand out before we begin to drive them. If the material is to be compressed, you will admit that there is a great deal more material capable of being compressed in a piece of large diameter than in one of small diameter. Metal is elastic; as long as we keep within the elastic limit of the metal, we are safe in assuming that it acts like a spring. In the large bolt and in the small one we have springs of different lengths. In the large bolt we have a long spring and in the small one we have a short spring. If we drive a bolt into a large piece of iron, it is the bolt which we compress; therefore the larger the bolt the more the pressure we can give it to produce the required result. Therefore if we adopt any fixed taper for our bolts, we will have to use discretion, or go into an elaborate series of experiments, as to how far we should let our bolt-head stand away from the work before we begin to drive it. Now I find varying practice obtaining in locomotive establishments. There are some builders of locomotives (I mean connected with railroads) who put the straps upon their stub ends with tapered bolts, but do not use tapered bolts in any other parts of the structure. The Baldwin Works use tapered bolts wherever they require body-bound bolts. They make an universal taper of $\frac{1}{16}$ in. to the foot in diameter. Suppose it is an inch bolt we are dealing with, and an inch bolt 12 in. long, and we started with an inch, and we ran it up to a taper of $\frac{1}{16}$ in., it would result in this being $\frac{1}{16}$ larger under the head than at the point.

They make all their bolts which are under 9 in. in length $\frac{1}{16}$ in. larger under the head than the name of the bolt. Thus a $\frac{3}{4}$ in. bolt is made $\frac{13}{16}$ under the head, provided that bolt is 9 in. long or under. Anything over 9 in. long is made $\frac{1}{8}$ in. larger under the head and still made a taper of $\frac{1}{16}$ in. to the foot. Most of the bolts used in locomotives are under 9 in. long. I have been shown bolts 20 to 22 in. long that were made a taper of $\frac{1}{16}$ in. to the foot, and those were the bolts that fastened the saddle and the frame together; practically, however, the great bulk of bolts that are used about locomotives are those which are less than 9 in. in length and come under the category of $\frac{1}{16}$ in. to the foot and $\frac{1}{16}$ in. larger under the head than the name of the bolt. A locomotive builder now in this city tells me that the specifications of engines submitted to him in many cases name the required tapers for all bolts—some call for $\frac{1}{8}$ in. to the foot. The Pennsylvania road calls for $\frac{3}{32}$ in. to the foot. All Baldwin locomotives are $\frac{1}{16}$ in. to the foot. He tells me that the majority of the specifications, if they do prescribe the taper at all, ask for $\frac{1}{16}$ with the exception of the Pennsylvania. The advantage of the $\frac{1}{16}$ would seem to lie in the fact that a bolt headed in the ordinary manner can be made to fill the requirements, provided it is made of iron $\frac{1}{8}$ in. larger than name of bolt. For the purpose of discussing this question at the present time, it would be as well for us merely to adopt some taper which I should say might be $\frac{1}{16}$ in. to the foot, and carry that through the system of gauges I propose to show you, so as to enable us to judge whether it is a practical system, and how far we can use it. If we shall decide that bolts should be tapered for the reason that when a tapered bolt is driven into its place it can be very readily knocked loose, if that tapered bolt, when it is in, proves to be loose, we have merely to turn out under the head and drive it a little further. These are arguments in favor of the tapered bolts, and show why it is an advantage to use them, their use rendering it easier to repair work that is secured by them than work that has straight bolts. If we adopt a tapered bolt, and let us say with a taper of $\frac{1}{16}$ in. to the foot, it is then well to make up our mind how we are going to make bolts, and bore the taper holes in a commercial manner; in other words, so that it can be brought into what we call the interchangeable system.

No matter what taper is adopted, either by general consent uniform among the shops and the railroads, or different in any of them, yet there is always the same need for a system of gauges to carry out the principle in each shop. The Baldwin Locomotive Works, having used the taper system for many years, and considering it essential, long ago perfected a system of gauges which seem to me to meet the case. This system may be explained as follows:

"For each diameter of bolt, and for all bolts under 9 inches in length, they keep in their store-room steel plugs ground to a taper of $\frac{1}{16}$ in. to the foot in length, and each standard plug is made at its largest end exactly $\frac{1}{16}$ in. larger in diameter than the name of the bolt it represents. Thus for a one-inch bolt the standard plug will be on the taper part say 6 in. long, and one end of it will be 1 $\frac{1}{16}$ in. diameter, and the other end will be $1\frac{1}{32}$ in. in diameter, a convenient milled handle being provided beyond the large end of the gauge.

"To this standard plug is fitted a ring gauge or female gauge of any convenient external form, which is in length the same as the taper part of the standard plug; so that when the hole and the plug are clean and dry, the one should just fit and fill the other and come flush at the upper end. These plugs and rings are to be retained in the store-room as standard to try other gauges by. It is stated that the large majority of bolts used on a locomotive and made taper, can on the taper of $\frac{1}{16}$ in. to the foot, be driven home if the size of the bolt and hole is such as will cause the head of the bolt to stand above the top of hole one-eighth of an inch, and when such a bolt has been driven home it will have compressed the bolt or stretched the metal into which it has been driven to the amount of ·0065 in., and the fit will be almost as tight as are car wheels forced on to their axle in the usual manner. The gauges used by the workmen at the turning lathes for bolt work are made of cast iron similar to the gauge described in connection with the steel plug, but are rectangular, so as to rest well on the lathe bed in a handy position for trial, and on each one of these gauges is cast the representation of one-half of the kind of bolt it is used for, as for example one for hexagon head bolt and one for countersunk head bolts.

"The bench, or rather lathe guage, for an inch bolt may be, say 6 in. long and $2\frac{1}{4}$ in. square; the same sized casting, in fact, may be used for several sizes of bolts. These lathe gauges are reamed to such a size that the standard plug in the store-room will be flush with the top of the gauge, precisely as is the case with the standard ring in the store-room on the same plug. Bolts turned taper must fit this gauge with the head just touching the top of gauge, and without rattle or shake over the length of the gauge. The reamers used for tapering the holes in the shop should be not only long enough to enter the hole drilled and tapered to the required size, but there should be several inches left at the large end to allow for re-dressing; thus a one-inch reamer should be one inch in diameter at its small end, at one foot from small end it should be $1\frac{1}{16}$ in. in diameter, and if beyond this it continues at the same taper, say three inches, it should measure $1\frac{5}{64}$ in. diameter at its largest end. Such a reamer may be reground until its largest diameter has been reduced to the standard size. These reamers are guarded at their upper end by a collar driven on and covering the entire unused part of the reamer, which collar can from time to time be dressed off at the lower end to gauge, to keep the size correct. To adjust the reamers there are kept in the store-room a set of rings, one for each size of bolt, which are so sized that the standard plug does not enter flush, but stands out one-eighth of an inch. It is well, too, to retain in the store-room reamers not guarded at the large end, which can be used from time to time in retapering the gauges in use at the shop. Figuring or lettering on the guages should not be on the upper end, as that part in readjusting requires to be turned away.

MORE ABOUT HIGH SPEED ON RAILWAYS.

In touching upon speeds, the mind naturally reverts to railway traveling. Here, however, it would seem as if for the present we had reached a maximum. It is surprising how soon the speed of the locomotive was brought up to something approaching its present limit. In 1834 the average speed of trains on the Liverpool and Manchester Railway was twenty miles an hour; in 1838 it was twenty-five miles an hour. But by 1840 there were engines on the Great Western Railway capable of running fifty miles an hour with a train and eighty miles an hour without. In 1841 we find Stephenson suggesting that forty miles an hour should be the highest regular speed for trains. Now, it is a remarkable fact that the highest speed at which locomotives run in ordinary practice scarcely seems to have been raised during the last twenty-five years; on the other hand, the weight of the trains has been perhaps doubled. Although the average running time of express trains has in many cases been improved, this has been almost entirely due to their making fewer stoppages. At the same time the speed occasionally attained is very great. Engines on some of our principal lines have repeatedly run fifteen miles in twelve minutes, or at a speed of seventy-five miles an hour, and express trains run regularly at fifty-three miles an hour. It does not follow, however, that there is never to be any increase in the speed of trains, and it seems a point well worth consideration in what way the time of transit between important centers of trade can be shortened.

What are the causes which have tended to prevent any improvement in this particular? In the first place it may be said that the permanent way would suffer seriously by further increase in speed; but this could surely be overcome in time by improving the permanent way itself, which also remains very much in the same condition and of the same construction as it was twenty-five years ago. Again, it may be said that running at a higher speed would require more powerful engines, and hence that trains now worked by a single engine would require two, or would have to be split up into two trains at a great increase in running expenses. This, however, assumes that it is not possible so to improve the engine that it shall be able to exert a considerably higher power without an inadmissible increase in weight. By utilizing a larger part of the total weight of the engine as adhesion weight, it would be easy to obtain the amount of adhesion required for the increased tractive force; and for this purpose Mr. Webb's compound locomotive which enables the number of driving wheels to be increased without the use of coupling rods, appears to merit particular attention.

The fact which lies at the basis of these results is of course this, that the attainment of a high speed requires a more perfect machine, and with a more perfect machine more perfect work is turned out.

In conclusion, it should be remembered that high speed, especially the speed of rotation, is almost necessary to give perfect accuracy and steadiness to motion, as in the case of an ordinary spinning top, or a gyroscope, and again of the ingenious centrifugal machines now in use for separating cream, etc. The speeds which we find in nature are beyond all conception high, and her operations under these speeds are absolutely true and perfect. We cannot hope to vie with nature even to an infinitesimal part of a fraction of her powers of speed and accuracy; but in this as in many other great lessons taught by her, we see the direction in which we must travel in our efforts towards the perfection of work.—*Engineering.*

A NEW PERIL which threatens large communities is thus mentioned in the New York *Sun.* "This manufacture of clothing in tenements is an enormous, dangerous, and constantly growing evil, infinitely worse than the manufacture of cigars in such places. It should be stopped by law as soon as possible. The people engaged in it are poor, filthy and ignorant. They are liable to disease, and most assuredly would not stop their work on account of any contagious disease that might break out among them. They are even capable of making out of the garments on which they are working temporary beds for small-pox, scarlet fever or diptheritic patients. Think for a moment how frightfully the germs of those fatal maladies might be spread in that way. Not only New York, but the whole country is at the mercy of these people, and of the mere chance that no such disorders break out among them. I am informed by a gentleman who has been for years in the clothing business that there is not a down-town wholesale clothing house that has its good made up in this way, that is not swarming with vermin, brought in on the clothing from the tenement workshops. All germs of infectious diseases retain their vitality longest when hidden away in heavy woolen fabrics, such as are made up here, and if we ever get an epidemic of cholera in this city, these workrooms will in all human probability be among our most dangerous sources of infection."

ON SEPTEMBER 3d the new postal notes will come into use, and they will be much more convenient and cheaper than money orders. Any sum from one cent to five dollars can be sent. A blank is furnished containing dollars, dimes and cents, and the amount sent is punched out in each column respectively.

A BREAD FACTORY in France takes the crude wheat in at one end and turns out 500,000 pounds of bread weekly at the other. All the processes are systematic and automatic from first to last.

BRASS, says Professor Hughes, is sometimes magnetic, owing, doubtless, to iron in the zinc used in making it.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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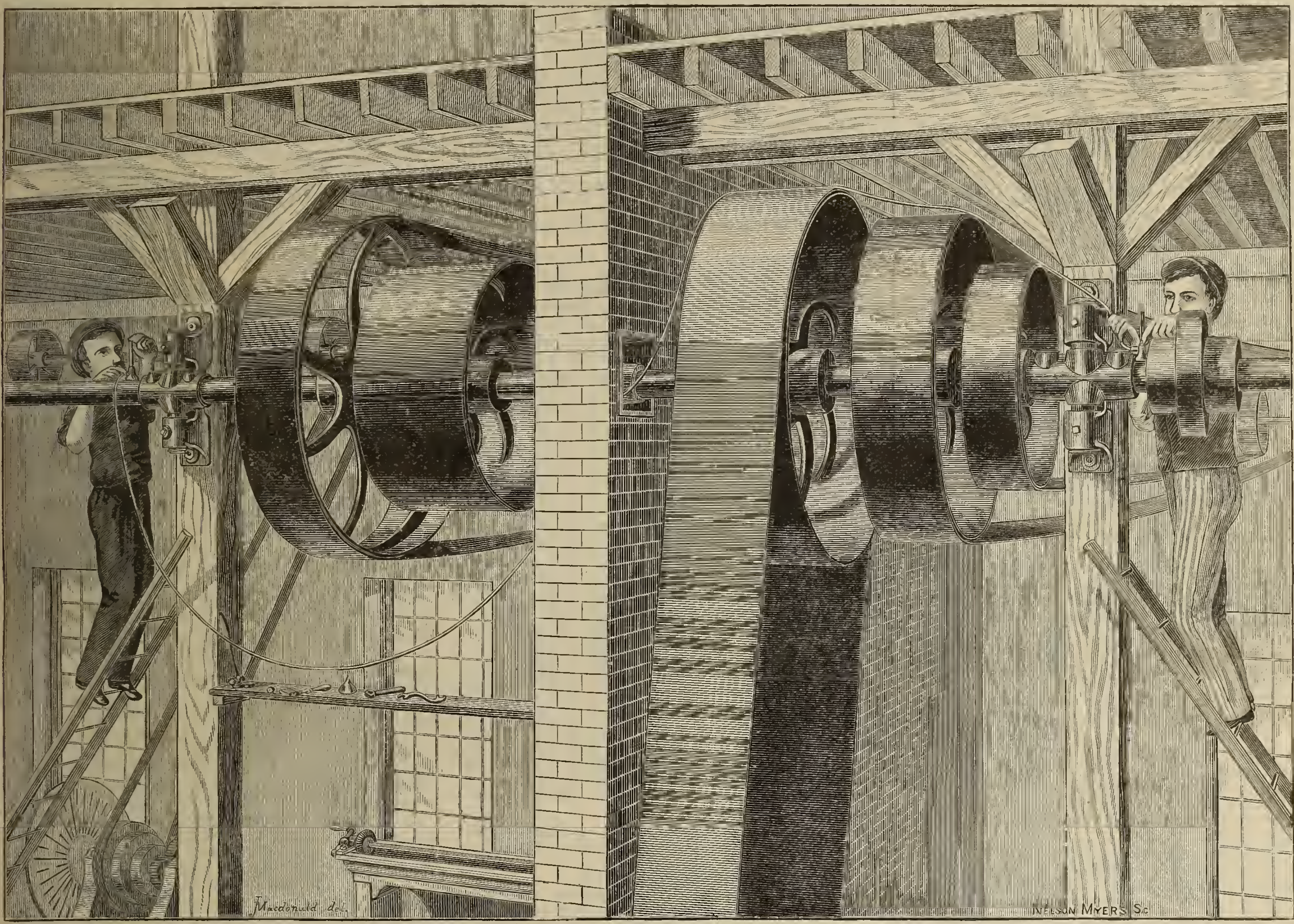
MACDONALD'S HYDROSTATIC LEVEL.

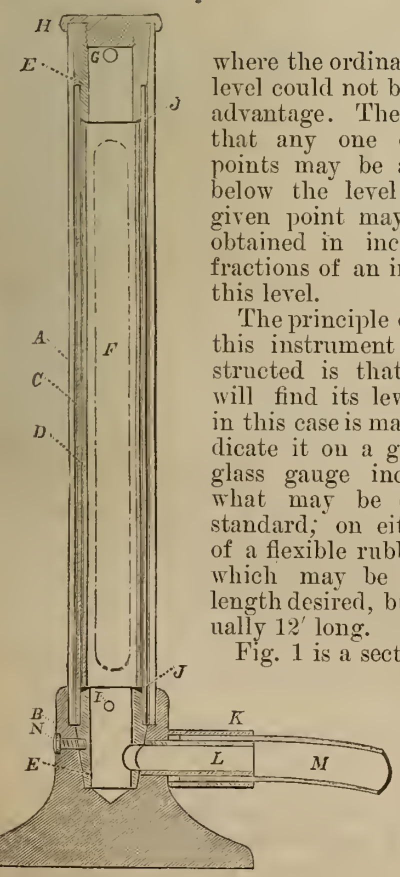
(*Communicated.*)

The level represented by the accompanying engravings was specially designed by Mr. James Macdonald, of New York city, for leveling long lines of shafting and other parts of machinery where the ordinary spirit level could not be used to advantage. The distance that any one or more points may be above or below the level of any given point may also be obtained in inches and fractions of an inch with this level.


J. Macdonald del.
Nelson Myers Sc.

MACDONALD'S HYDROSTATIC LEVEL.

The principle on which this instrument is constructed is that "water will find its level," and in this case is made to indicate it on a graduated glass gauge inclosed in what may be called a standard; on either end of a flexible rubber tube, which may be of any length desired, but is usually 12′ long.



Fig, 1.

Fig. 1 is a section, and Fig. 2 an outside view of a standard. In Fig. 1 the glass gauge, *D*, is a piece of tube, graduated in thirty-seconds of an inch, each quarter being numbered 1, 2, 3, etc., from the bottom, as seen in Fig. 2. This gauge is held between the conical valves, *E, E*, by water-tight joints at *J, J*. The valves are connected together, and work as one, by the brass tube, *C*, which is slotted vertically on opposite sides to expose the graduations on the glass gauge, *A*, is also a brass tube slotted vertically to correspond with *C*, and secured permanently to the base, *B*. The upper conical valve, *E*, is ground into the tube, *A*, and contains a vent-hole, *G*, communicating, when in the position shown, through *A* with the atmosphere. The lower valve is for the purpose of opening or closing the passage through the arm, *L*, leading to the hose, *M*. These valves are operated from the knurled edge of the cap, *H*, which is screwed into the upper valve. To close the passage through *L* and the vent, *G*, they are made to revolve to the right till the movement is restricted by the stop-pin, *N*, in the base, which extends into a horizontal slot cut in the outer circumference of the lower valve.

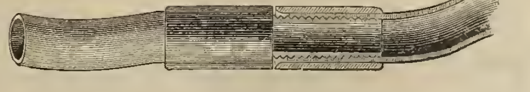


Fig. 3.

The level is kept constantly filled with water to a point about half-way up the graduations on each gauge. It will be readily seen that, when the valves are closed, the air that may be above the surface of the water in each standard will be prevented from passing into the hose, *M*, and becoming mixed with, or mechanically suspended in the water during the process of handling the instrument, which, if allowed, would prevent the surfaces from indicating the level.

When the altitude of two points relative to a horizontal line is to be determined, a standard is placed on each, the valves are opened, which admits the atmosphere, and the surfaces of the water immediately become level. The vertical difference, if any, between the points on which the standards are placed will be the difference between the points on the gauges at which the water rests. Thus, if the water rose to 10 in one standard and 6 in the other, the latter would be four quarters or one inch higher than the former. The same results would be obtained by placing the top of the standards against the under side of the objects to be leveled, and reading downwards to the

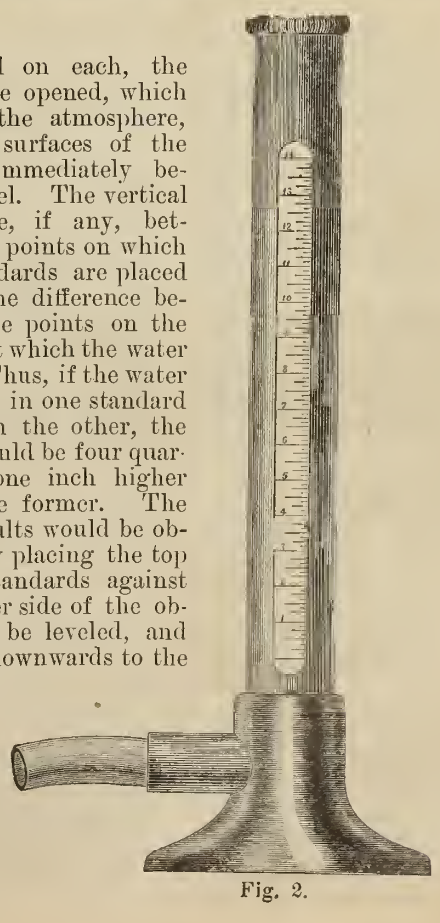


Fig. 2.

surfaces of the water in the gauges. As the bases of the standards are only 2″ in diameter, they may be used in cramped positions—a condition that often exists, especially in line shafting. The flexible tube may be passed over, around, or through any obstructions that may be between the points to be leveled, and if extra length of tube is required it may be inserted by means of the coupling shown in Fig. 3, which is merely a brass nipple on which the ends of the tube are stretched and held in position by ferrules on the outside.

The instrument is well made and handsomely finished in nickel plate, and provided with a suitable box for keeping it in when not in use.

Mr. Fred A. Hodgson, 294 Broadway, New York, is the agent for the United States and Canada, and will supply all details as to cost, etc.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

FRICTION.—THE PROFESSOR IN THE MACHINE-SHOP QUESTIONED.

Editors Mechanical Engineer:

In a recent number of your paper I noticed that "*The Professor in the Machine Shop*" had been making some experiments on friction. The result was that he told Jacob that "friction was not independent of the extent of the surfaces in contact, and that if it was a shaft would run as easily on centers countersunk four inches across, as it would on an infinitesimal point." And that "if friction was directly as the pressure and independent of the surfaces in contact, a platform scale might as well be hung on three-inch journals as knife edges."

In short, he gave Jacob the impression that Morin was ignorant of the first principles of friction.

I supposed that some one would undertake to defend the memory of General Morin, and set the Professor right on the subject; but as considerable time has passed since he gave us the result of his experiments, and as no one has made any reply to him, I feel it to be my duty to do so.

Morin spent considerable time and money in his experiments, and was no doubt fully competent to make them. And in view of this I should think few men would want to dispute the truth of one or more of his laws of friction, simply because a very crude experiment, hastily made, *seemed* to give results which were inconsistent with those laws. I believe that Morin is generally credited with the original discovery of the following laws of friction:

I. The friction bears to the pressure on the surfaces in contact a ratio which is constant for the same materials, and with the same condition of surfaces.

II. The measure of the friction is independent of the extent of the surfaces in contact, the pressure and the condition and character of the surfaces remaining the same.

III. The friction is entirely independent of the velocity of continuous motion.

One authority defines friction as "The resistance occasioned to the motion of a body, when pressed upon the surface of another body which does not partake of its motion."

Now it seems to me that, if a man thinks a little as he goes along, it won't be necessary for him to read these laws and definitions over anywhere near a thousand times to make it plain to him that in experiments of this kind it is necessary to arrange things so that the weight which produces motion will have the same velocity as the rubbing surfaces have, or else by computation, the thing must be reduced to the same basis. Now this is just what the Professor neglected to do, and for that reason he obtained results which he thought were at variance with Morin's laws. If he had got Jake to turn places on the shaft just equal in diameter to the average diameter of the rubbing surfaces in each case, he would then have reduced his experiment to the same basis as those of Morin, and would have obtained the same results. As it was, the weight in the first place had probably about eight times as much leverage over the rubbing surfaces as it had after the centers were countersunk. Consequently the shaft could be revolved with one-eighth of the weight. notwithstanding that the friction was the same in each case.

There are many men who believe in the truth of the first and second laws above, yet who do not believe that an engine would turn as easily if the face of its twenty-foot fly-wheel were made use of as a journal for the crank-shaft, as it would if that journal was on the shaft itself, and only twenty inches in diameter. And this is entirely consistent; because, although the resistance to motion would be exactly the same in each case, provided the character and condition of the surfaces were the same, yet in one case that resistance would be applied at the end of a lever only ten feet long, and in the other case it would be applied at the end of a lever only tên inches long, which would make the engine work just twelve times as hard to overcome it. You may increase the surface of a journal by adding to its length as much as you please without increasing the friction or the power necessary to overcome it. Neither will you increase the *friction* by adding to the diameter of the journal, but you certainly will increase the power necessary to overcome it.

The fact is that the first and second laws have been repeatedly proven to be true by actual experience; and they are dependent upon one another. If one is disproved it is evident the other is disproved also. Any one, by taking a block of any convenient material, having any number of faces of different areas, and by means of weights dragging it along over a surface, first sliding it on one face, and then on another of different size, can satisfy himself that friction is really independent of the extent of surfaces in contact. And by piling other weights on top of the first one he can demonstrate the truth of the first law also. But he must in all cases have the weights move at the same speeds as the blocks; or, in other words, have no leverage.

Knife edges are not put into platform scales to reduce the amount of surface in contact, but to bring the surfaces which produce friction as near the center of motion as possible. Moreover, a knife-edge bearing, if in good condition, has rolling friction only, which is the kind of friction which offers least resistance to motion.

The Professor is wrong in speaking of rolling friction in connection with his experiment, because there was no rolling friction about it. Now in regard to the third law:

The Professor wants to know, if it is true, how we account for heating at high speeds, when the same bearings run perfectly cool at less velocity. As I understand the matter, this is not inconsistent with the third law at all. I believe that, if two surfaces could be produced which were *perfectly smooth*, and so hard as to be entirely unyielding, there would be absolutely no friction between them when placed together.

Friction is believed to be caused by the more or less minute projections and cavities on the surfaces which interlock, and require force to separate them. This force, in accordance with a universal law, manifests itself in the form of heat. If the motion was slow, say one revolution per minute, there would be a certain amount of heat developed, but it might be so small as to be absorbed by the parts of the machine itself and the atmosphere. But now suppose the speed to be increased to five thousand revolutions per minute, it would require the same force per revolution, and there would consequently be the same amount of heat developed per revolution; but there would evidently be five thousand times as much heat developed per minute as before, and this might be developing heat faster than it could be absorbed, in which case it would remain in the journal and cause trouble.

Morin's third law, however, is not believed to hold true under all conditions, as it is pretty well established that in extreme cases, such as very high or very low speeds, or very heavy or very light pressures, the coefficient of friction does not remain precisely the same. I hope the Professor may be induced to make new experiments under the proper conditions, and then let us know the results.

Conservative.

Ohio.

[This letter was forwarded to Mr. Moulton and his reply is appended.—Editors Mechanical Engineer.]

MR. MOULTON'S REPLY.

I thank the gentleman for his criticism, and beg to assure him that I am by no means desirous of overthrowing authorities or of setting up a hastily performed experiment as conclusive of anything. Experiments, to be of value, should be most carefully performed. Not all of us are competent to make them. The criticism above is very well written, and shows that the gentleman thinks; and though I do not feel that he is entirely correct on some points, and that perhaps his reasoning and conclusions are in a degree forced, I do not at this moment feel equal to responding at length, being under the weather, for one thing, and desiring to look into the matter further for another. I will take an early day to reply at some length to the positions which "Conservative" takes on some points in his letter.

I also take this opportunity to say that I hope all will feel themselves at liberty to criticise freely anything that I write. I am just as liable to error as the rest of the human family.

BOILER-SETTINGS.

Editors Mechanical Engineer:

In your issue of August 18th, 1883, you have an article headed, "*A Bad Case.*" It relates to a boiler setting, and in your criticism of it you seem to think it a very bad way to set a boiler, as you ask if the proprietors own a coal mine.

I will give you a description of how three boilers are set in Washington University, a large school in this city, and the work they perform, and allow you to judge if they are extravagant in the use of coal.

There are three boilers of the following dimensions: Each 18 feet long, 5 feet in diameter, 36 4 inch tubes, and 24 square feet of grate surface. The distance from grate bars to bottom of boiler is 40 inches. Bridge wall 10 inches from bottom of boiler, and the space immediately behind the bridge is 24 inches from bottom of boiler, continuing to end of boiler. Side walls close in at about water line.

Now I will state what these boilers are doing; two only are used at a time, the others are held in reserve, they being set independently. They have 760 square feet of heating surface each. All fuel is weighed and all water is measured by meter or weighed as desired. The coal used is bituminous, from the neighboring mines in Illinois. Per cent. of ash, 12. Fuel and water weighed for one week; one boiler—maximum coal per square foot of grate 38 pounds, mean evaporation from and at 212° Fahr., 6·49 pounds. Priming, 2 per cent. Two boilers—coal weighed and water by meter (Worthington) for one week—mean evaporation for the week 7·1 pounds. Maximum for 24 hours, 7·9 pounds.

These boilers heat five distinct buildings. The larger one, the University, being situated 580 feet from boilers. The following figures will give the cubical contents, and number of square feet of heating surface in each building of the group: Academy—volume, cubic feet, 450,000 c. f.; Manual School, 225,000 c. f.; Museum of Fine Arts, 500,000 c. f.; Gymnasium, 100,000 c. f.; University, 750,000 c. f.

Heating surface in square feet for Academy, 3,500; Manual School, 1,870; Museum of Fine Arts, 3,300; Gymnasium, 500; University, 6,000.

Now here are buildings aggregating 2,025,000 cubic feet of space, heated by 14,670 square feet of heating surface to an average temperature of 70° Fahr., and this work is done without any special forcing. The usual proportion of heating surface in coils to that of boiler, as allowed by prominent firms in the steam heating business, is 5 to 1. The boilers just described have only 1 square foot of heating to 9·5 square feet in coils. Does not this prove their efficiency? Does the "new departure" in setting show extravagance in coal? Few boilers are doing as well as to evaporate 7 lbs. of water per pound of coal, right along every day.

St. Louis, Mo. A. H. Goff.

[The boilers spoken of by our correspondent who wrote the letter entitled "*A Bad Case,*" do not seem to us to be in any respect set as those described above, and we fail to see why the parallel is drawn.

In respect to evaporation, 7 pounds of water per pound of coal is considered in this part of the world a very ordinary performance for daily work—with boilers properly set and fired.

Another correspondent has something to say on this subject, and the result of his changes is given. We are greatly obliged to both correspondents for their favors.—Eds.]

HOW SHALL THIS PUMP-ROD BE PACKED?

Editors Mechanical Engineer:

Will some of your readers tell me how I can keep the packing tight around the water piston rods of a duplex steam pump used as a boiler feeder? I have tried everything I could think or hear of, but can keep them tight but a day or two at most. If I keep forcing the glands in, the friction is so great that it will hardly move, and the rods become badly fluted. If I don't, then they are leaking all the time. Only a short time ago the rods were removed and turned off, so they are now perfectly smooth, but it will be only a short time before they are fluted as bad as ever. The water we are using is very good when clear, but in six months I have not seen it the same number of days in such condition that it is considered fit to drink. It is pumped from the Cumberland River, and during the season of high water is about the consistency of "dock mud." And yet we are expected to use such stuff in boilers! I am informed that further south the water is worse than here, and there is hardly any clear water south of the Ohio River except well water, and that is so full of lime and substances of a like nature as to be unfit for making steam. A globe valve that is tight after having been opened and closed twice is an unknown quantity here, and straightway valves not much better. There is, however, one peculiarity I have noticed, and that is the pipes do not choke up or corrode as fast as in many places with clearer water. The boilers, however, receive the deposit, minus what settles in the heater in its passage through it to the boiler. Boilers here have to be blown out every morning and sometimes twice a day, and washed out at least every two weeks, or the mud and "slush" will be so thick as to seriously interfere with generating steam and endanger the boiler and lives of all persons near. When one stops to consider for a moment, he wonders not at the frequency of explosions, but that there are not more of them.

A great many employers in this section hire a man because he will work cheap. They pay him the magnificent salary of one dollar and fifty cents per day, and, in return, he must raise steam in the morning, take care of his engine and boiler during the day, and do all his repairs on both in his own time without compensation. What spare time he has, he can do odd jobs about the factory, repair elevators, lace belts, etc. Although it is right and proper for a man to do all he can for his employers, they must not expect him to do two men's work and do it satisfactorily.

I should like the opinion of intelligent engineers concerning a firm that will use an engine whose exhaust is so cramped as to give back pressure sufficient to run a steam pump (the diameter of whose steam and water cylinders are as 2 to 1), forcing water against a pressure of 90 to 100 lbs! Such is the case in a certain flour mill which I have visited in the course of my wanderings. These instances are not uncommon, but let us hope for the day when they will be no more

Tennessee. Tramp.

[There must be too much clearance around the rod of the pump. Put one turn of lead pipe in the bottom of the stuffing box.—Eds.]

THAT "BAD CASE."

Editors Mechanical Engineer:

In looking over some of the communications in No. 4 I chanced to see one signed by L. I. S. entitled as above. I would say that I once took charge of a boiler very much the same, only worse. The grates were 46″ from the boiler, the bridge-wall very near level with the grates, and there was room enough in the back end to hold an old-fashioned camp-meeting in. Aside from that, it was arched over the same as in the case mentioned in The Mechanical Engineer, the brick work not touching the boiler by from 4″ to 5″. Not satisfied with setting a boiler in that manner, they stuck the feed-pipe in the lowest point possible in the front head. Now, I wish to tell you the result of running a boiler in this condition.

The boiler was 18′ long, 72″ shell, and had 100 3″ tubes. It gave out in the first seam over the grates, and the owners were obliged to put on a patch 6″×12″, and could not keep it tight then. The patch was taken off and replaced four different times, until its size was 8″×30″. and they were just putting on the third one when I took charge.

I ran the boiler two weeks, and then did what I thought best. I looked it over carefully and found that it was rivet-cracked very badly in some places on the underside. I noticed that most of the cracks were on the horizontal seams; the patch was quite loose and leaked like an old sieve.

My theory was that the water in the boiler retained the heat after the fires were allowed to die, and that the top of the shell, by having a draught of air around it, cooled and contracted, while the bottom was yet hot and expanded. This sprung the shell up at both ends, straining every rivet and seam in it. I also found plates above the water line very badly crystallized, and burnt in some places.

My remedy was as follows: I cut the arch down to the water line and closed in upon the boiler from that point. I put the feed-pipe in the back head, raised the grates up to 24″ from the boiler, and put in front and back bridge walls. The front wall was 8″ below the boiler, the second or back wall being 12″ from shell, and replaced the old patch by a larger one.

The results were that we ran with a third less coal, did away with forced draught, and the boiler remained as tight as a bottle for four years of constant use, and until the establishment burnt down.

I would recommend these changes to L. I. S.

Romeo.

New York.

FROM THE STATIONARY ENGINEERS' ASSOCIATION NO. 2, NEW HAVEN, CONN.

Editors Mechanical Engineer:

Perhaps a few words from the Elm City would be well received, or I should have said from the association located here. We are, to use Brother Davy's words—"booming." We have a membership at present of 49, with 10 more who have been accepted and are entitled to become members. We have a snug little sum in the treasury, and we have our by-laws all ready and distributed among the members. On or about the first of October we shall meet in a hall of our own, where we shall have papers, pamphlets, books, etc. The manufacturers are helping us along. The New Haven Clock Company have, through its President, presented us with an elegant bible, and with the rituals, which we have received lately from Secretary Davy, we can, and do run the *mill* to perfection. When we get settled in our new quarters we expect a number of our leading business men to join hands with us, as many have signified their intention of doing so.

As the time draws near for the National Convention, we are anxious to learn whether there will be any reduced rates, as perhaps we may send a delegate to represent us there. We think here that this association is the thing long needed; it will in time prove a blessing to all engineers, as the Marine Engineers Association has done and is doing to marine engineers. I ought not to forget to say that the Marine Engineers Association, No. 36, is doing well, and has been the means of much good. They will show a good report of themselves at the expiration of this, their first year.

F. A. Foster, *President.*

124 George St., New Haven, Conn.

[We are glad to hear from our friends in New Haven, and especially that they are prospering. We hope to be favored with further reports. All associations will read them everywhere in the United States.—Eds.]

ATTENTION, DELEGATES!

Editors Mechanical Engineer:

I would like to call the attention of all stationary engineers' associations who send delegates to the National Convention to be held on Oct. 2d in this city to the matters subjoined. Many, no doubt, will find representation a new business to them, and it is for the guidance of the newer associations that these hints are thrown out.

1st. We should have a distinctive name and title for associations which would be adopted by all. As it is now, there are "lodges," and "brotherhoods," and "societies," and "associations." This creates confusion, and signifies a want of unity and purpose.

2d. We want a national constitution and a subordinate constitution in common to all. Individual associations can make by-laws for themselves which will not conflict with the national association.

3d. We want a simple mutual aid association.

4th. We want distinctive and uniform titles for all of the officers. As this matter now stands it is open to great objection. Some associations have presidents, some have chiefs, some have guides, and some conductors; some have financial secretaries, others in the same office are called scribes. All similar officers should have uniform titles, so no matter where an engineer may be he will know how to address officers,

I think it may be well to consider, also, whether we should not do away with grand State lodges, and let all associations have their charters and draw their supplies direct from the National Association, and all decisions on points of law be referred to it. I see no use for middlemen among stationary engineers.

The points above mentioned should be promptly discussed, and instructions to delegates given in writing, so that they come with their minds and opinions formed. Some license or latitude must of course be allowed delegates, according to what may transpire in general conclave.

Now, let me urge every association to be represented at the National Convention. Brothers, you will never have a greater opportunity than the present, for this Stationary Engineers' Association is bound to become one of the strongest and most influential in the United States, and every man wants to be in at the foundation. Then he can say, "I was one of the founders of that society;" and he can make no prouder boast. Even if individuals have to draw on private funds they should not hesitate to do so, for it will all come back to them in the benefit and protection afforded.

Throw aside all other considerations, and work this one week for the National Association. Come on the first day and stay until the curtain drops, and if you don't feel paid at the close for your efforts, I have lived all my life among the members of the craft to little purpose.

William Ponsonby,
Brotherhood No. 1.

Chicago, Ill.

A BOILER EXPLOSION.

Editors Mechanical Engineer:

A very disastrous boiler explosion occurred at Oakdale, Ill., about seven miles from here, on the morning of the 21st., killing the man in charge, tearing the boiler to fragments and demolishing the building it was in. I will state the circumstances as near as I know them, and would like very much to have your opinion as to the cause.

The boiler was 26 feet long and about 40 inches diameter, it was made of 3-16ths inch iron, had two flues and had been in use about 15 years. During that time it had been operated by a great many different "engineers." I was told that the boiler had not been cleaned out for a "long time;" how long I cannot say, but as it was only in use part of the time it was probably long enough for a good deal of dirt to settle in it. The man who was running it had never had charge of a boiler a day in his life, and was running that day to accommodate the proprietor, who ran the engine himself; he being sick that day was not at work. The man running the mill was to oversee him, and testified at the inquest that he had been down to the boiler five minutes before, and found two gauges of water and 75 pounds of steam, and stopped the feed pump before he left.

We found the steam gauge after the explosion, and it was uninjured. On taking it apart we found it bright and clean on the inside and apparently all right. The boiler showed no signs of overheating, and it looked as though there had been considerable water, as mud was stuck to everything.

The almost universal opinion here is that a boiler can't explode if it has plenty of water and the safety valve is in good order. I suppose that theory will be all right when they make boilers that will always be as strong as the day they are made.

Coulterville, Ill. J. B. B.

[It is impossible to say what causes an explosion without viewing the fragments, and in most cases it is not possible then, for in a destructive explosion it is difficult to tell what part gave way first. The time to find out what causes boiler explosions is before the fact, not after it. There are so many well known causes that it is not difficult to tell when a boiler is unsafe.—Eds.]

A POINT ABOUT STEAM LEAD.

Editors Mechanical Engineer:

I noticed in Number 5 an article entitled "A Point Against Steam Lead." I have read it several times to be sure that I thoroughly understood its meaning, but I cannot quite understand how the number of revolutions of any engine can be increased by taking away all the lead, and what is still worse setting the valves so that they open a little late. By this operation the piston is running away from the steam (in one sense of the word), which looks to me as though it would have a tendency to reduce the speed instead of increasing it.

If you had said that a little of the lead had been left to take up the momentum of the moving parts, it would have been clearer—I refer to the change made in resetting the valves of the steam yacht *Stranger*.

Again, what seems curious, is that a firm who has had the experience of building steam yachts and steam ships for a number of years, should have set the valves so that the engine was deprived of its full number of revolutions. It is very evident that some one is at fault. The question is, Who is it? Please inform me if I have viewed the matter in the right light.

Tiverton, R. I. Fred. S. Bradford.

[We think not. The question of lead and no lead is a moot point, both aspects of the matter having strong supporters. Altering the lead may produce marked results in the speed of the engine. As to the facts related in the article mentioned, we know no more of them than there are there given. The firm who made the engines may have had very little to do with setting the valves, for our correspondent, who is an old marine engineer, knows that valves are frequently changed after the engine leaves the makers' shop.—Eds.]

ATTENTION, STATIONARY ENGINEERS!

The Second Annual Meeting of the National Association of Stationary Engineers of the United States, will be held in the City of Chicago, commencing on Tuesday, October 2, 1883, at 10 o'clock A.M. Each association chartered by the N. A. of S. E. is entitled to one delegate.

Associations not chartered previous to this meeting, who have at least ten members, can at the meeting make application through their delegate for charter, provided they have conformed with the rules of the N. A. of S. E.

Delegates must in all cases be members of Engineers' Associations, and come provided with proper credentials; they will also deliver their *per capita* tax to the Secretary *previous* to the hour of meeting.

The secretaries of the different associations will send me copies of the credentials at their earliest convenience.

A. M. Davy,
Secretary N. A. of S. E.

175 Elmwood Ave., Detroit, Aug. 29th.

THE BALDWIN LOCOMOTIVES IN ENGLISH COLONIES.

Editors Mechanical Engineer:

Referring to the article on American Locomotives in English Colonies, signed "Wayne," published in Number IV., current volume of The Mechanical Engineer, commenting on the reported failure of one of our engines in South Australia, it may be proper for us to say that it is now well understood that the whole difficulty arose from the fact that the engine was sent out to draw an excursion train without having been properly inspected beforehand, and that the grate bars partially burned off owing to incompetent handling in previous service. Before going one-third of the distance, two or three of the grate bars dropped, letting the fire into the ash-pan, hence loss of steam and failure to make time. When it is understood that this was a special excursion train, with a good dinner awaiting the party at the destination, the indignation at the delay can be readily understood.

Later advices from South Australia report that there have been several trials of the same engines since the trouble referred to. On one trial the engine had a train of 103½ tons, a heavier train than on the opening day, and maintained a uniform pressure of 125 to 130 pounds of steam, making an average speed of about 25 miles per hour.

A. B. J.

Philadelphia, Pa., Aug. 28th.

THE RIVERDALE EXPLOSION.

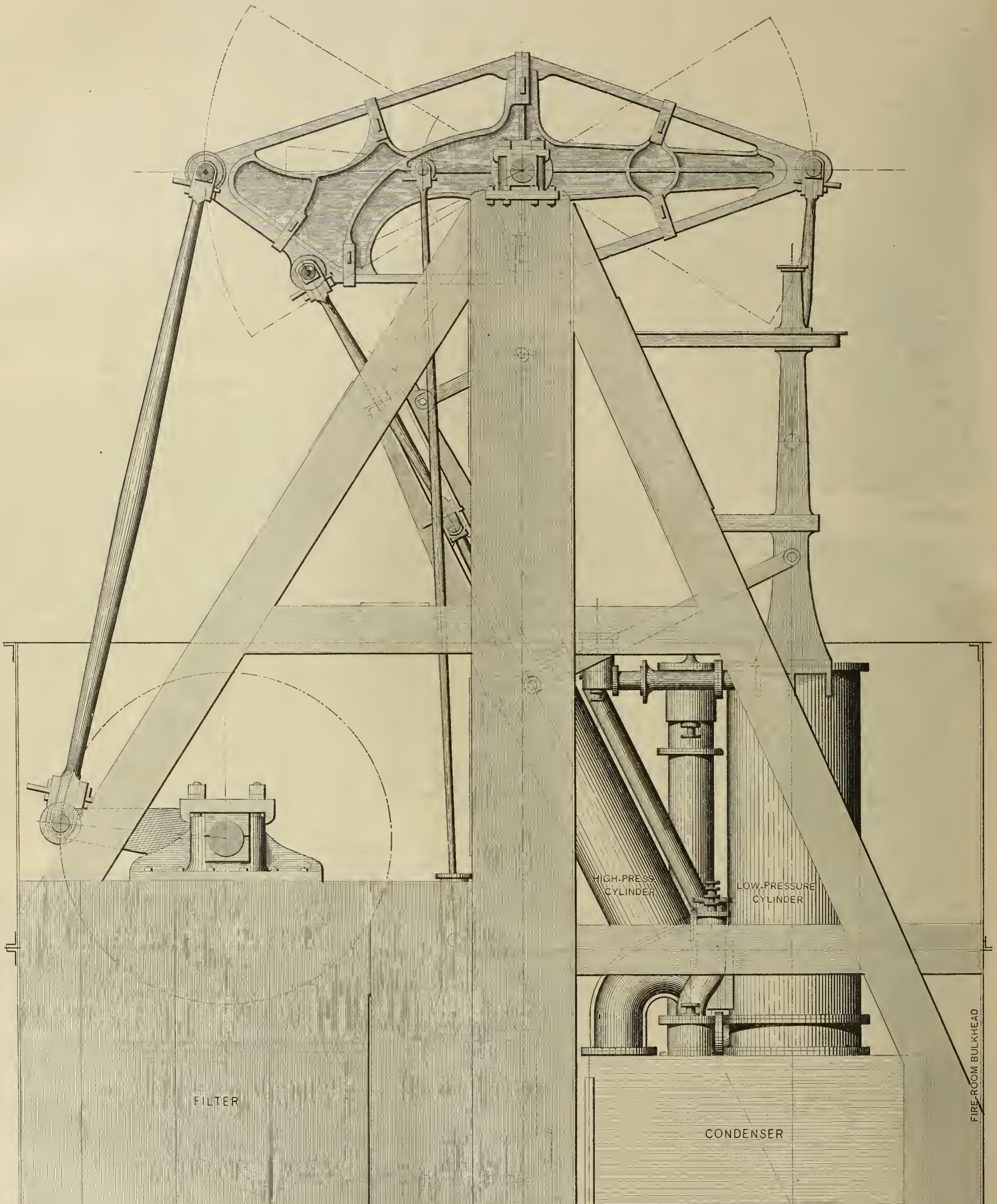
On the 28th ult. the boiler of a river steamer blew up in this harbor, causing loss of life. The vessel is now under water, and of course no examination can be held upon her until she is raised. The point involved is that the pressure at the time of the explosion is stated to have been only 25 to 30 pounds, whereas the boiler was inspected and allowed to carry 40 pounds. The inquiry will naturally turn upon this discrepancy.

We have nothing to say as to the causes of the explosion, but it is not improper to inquire into the methods of inspection followed in this port. If, as some allege, this is merely perfunctory instead of careful and searching, a great responsibility has been assumed by some one. We wish our friends would send us information, of their own knowledge, as to plans pursued by government inspectors of steam boilers. We will publish them, without names, but they must be signed in good faith.

So long as boiler inspection is in the hands of politicians who make its offices contingent upon services for party consideration, there is danger of imperfect inspection.

* * *

An Article on "Milling" is going the rounds of the technical press, the same being a paper by W. Ford Smith, read at a recent meeting in England. It contains absolutely nothing, being chiefly a catalogue of cutters of various shapes and sizes.



NEW DESIGN FOR A COMPOUND BEAM-ENGINE AND GALLOWS-FRAME.

NEW DESIGN FOR A COMPOUND BEAM-ENGINE AND GALLOWS-FRAME.

(*Communicated.*)

These present many novel features, but they are all practicable, which in construction will lessen the cost of the machinery, and at the same time add to its durability.

Gallows frames are now mostly built of plate-iron instead of wood, but, singularly enough, although entirely diferent mechanical conditions are presented to the designer by the change of material, all that have been built in this country are copies of the old wooden frames. The change in the material used has made the supports, braces, and girders hollow, but outwardly they are of the same form and, very expensive to build of iron.

An iron gallows frame of this design in a wooden boat would greatly strengthen the hull, and save several tons of weight; but in an iron boat the gallows frame should become a part of the hull, construction, adding to its strength for every pound of material used.

The arrangement of athwartship bulkheads, in connection with the sides of the gallows frame, distribute the forces exerted by the engine power over such a large surface of the hull, and so equally through so large a number of rivets, that weight of material is considerably reduced, and the needed strength obtained.

The design of this engine is intended to represent good engineering. All are familiar with the many good qualities of the American overhead beam engine, among which are durability under heavy work, small repair bills (excepting after a working-beam has broken), and easy handling under the bell signals, while its general arrangement gives ready access to all the working parts.

Compound engines have entirely superceded the old system for sea-going vessels. This design will so improve the single cylinder beam engine as to develop 60, 70, or 80 per cent. more horse-power with the same fuel and a slight increase of weight of machinery and boilers by compounding it, and in doing so will, by a judicious application, procure this greater development of power without increasing the strains upon the working parts, using more space for the machinery and boilers, or complicating the mechanism.

The gain of additional power will be had by using steam of 120 lbs. pressure and over, and working it expansively in the two cylinders. This enables us, on account of the gain in efficiency due to the expansions, to provide the necessary steam with the same, or less, weight of fuel, while by a proper selection of boilers they will not exceed those now in use in weight, ready for work, notwithstanding the higher pressure to be safely carried.

By using rightly proportioned cylinders, the power developed in each cylinder will be alike, and as the acting upward force exerted upon the beam by one piston is balanced by the downward force of the other, the center pin of the beam is not acted upon in either direction, and is practically relieved of strains. The same pin in the ordinary or old system of beam engine, or any engine having all its piston power exerted in only one end of its beam, has a strain upon it of double that force; therefore we may safely say that the saving of material in the beam of this design over the other will nearly compensate for the weight necessary to be added to the connecting-rod, crank and shafts to carry the 80 per cent. more power gained.

The space occupied will be the same in the hold of a vessel as the old style, but it saves the space on main deck in front of the cylinder, used for the steam-chests, side-pipes, cut-off and valve gear, and the room necessary for the engineer to work the starting-bar. The valve gear will have a few more parts than the old style, but will have only the same number of rocker shafts and eccentrics, and can be readily handled to the bell signals.

Working beams, especially for the larger class of old style engines, have been broken frequently, causing expensive repairs, as they have to withstand twice the strains of any other part. The design here shown brings in a large element of safety by relieving an important and expensive part of the engine from liability of breakage. The fact that the hull of a steamboat can be free from the shocks occasioned by the strains upon the center-pin of a beam, which are communicated to the hull twice for every revolution in the old-style engine, would indicate that the increased power obtained is already provided for in an ordinarily constructed hull through the relief so obtained, especially if the new design of gallows frame be used to distribute the strain over a larger area.

To continue to build engines for river and sound service, using steam of a low pressure expanded to only about twice its volume, simply means that the boats are to be overloaded with the weight of the machinery and boilers to produce the power, or to build a compound engine to expand the volume of steam to less than ten volumes is bad engineering, for the same expansion can be had cheaper in single cylinders. To compound a beam engine, placing both cylinders on one end of the beam adds largely to the risks of overstraining that part, besides the extra room and extra weight demanded.

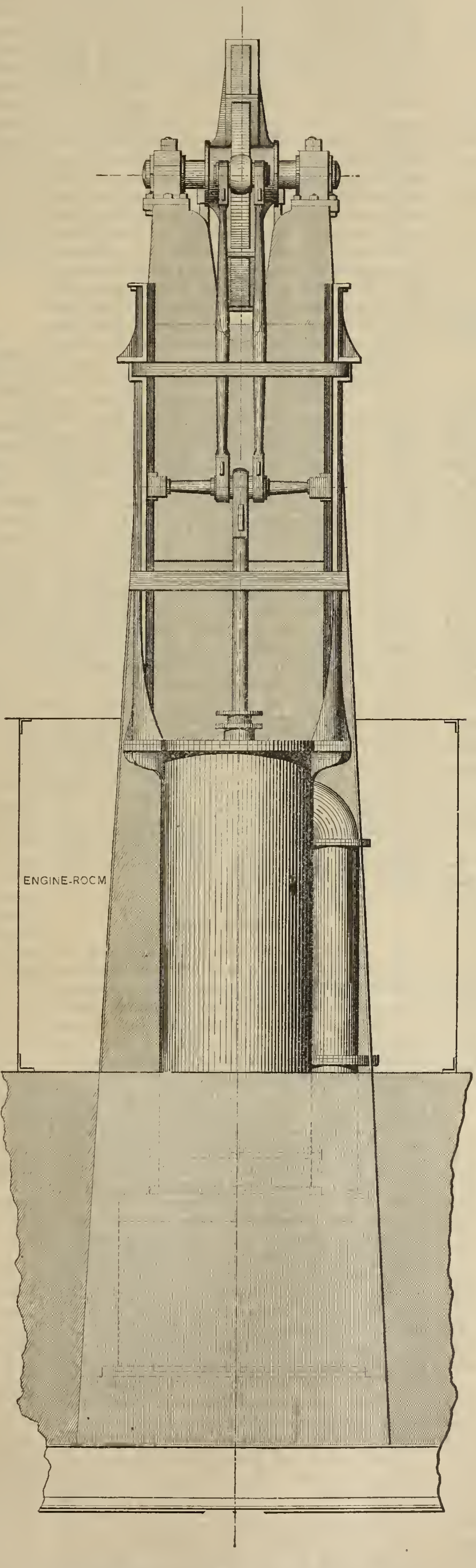
Where both cylinders are on one end of the beam the entire length of the low pressure cylinder must be traversed by the exhaust from the high pressure, thus practically enlarging the clearing spaces enormously, and with decided loss.

In the design here illustrated the exits are direct from the top of the high pressure into the top of the low pressure, and *vice versa*, an advantage which engineers will acknowledge at once to be very great.

The engineering difficulties arising from the use of high pressure steam in large engines have been reduced to almost none at all. Metallic packings for piston-rods and valve stems, light working but steam tight piston packings, and lubricating oils which do not foul the working parts, are readily obtained. Frequently the rod and stem packings last without renewals or adjustment for over a year; and as boilers having positive water circulation, furnishing dry steam, and perfectly safe at pressures from 150 pounds upwards can be furnished, there is no reason why the coming steamboats shall not attain a speed of two or three miles per hour over and above their present record by using the means at their disposal.

In pursuance of this subject, which is a matter of the greatest interest to all concerned in steam navigation, I shall, in the next issue, revert to compound engines and boilers, and their details as their present construction strikes me, and offer some hints for their improvement.

M. C.



NEW DESIGN FOR A COMPOUND BEAM-ENGINE AND GALLOWS-FRAME.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors,

150 Nassau Street, New York.

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No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, where possible.

A BUSINESS BY ITSELF.

No one refuses to pick up a dime because it is not a dollar, but very many steam users throw them away by the handfull daily, because they do not understand the business of steam using and will not let engineers tell them. It is hard, indeed impossible in most cases, to make proprietors understand that a quarter of a dollar saved per gallon on the price of oil sometimes costs half a dollar on repairs and in loss of efficiency in the engine. It is harder still to make them believe there is any difference in fuel or boiler settings, and that so long as the fire burns, water boils, and the boiler does not explode all goes well. It is hard to make them see that while they are making money they are also losing it. That is to say: they make a good profit, perhaps, in their trade but would make much more if there were not leaks of greater or less magnitude in the pockets they are trying to fill. It is hard to make the average proprietor feel that although the windows are clean, and their shop in good order outwardly, there is an enemy stealing away his cash whom he refuses to be warned against.

The prophet of old was stoned when he lifted up his voice and cried out against abuses, and the engineer, although he may not be stoned shares the same fate. He is derided and put down. His suggestions of sources of economy and his detection of positive losses are ignored, or, if considered, are half acted upon. Like fire, steam is a good servant but a bad master, and it sometimes gets the upper hand so far as to ruin the establishment by fuel bills.

The burthen of our jeremiad is that those who employ steam should remember that the charge and supervision of it is a business by itself, and an intricate one. It is a profession that requires constant study and weighing of cause and effect to find out where the money goes that is put into it. This being admitted it follows that the man employed for that business is the fittest one to have the sole direction of it. No one can judge as well as he whether repairs are needed, or whether the apparatus is safe. A man can tell the financial condition of a firm by looking at the outside of the ledger quite as well as the steam user can decide whether a boiler is or is not safe.

If the steam user had eyes for the future he would see that the expenditure of one hundred dollars now is cheaper than the slow but certain loss of thousands hereafter.

SNUB-NOSE TOOLS.

We believe it to be susceptible of proof that cutting tools, taken by and large, on lathes and planers throughout the country are by no means kept at their best efficiency as regards shape, and this not in small shops in out of the way places, but in large ones as well; in any place, in fact, when a person is not specially detailed to attend to this duty solely.

We say this because observation shows it to be a fact. We have been in many shops, where perhaps one in a dozen of the tools would be properly dressed and ground, the others being in all conditions of "stubbedness" and thick edges. A tool cuts the material, whether wood or iron, simply by cleaving it, as a wedge cleaves; the blunter the wedge the more force required to drive it in. There is an angle of cutting which varies with the material worked on, known to be the most efficient, but as a rule we shall find that this is not adhered to, and that all sorts of shapes exist on the same machine. The reason is not hard to find, and to put it mildly it is a personal disinclination to go to the grindstone in some instances, and in some others an opinionated tool dresser, who feels that one form of tool is as good as another.

But what of the results! Aside from the increased amount of power required to do the work, the wear and tear of the machine is much greater. Evidence enough of this is furnished by the eye on every lathe where the tool cuts badly or, rather, works hard. With a heavy cut, at times when the back gears are in, they will fly out from sheer strain upon them, and when the cut is intermittent and abrupt, the same thing occurs. This happens oftenest when the tool is blunt and stubbed than when it is sharp and of the proper shape, and many a lathe at this writing is weighted down with old iron on the back-gear handle to keep it from flying out. Other evidence of useless work and wear on the lathe is given in the constant jar and tremor all over it when a tool cuts badly. There is nothing in the mere process itself to cause this. Removing the surface of a casting or a forging in the lathe, no matter how heavy the cut, need not cause any appreciable vibration if the cut is continuous and the work is adapted to the machine itself, this only when the cutting tool is of the right shape for the material it is working on. We feel that there are more snub-nosed ground down, machine cutting tools in daily use than is supposed, and any one who takes a tour of observation through a shop can speedily find out whether we have prophesied truly or not.

THE INDICATOR.

The mystery with which many surround the indicator and its action is unnecessary, for, in so far as the instrument itself is concerned, nothing can be simpler; but it has been so dealt with by many who have magnified their office, that the average man is afraid of it. He reads about adiabatic curves, ordinates and co-ordinates, and comes to the conclusion that without such terms the indicator is useless, and that he has to study up the philosophy of heat before he can use one. Sometimes he sees the mystic word PLAN used as a formula in connection with the indicator, and this completely destroys whatever enthusiasm he may have formed. In some vague way the average engineer also feels that an education in higher mathematics is necessary before he can hope to solve engineering riddles with it; as a consequence the use of this instrument is very much restricted.

The views we have mentioned, as attaching to the indicator, are unquestionably held by a larger number than is generally supposed, but it is almost needless to say they are erroneous. There is no mystery in the indicator, and nothing in the principles upon which it acts that cannot be understood by any man of ordinary intelligence. There are no intricate formulæ to be used in estimating the work of an engine as interpreted by an indicator, for any man who knows the first four rules of arithmetic and the rule of three, can work all the "problems" the indicator can furnish. As a matter of fact, the instrument itself is credited by some with a great deal more than it can possibly perform, but as a balance, as a mechanical device for showing the action of the steam and the condition of the valves and piston, it is indispensable. As a thermostat (heat measure), it is useless.

As we have said before, in its place the indicator is an instrument which should be in every engine room; it belongs to it as much as the oil tank, and rightly looked upon is of as much importance. For the small sum of one dollar an excellent work upon it can be obtained which will give all the instruction needed for its successful use, and every one who aspires to reach the highest economy and best adjustment should use the indicator.

CONCERNING GENERAL INFORMATION.

All classes of mechanics, now much more than formerly, recognize the necessity of knowing something of all branches of their business. It does not follow that because a man is an engineer he does not need to know anything about boiler-making. He does need to, and he must know something about it, for the interests committed to his charge, no less also his own safety and that of others, demands that he should possess a general knowledge, at least, of the methods employed in constructing boilers. An engineer's lightest duties are connected with his engine, and his heaviest responsibility with his boiler. The utmost an engine can do is to break down, and usually without hurting anyone, but that is not the case with the boiler.

Of course, our readers will not accuse us of counseling carelessness or recklessness with the engine; our remarks are comparative only in this example.

What has been said of boiler-making and its connection with engineering applies equally to other lines. A machinist ought to read up on pattern-making and foundry-work as parts intimately connected with his own branch. Particularly is this true if he designs machinery, for in that case he will go far astray unless he knows something of lines connected with his own trade.

Special knowledge is good, and engineering is a branch of trade wherein a man is always a student, if he would be any more than a hewer of wood and a drawer of water, but as the saying goes, "all roads lead to Rome," and a versatile, well-read engineer loses nothing in advancement by reason of being possessed of a general knowledge of all things connected with his calling. There are many strands in his rope, and he weaves them all together into a strong cord.

AN AMERICAN ENGINEER IN CHINA.

An American engineer of long experience in one of the oldest marine engine shops in this country, went to China some few years since and took charge of a line of steamers there. One of these vessels had a Hirsch wheel which is variable in pitch, and as it did not prove satisfactory, the American engineer demanded of the makers of the engines, Randolph & Elder, Glasgow, another kind, forwarding a drawing of the one wanted, which was simply a true screw 11 ft. diameter. Randolph & Elder replied in due course, declining to furnish another, saying that if the Hirsch wheel was taken off, the vibration would be very great, and further that the drawing sent was evidently made by a person unacquainted with screw propulsion!

In going up the river subsequently, the ship lost her wheel and had to have another. Being unable to get one otherwise, the American engineer had a screw made in China by native moulders, sweeping it up in the usual way. There being no large foundries then, the iron was melted by natives in small crucibles and poured into a large ladle, which was kept hot, (until it was full), by fire externally. The casting was a complete success, and the ship made two miles an hour better time than with the Hirsch wheel.

In a recent paragraph we quoted from *Iron* concerning a new mill to roll molten iron, and added that we should like to be told how molten iron could be rolled. The *Iron Age* saw this, and alludes to it in this courteous way:

"A mechanical contemporary who knows more about lathes and planers than it does about metallurgy," etc., etc.

The *Iron Age* is right; we know very little about metallurgy, but it answers our query by telling us that Sir Henry Bessemer tried to roll molten iron, but did not succeed.

This is light and no light.

We are unable to see why the *Iron Age* does not call us by our name, instead of the general term "mechanical contemporary," which may belong to three or four other papers in this city. Possibly it fears that the bare mention of us may induce several hundred subscribers to desert from *Mechanics*, or people generally to clamor at once for The Mechanical Engineer. On no other ground can we account for its want of journalistic courtesy.

It should not hesitate to print our full title in its columns. Subscribers do not secede from one paper and join another on so slight occasion, and the *Iron Age* loses nothing by observing the usual civilities of the profession.

We acknowledge the receipt of "*A report on an air refrigerating machine*," from the Bureau of Steam Engineering, Washington. Also hydraulic tables, for the calculation of the discharge through sewer pipes and conduits, from D. Van Nostrand, N. Y.

We have also from the Baldwin Locomotive Works, Philadelphia, a handsomely illustrated catalogue of their exhibit at the National Exposition of Railway Appliances in Chicago. It contains full details of weight, dimensions and performance of their locomotives, and master mechanics and railroad officials will find it of great value to them.

The Yale & Towne Manufacturing Company, of Stamford, Conn., send us their catalogue of cranes, hoisting machines, and other tools made by them. The engravings are very handsome, and set forth the uses of every conceivable sort of crane for mechanical use.

Typographical errors are annoying anywhere, but especially in a technical journal, where exactness is essential. We have had more than our share of them lately, and must ask our readers not to believe us capable, wilfully, of asserting that the "*co*-efficiency of a boiler is secured," etc., etc.; that "*reporters hesitates*," or that heat is absorbed by the *water* of the cylinder, when we wrote walls; that a yacht *run* 14 miles an hour, or that a screw made the same speed without allowance for "*slips*." All of these egregious errors were in the last issue, and we feel humiliated by them. Even Homer nods at times, and proof-readers are only human, but they must not do so any more.

Of course all Stationary Engineers' Associations are looking forward to the National Convention which is to be held in Chicago on Tuesday, Oct. 2nd, and will continue until Friday. The Chicago Brotherhood, Numbers 1 and 2, have the reception of delegates in hand, and with their well-known reputation for hospitality, our friends may expect to see all that there is of interest in the city. This meeting is purely official and with the object of consolidating the interests of all engineers everywhere, except in so far as regard wages or hours of labor. With these, or in fact anything affecting the liberty of individuals to work when and where they please, it has nothing to do.

The indicator cards published from Webb's compound locomotive, concerning which so much has been said of late, do not bear out the assertions of economy made for it. The work in the low pressure cylinder, at a speed of fifty miles an hour, is a mere trifle, scarcely worth the additional complication and weight entailed. On this point—the multiplication of parts and the crowding necessary to get them in—there is great objection, and it will require much longer trial and impartial judges to determine whether this engine is a good example to be multiplied.

We are again obliged to omit the articles on "*Foundry Practice as Allied to Pattern Making*," by reason of surrendering so much space to the engravings of the compound engine.

Many persons will not ride upon fast trains from fear of accident to them, thinking that the chances of disaster are greater than at lower speed, but upon old roads well managed there is little difference between fifty miles an hour and twenty-five, as regards danger. As for accidents, a man's head breaks as easily at twenty miles an hour as at forty.

The following is recommended by Professor Olmstead, of Yale College, for keeping bright work clean when it is stored away: Melt together six to eight parts of lard to one of resin, and stir until it is cool; it can be thinned with coal-oil or benzine. Applied to bright work it effectually protects the polish, but the surface should be both bright and dry, as it will not prevent the continuance of oxidation already begun.

According to a writer in a foreign paper animal oils are unsafe to use in air compressors, as they take fire spontaneously in compressed air, or in other words they create an explosive gas.

In 1882 the total value of the anthracite coal mined in the country was $139,974,013. Of gold and silver—for the first, $32,500,000; and the second, $46,800,000; an increase of $1,600,000 over 1881.

THE PROFESSOR IN THE M

NO. XLI.

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good for something; a nonsensical notion enough; but impulse is not reason.

So soon as the fit passed away from Bill, he went and seated himself in a corner and leaned his head against the wall in silence. I let him alone and said nothing, for, to tell the truth, I did not know what to say. If I consoled him it might encourage him to go on with his efforts, when I came there with the intention of discouraging him.

"When in doubt, do nothing," is a good motto, and I followed it. In a little while he got up and came over to the machine.

"Something must have got foul somewhere," said he, "for if it will run three days it will run thirty years. Take a look at her, Moulton, and see if you can find anything wrong."

"Bill," said I, "you must excuse me. I don't know anything about it, what your principle is, or where the machine begins or ends. I'd do more harm than good."

But before I had done speaking Bill had the lamp in his hand and was peering in among the gears and the toggle-joints, and the lazy-tongs, and every sort of mechanical movement that was ever heard of. He reached in his hand, drew his finger over the teeth of the escapement, and looked at it.

"She's dry as a bone," said Bill. "No wonder she stopped. Those pallets are hardened steel, and they ought to be made of something harder. I'll send to New York and get some iridium, the metal they point gold pens with, and try that to-morrow. Once I get that all right she will run then, and no mistake. I ain't going to give her up now when I have got as far as this."

"Bill," said I, "are you going to work on this machine any longer?"

"Didn't you hear what I said?" he answered. "Of course I am."

"Well, now, let me tell you something," said I. "Suppose your escapement is dry; don't you see that a machine which weighs a ton, and which is supposed to have power within itself to drive itself, must be pretty nearly balanced as regards running or stopping when a little thing like that can defeat it? You are too good a mechanic not to see that, Bill."

He thought for a moment, and said slowly: "I don't know but what you are right."

"And no matter what rigs you get up," said I, continuing, "you come out at the same place you started in at."

"What's that?" said he.

"Why, your machine stands still," said I. "You may annihilate friction—almost—and balance your moving parts until a breath will start or stop them; but, Bill, the more you put in the worse you are off. Every piece you put on that machine since you began it was a mistake; for the matter of that, the whole of it is, and I want you to promise me one thing right now—that you will drop this job at once and never do another stroke on it."

He sat moody and silent, his legs stretched out in front of him, his chin sunk on his breast, and his eyes gleaming underneath his shaggy brows. I continued to exhort him, laying down the law, explaining why the machine could not work, and endeavoring by all the arguments I could summon to break up his infatuation, and I thought I had succeeded, until he broke in by saying:

"Moulton, I'll make that machine work. I can't give it up now. I have been at it too long, and I never shall hear the last of it if I stop. I'll be 'Perpetual Motion Bill' as long as I live."

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g of a ship's sail in a hurricane, and in an
instant we were all in the cellar together.

The noise was appalling, and the dust was suffocating; but, after what seemed an age, Bill hallooed out to know if I was hurt, and his wife came down, pale and trembling, with a light. Nobody was hurt except the machine, and that was a wreck, complete and utter. It had fallen about seven feet, struck on one corner, and was as wholly annihilated as though it had been blown up with dynamite. The cause of the accident was easily explained. Bill had gone on adding piece after piece until the whole thing weighed over a ton, and was, of course, entirely too heavy for an ordinary dwelling-house floor. When I came in and added my weight, and Bill made his lunge, that was the last ounce it could bear, and the result was as stated.

It cured him. He never touched it again except to clear away the rubbish, and he went to work like a man to retrieve his error.

"Moulton," said he one day as I was passing through the shop, "what made that thing start up again after it had stopped?"

"Why, the settling of the floor," said I. "It threw the machine on one side, may be ever so little, but enough to get her eff the center, and start into the semblance of life, just as a battery will make a dead man twitch his muscles; but it would have soon stopped again."

This is a veritable experience, barring names, and I dare say it can be matched at this day. I hope every one will have as lucky an exit as Bill Young had.

Now that sounds all right, seems correct, and does not offend the proprieties in any way, but part of it is untrue. The absolute facts are that Bill did not get over his disappointment but drank himself to death in a few months after the occurrence narrated. His fate is what made me say he had hard luck, and that I regretted stopping him smashing the machine when he wanted to. If I had let him he might have recovered himself; but that starting of the machine after it had stopped always stuck to him. He could not help feeling that there was something in it after all, and he sought solace for all his woes in that false friend and worse comforter—*rum.*

SMOKE AND SMOKE-PREVENTION.

LECTURE OF PROF. R. S G. PATON, BEFORE THE BROTHERHOOD OF STATIONARY ENGINEERS, NUMBER ONE, CHICAGO, ILL.

I feel a little diffident, Mr. President, ladies and gentlemen, in coming before you, especially the male portion of the audience, to speak on the subject of smoke. Most of you, I understand, have been brought in contact with this subject personally for a number of years.

Unfortunately the advertisement of this meeting states that I will speak on the subject of consumption of smoke. Now, there is no chemist would stand up before you and say that smoke can be burned; it cannot. But smoke can be prevented. It may be a peculiar differentiation, but it is a fact. It has been tried years ago in many different countries, and it has failed, and signally failed. The question is, what is smoke? Smoke, surely, as we know it now, is the product of incomplete combustion. In order that I should be understood, we must first know what is meant by the word combustion. Combustion, according to Roscoe, so far as I recollect, is the union of certain chemical materials resulting in the development of heat and light. There is a question which a good many may ask, but perhaps not many can answer: Here is an ordinary piece of lime, shell we call it in Scotland; I believe you call it here lime-rock. It is cold, as any one can see. Now, why is it, when Paddy goes to make mortar, that he pours cold water on the cold lime? And why is it that from this cold lime and cold water steam arises, and the development of heat? For the simple reason that the elements contained in that lime, namely, calcic oxide, and the water, hydric oxide, unite, and in chemical union you always have the development of heat. In some cases it may not be perceptible to the senses, but by fine thermometers we can prove that the development of heat has occurred.

The question with regard to smoke being turned into our city is, of course, a question which we must look at in a number of lights, at least three, viz: mechanical, chemical—I forgot you were engineers, if you had been owners, then I would have said pecuniary light. That is the third and, of course, the last for you. You, gentlemen, I understand, are engineers employed in the City of Chicago. I have the honor to be the "Smoke Inspector" of the City of Chicago. I have here a few copies of our ordinances bearing upon this subject which I will distribute. The sections are Nos. 1650 and 1651, and are as follows:

> "SECTION 1650.—The emission of dense smoke from the smoke stack of any boat or locomotive, or from any chimney anywhere within the city, shall be deemed and is hereby declared to be a public nuisance: Provided, that chimneys of buildings used exclusively for private residences shall not be deemed within the provisions of this ordinance.
>
> "SECTION 1651.—The owner or owners of any boat or locomotive engine, and the person or persons employed as engineer or otherwise, in the working of the engine or engines in said boat, or in operating such locomotive, and the proprietor, lessee and occupant of any building, who shall permit or allow dense smoke to issue or be emitted from the smoke stack of any such boat or locomotive, or the chimney of any building within the corporate limits, shall be deemed and held guilty of creating a nuisance, and shall for every such offence be fined in a sum not less than five dollars nor more than fifty dollars. Sections 1650, 1651 and 1652 shall take effect and be in force from and after May 1, 1881."
>
> GEO. C. DEWOLF, *Commissioner of Health.*

Now, if you please, just note the exact wording of these ordinances. It is the emission of dense smoke. We do not say black smoke, white smoke, or yellow smoke. I find among those men who are working in planing mills and such, where they use for their fuel almost entirely wood shavings and saw-dust, that they claim "our smoke is white." All right then, I say, is it dense? Our ordinance does not ask you whether it is black or white. It simply says "dense," and then the law department defines what is a nuisance.

I am not a lawyer, but I have to be in court at least twice a week, and I have learned that a nuisance is that which interferes with the comfort or health, or, I might say, happiness of the surrounding neighborhood. I have been asked, on many occasions, to describe in court what I considered dense smoke, and I am only too pleased to be present here this evening in order to reply to so many of you gentlemen exactly what I mean by dense. That is, wherever you have smoke, sensibly opaque, issuing from the summit of a chimney, or on a clear day you cannot see the sky above you; in many cases you cannot even see the sun. It is dense when that smoke will travel for say two blocks. This matter of two blocks is not simply two blocks north, for the winds in Chicago blow from all directions, and you therefore have a radius of two blocks around that chimney. You can easily understand that that is an immense space of ground for one chimney to interfere with. Again, in very moist atmospheres, I have actually seen the smoke travel down the side of the chimney; probably you all have. Now, that doesn't interfere with a very great radius, but nevertheless it interferes with some one, and you have therefore to take that into consideration. As we all know, scientific experiments require that we take into consideration the atmosphere that we are dealing with, and I may say that I consider the firing of a steam boiler a scientific experiment.

Again, referring to the lime: There you have it—heat developed from cold material. It is plain and easily understood. Simply the fact that the union of chemical substances gives rise to the development, always, of heat; sometimes palpable to the ordinary senses, at other times not.

The next question that naturally arises would be an investigation as to what is smoke? Of what is smoke composed? If you speak of wood-smoke I say it is worse than coal-smoke. I am willing to answer any contradiction on that subject, for the simple reason that we can't see where wood-smoke goes, but we can tell where coal-smoke goes. Again, those materials which are evolved from wood are of a different class from those developed from coal, at least many of them are. In the distillation of wood you have given off certain gases which are similar to those from coal, but you have also other products, viz: what we call pyroligneous acid, carbolic acid, and acetic acid. Pyroligneous acid is the same as acetic acid, the fumes of which will not only act upon you personally, but will tarnish the metal in your rooms, especially brass.

Now, the materials from coal-smoke are those that we call from the benzole family, and are quite dissimilar from those from wood. I hope I am not anticipating myself now, but I want to show you that in the matter of combustion certain things are necessary, and I may probably be able to show you some combustion that you are not familiar with. I take here a jar 3¾ full of water. On the surface of that water I shall pour some benzole, the same as our lady friends use for cleaning gloves. Then I cut off here a small piece of potassium which will float on water, and also on the benzole. In order to compel it to sink, I put a common tack through it and throw it in—thus—and your benzole is afire—I certainly did not use any matches—and that, on the surface of water. I would like to ask engineers why, in lighting your fires, you use paper or shavings, then wood, and then coal? Why don't you put in the coal first? Why do you use paper, or shavings, or wood at all? Of course there is a very simple answer—the coal would not ignite if you put a match to it. But why won't it? I will allow some gas to escape and mix with the air in this room. Why don't it burn? Because the material composing that gas, and the materials composing the air, are not brought to the temperature at which they will unite.

All of the elements were there, were they not? The gas was blowing off, the air was in the room, and yet no ignition occurred. We light the match and you see we have fire at once. That is the reason that I have protected you engineers in my official capacity as far as I possibly could; the temperature in your fire-box is supposed to be, some say 1,000, others say 2,500. The fire-box door is open while you are shoveling in the coal, or, if you are too high-toned, your fireman is throwing in coal, and, the temperature of the atmosphere, rushing into that fire-box, reduces the temperature from 2,000 degrees down to about 80 degrees Fahrenheit, and that temperature is not high enough to unite the materials. We have in this room nearly 80 degrees, counting the heat from the gas as well as the materials around, and yet they do not unite. The fuel, naturally, then had to smoke, but after the door was closed and there was simply the passage of air underneath the fire-box (the necessary amount, not the extra amount) you then ceased to smoke, or, I might better say the fire ceased to smoke. Some engineers never cease smoking.

In this connection I have also to say that there isn't a man in this assembly who does not know that if he turns up the wick of a common kerosene lamp too high, but that it smokes the chimney. He also knows that when he puts this kerosene lamp up in his hall, with the proper height of wick, when an extra draft comes through the hall his chimney is blackened. Why? In the first instance, where the lamp wick is raised too high you have more oil blazed up into that chimney than you have air to burn it, hence you have a blackened chimney from the deposition of carbon; in the other case there was more air than was necessary, and cooled down the contents of that lamp chimney.

Again, with regard to combustion, there are some two or three peculiarities that I would like to show you experimentally. You all believe gunpowder burns; if there is one person here who does not I will blow him up for an experiment. I will show you some that does not, under certain circumstances. This, as you can see, is an ordinary gas lamp; I have here some iron filings, and, I was informed, some steel. I will sprinkle these through this flame, and you will see these filings burn as I throw them through. I now take some gunpowder and throw it through the same flame, but you see it has gone through it and has not burned. If you doubt that that is gunpowder I will prove it to you by burning it—it seems to be pretty lively gunpowder! Why was it that the iron filings burned and the gunpowder did not? For the simple reason that the temperature of the flame is sufficient to raise the iron to the temperature necessary to cause it to unite with the oxygen of the atmosphere, while the temperature of the flame was not sufficient to raise the temperature of the gunpowder to the point of union; as we call it, the unit of temperature. To go a little further on the question of combustion: here we have the ordinary gas flame. (Illustrations by the Bunsen burner.) There you have what we call incomplete combustion; that is, you have more gas than is necessary to complete combustion, but if we gradually turn off the volume of gas we get better combustion until we get to the point that we call complete combustion. That flame cannot be seen in direct sunlight. That is the flame that we use for the purpose of heat in our laboratories. You notice that the moment you close these open spaces at the base of the lamp we have smoke; and gentlemen, I am sorry to say, that in the city of Chicago I find a great many who allow clinkers to lie all over their furnaces. Shut off the air that way from your fire-box and it must smoke. As long as there are these immutable laws of nature, it is unnatural to expect that coal inside of a furnace can be burned without smoke, particularly when you have so many clinkers on your grate bars that the air can't get through them.

This brings me to another point, viz.: The subject of flame. We all look at these gas jets and think there is but one flame there, when in fact there are three, and that is where I played the trick on you in reference to that gunpowder. I poured the gunpowder and the iron filings both through that blue portion of the flame, which is the coldest part. Now, why is it that the central portion is blue and the outside white? For this reason: that there is little or no heat in that central portion, hence the white is incandescent carbon, and the constituents of the coal gas are chiefly carbureted hydrogens. The hydrogen very easily parts with its carbon and becomes united with the oxygen of the air in order to form the outer, while the free carbon, heated to a white heat, is that which gives us our light. I would like to show you the third flame; that is the outer envelope. You cannot under ordinary circumstances notice it alongside of this white heat. You see the blue inner flame, or what we might term that of noncombustion. It is a flame of slight combustion. The white is that of partial combustion, and there is another outside of that which we shall be able to show you, being complete combustion; such as we have in this lamp I have shown you. Here we have some hot coals from a hard-coal fire. In order to see the third flame we have to throw some nitrate of sodium on them and allow the fumes to pass upward through the flame. You will notice at once, on the outer edges, a yellow flame, and that is the zone of complete combustion. That is the third zone of combustion. Then again, in order to show the inner flame, I take a piece of common stove-pipe covered above with a wire gauze, and below plugged with a cork having four perforations of equal diameter. I pass into the central one the gas which we have here. The gas and air mingle; I touch a match to the top, and, if you will notice, there is a circular and conical flame, the inner portion of which is exactly similar to that blue flame you see there in the ordinary gas. I now pour gunpowder through this flame and there is no combustion.

PRODUCTS OF COMBUSTION.

I will now speak of the products of combustion, and the question is partial, or complete combustion. Partial combustion is the time when we get smoke. Smoke is composed of carbon (in other words soot); various hydrocarbons, and also carbonic oxide, which is extremely poisonous. You might be responsible for the death of some of your own family by not preventing the formation of smoke. Carbonic oxide will pass through the pores of cast iron, which would seem pretty dense material to get through. It is thoroughly poisonous, because it deoxidizes the blood. We simply breathe for the purpose of oxidizing the blood, and if we inhale or take into our lungs a material that will deoxidize it we are surely poisoning ourselves. Are you, gentlemen, going to supply poison without a license? Druggists have to get a prescription before they part with any. If you have any cast iron around your works through which your gases have to pass they will come back on yourselves. The boilers standing under the sidewalks here are crammed in; the breeching is about on the level of a man's head. It is sometimes made of iron and sometimes not; anyway, if there is the slightest leakage (and there usually is, even in the best made breeching) through a break in the metal, the man about it is inhaling poison he himself makes, and is simply committing suicide. The fact is, if you do not supply the carbon in your fuel with a sufficient amount of oxygen you will produce carbonic acid.

I will now manufacture that material for your pleasure. Here I have some marble, to which I have added muriatic acid, and you will see it coming through this tube, and into this glass (or would, were it not an invisible gas, and remarkably heavy) by putting a lighted candle down into the glass, the moment the light reaches the top edge of that glass it goes out, so you see that jar is quite full of it, but you will notice that if I hold it immediately above the level I can keep it alive. Now, this gas is not poisonous, but it asphyxiates in the same way as if you closed up the mouth and nostrils of a person; it is remarkably heavy and would probably carry down any soot that it came in contact with. Both these jars are empty enough, as far as you can see, but I say this one is full of carbonic acid, and in order to prove it I pour the carbon dioxide from this full glass into the other. In order to prove to you that I have done so I will try this candle and see if it lives; you see it goes out, and in order to prove that I have poured it out of the other one I will put the lighted candle in, and you see it lives. It burns in the same jar that it would not live in until I poured the carbon dioxide into the other glass. There is no magic about this and no deception.

I have gone a little ahead. The carbon of which I spoke, commonly called soot, is not only objectionable to yourself but to your neighbors; not in a chemical, but in a mechanical sense. This carbon (the soot) falls upon the surface of your bodies and closes up the pores of any portion it comes in contact with; if it goes into the lungs it fills up the air tubes of the lungs, therefore the blood is not oxidized; if you wish any proof of this, all you have to do is to examine the lungs of a coal miner. There it is shown especially, that even impalpable dust goes into the lungs, and of course will find its way into those of others exposed to similar influences. It is said that a great many of our citizens troubled with consumption are cured by going out to the western mountains. Of course the only cure they had was in going away from Chicago. It wasn't consumption at all. It was the clogging of the air tubes of the lungs. We can get that kind of consumption in shoddy mills and flour mills. If instead of living in a flour mill I have got to stand alongside of the chimney of it, I am just as liable to die of that same kind of consumption inside as out. That is to say, if the boilers turn out smoke.

Again, this carbon coats the inner portion of the flues of your boiler, and there is no greater non-conductor of heat than carbon. Now, if you have this carbon on the inside of the flues, where is the heat going? Certainly not through the carbon.

Then again, if you burn the carbon on to that inner surface of the flues you burn your flues. There is no medium known to day stronger to resist temperature, &c., than the metal, platina, and in the analysis of coal, with which I have had a great deal to do in Scotland, there was nothing ate my platinum vessels faster than this analysis of coal. In burning up this carbon you burn a hole in your platinum vessel, and the only thing that will fill up that hole is gold.

COKE AND HARD COAL.

There is one fact that I would like to call attention to, and that is in reference to the use of coke and hard coal; I don't know how it came to be stated that the health department had ordered everybody to use coke. I was under the impression that it was from this part of the health department that such an order should have come. If I meet any of you gentlemen in the future, as I have with a number in the past, and been received very kindly, I don't wish it understood that we mean that you *shall* burn coke, nor do we wish you to understand that you shall burn hard coal, but we simply say to you that you have to prevent or abate the smoke nuisance. It is for you to decide how you shall do it. The question with regard to coke or hard coal, is very peculiar but very simple. You require peculiar arrangements before you can use it. The fact of the matter is with regard to the use of coke, or hard coal, that the heat is very intense when you have got it, but it is local, and therefore acts on a certain portion of your boiler, while that which you can form by means of soft coal, carefully handled, is diffused over a considerable portion of your boiler, and therefore does not act so intensely upon any one part and compel it to do all the work.

There is another point also: I understand that there are some engineers in the city of Chicago who think that the top of the boiler is colder than the bottom of it. I was under the impression—in fact have been for 25 years—that iron was a metal which conducted heat very rapidly, and I think that you will find the top of your boiler about as hot as the bottom.

THE BEST SMOKE BURNER.

Probably you are under the impression that I am going to advertise a smoke burner for you. Well, I am. I will tell you the best smoke burner in the world—a well-set boiler. I don't believe in a boiler where the fire bars are within eight inches of the bottom of it. I would like to have them a good deal further away, and if you want any boilers set come to me. I would set them on a deep grade, a long boiler and wide, where you can have time in your fire-box to consume your gases. There is no such thing as burning smoke, as I stated when I first started out, have your air spaces underneath your boilers to agree with the air spaces in your flues, have a good breeching, and don't have it like one I saw two or three years ago, about nine inches lower where it joined the chimney than it was where it started. Any person that supposed that a breeching that falls like that will not obstruct the draft, is badly mistaken. The breeching I don't think should be four sided. I think it should have free elbow joints, and be circular, but not crammed in a small space, as they attempt in Chicago, with what I call sidewalk boilers; that is, boxed close under the sidewalk. The breeching should agree in capacity with the dimensions it first started with, and should have a chimney of equal capacity. I can show you boilers to-day where the coal is touching the bottom of the boilers; to ask any engineer to run them without making free smoke is absurd.

I have commenced at the top of the chimney and come down, and now, underneath the boiler there should be a good quality of coal, and in front of it intelligence. For instance: An engineer is appointed at a dollar and a half a day (I simply state this for figures) and then get a fireman there at 75 cents a day; the fireman goes up to the boss and says:

"Now boss, look here! I have been firing here for six weeks (probably the fellow just came off the road and had been digging holes for hitching posts), and here you are paying out two dollars and a quarter a day for the engineer and fireman, and I know just how the engineer does it. You give me a dollar and a half, and save 75 cents a day, and I will do all the work."

This is done in Chicago in many cases. I say this: If you want good work done you are compelled to use good tools, and if you wish to know what smoke burner I want put in, it will cost you $500. Just take that $500 and buy better help, and you have got your smoke burner!

"IN THE ROUND HOUSE."—No. 9.

By L. O. Danse.

FIRING.

When an inexperienced person looks into the fire-box of a locomotive he sees nothing but a bright glow; but the experienced fireman, whose eyes have become accustomed to looking into the fire, readily distinguishes the thin parts from those where there is a heavy layer of fuel, and takes care to keep an even fire over the whole grate. Clinkers and slates, too, are easily detected by the practiced eye.

Thin spots in the fire reduce the steaming capacity of the boiler very greatly by allowing large volumes of cold air to enter the fire-box and cool the heating surfaces. Unequal firing is not the only cause of thin spots. Broken grate-bars and improperly adjusted lift-pipes are frequent causes, and often make a "cooking-stove" of a locomotive. The lift-pipe should be nearly the same diameter as the chimney, and its "skirt" should stand out at an angle of 60°. The best size for the skirt varies with different conditions. The bottom of the skirt should be on the same level as the lowest row of tubes, and the top should be about four inches from the base of the chimney.

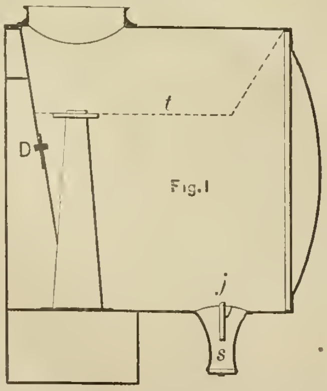
When the fireman notices that his fire appears to dig out in front, despite his efforts to keep it even, he calls the attention of the runner to that fact, and they lower the lift-pipe at the first favorable opportunity. Should the fire dig out at the back the petticoat must be raised. The reason for this is that the gases of combustion produced at the front of the grate go through the lower rows of tubes, while those from the back part seek the upper rows, as affording the quickest egress. Lowering the lift-pipe increases the draught of the upper rows to the detriment of the lower ones. Similarly, raising the lift-pipe reduces the draught in the upper rows and increases that of the lower.

Even though the draught does not dig out the fire, the adjustment of the lift-pipe may be imperfect. Opening the smoke-box door, we notice the condition of the tubes. If they are all clean the lift-pipe is properly set; but if some are choked with soot, cinders and ashes; it is evident that the draft through them is insufficient, and we regulate it accordingly.

Whenever a grate-bar is broken, even though the break be small and appear insignificant, it should be replaced as soon as possible, as, if allowed to remain, it may cause enormous consumption of fuel.

When standing at a station the fireman should never open the fire-door without having previously put on the blower, as otherwise the poisonous gases from the fire would come out into the cab, to the manifest injury of its occupants.

Locomotive building has its fashions, and one of the present fashions is to put "extensions" and straight stacks on all the smoke-boxes. Extensions are by no means new, as the writer knows them to have been used more than twenty years ago; but they never became common until within the last few years. Although not much liked by the runners, they have proved the most efficient spark arresters yet devised.



As will be seen from Fig. 1, the lift-pipe is dispensed with, its place being taken by a "deflector," *D*, made of two plates, one of which can be adjusted by sliding it on the other. The deflector does double duty, equalizing the draft among the tubes and breaking up the cinders. The sliding-plate must be adjusted in a manner similar to the lift-pipe, to keep the fire even and the tubes clear. The large area of the netting, *t*, obviates much of the danger of its gumming. The accumulated cinders are occasionally blown out through the spout, *s*, by the steam jet, *j*. It is evident, from the great volume of the smoke-box and extension, that the current through it is much less rapid than that in the stack, a condition which eminently adapts it to stopping the cinders. Hand-holes are provided to facilitate cleaning out.

ENGLISH DOCK-YARD ABUSES.

Under the title of "*The Battle of Port Said*," *Engineering* publishes a most interesting account of the system, or lack of it, or too much of it, which prevails in English dock-yards. The accounts of expenditure made on English iron clads, and the cost of them, are incredible:

"Another very serious question was the enormous cost of building our ships. An ironclad is often six or seven years in construction, and the sums of money expended on alterations is out of all proportion to the cost of the vessel. The system carried out is as follows: the drawings which show all the principal arrangements of the ship approximately, but not exactly, are sent to the dock-yard, and the frame is built and plated, this part of the work goes very well; then come the minor details, such as cabins, small auxiliary engines, pipes, &c. Of these there are no drawings, they are put on board the vessel as they arrive alongside, in about the positions shown on the general arrangement drawing sent several years previously, when the vessel was commenced, and to suit the taste of the foreman in charge; when this part of the work is complete, somebody has a new idea, and requires room for his invention; this entails pulling down much of the work which was complete and putting it elsewhere, this again interferes with something else, entailing further alteration, so that the work is often done three or four times, wasting both money and time.

"There is another means adopted for wasting time and money. Before anything is put into its place a "mould" as it is termed—that is a framework of wood—has to be made and tried in place to see how it looks; when it has been altered to suit the taste of the foreman, a superior officer is informed that the "mould" has been made and is ready for inspection; the following day this officer arrives on board, and, after looking at the mould, tells the foreman to move it half an inch further forward and see how it looks; in a day or two, down comes the officer again, and is not satisfied with the mould, and gives orders for it to be moved an inch further aft, which position seems to satisfy him when he next comes on board, and the work is allowed to proceed; all this time, often a week, the shipwrights who ought to be doing the work are waiting for orders to begin, while the officers are amusing themselves with a model or "mould" as they call it; you may be able to form some idea to what an extent this is carried if you consider that on one small turret ship alone a million square feet of timber, half an inch thick, was used for moulds; the strips of wood are usually about three inches wide, and if they had been placed in a line, you would have found that there was enough to reach from London to Edinburgh and back.

"Another very important matter was the system of repairing vessels that had been in commission. The custom was for an ironclad, and in fact any other vessel, to return home to be paid off. So soon as the stores had been returned, and the crew gone away, the dock-yard people came on board and pulled everything to pieces as the first step towards making good defects. This work was carried out as quickly as possible. Then most of the workmen are removed, and a foreman begins to make out a list of defects, with the probable cost of making them good. The ship remains in this state, with about twenty men on board, doing something or nothing for a long time, occasionally for years. At last it is decided to "bring the ship forward for commission." A large number of men are then sent on board, and after a few months the vessel is ready for sea.

"Years ago every man was responsible for his own work; this has all been changed, and, according to the new regulation, the head man is responsible for all those under him. This sounds very well, and if a rivet boy heats a rivet badly, the riveter is to blame for not seeing that the boy heats the rivet well, and the leading man is to blame for not making the riveter attend to this duty, and the foreman for having allowed the leading man to be careless, and so on till it comes to the admiral superintendent, port admiral, and at last my Lords Commissioners for executing the office of Lord High Admiral of the United Kingdom of Great Britain and Ireland, &c., are to blame because the little rivet boy has not heated the rivet well. Now, according to regulation, it is my lords who are responsible and should receive the punishment, instead of this the boy gets his ears boxed, which is, to say the least, very unfair, as according to regulation he has done no wrong; this is the comic view of it, but there is another side which is very serious; to explain this I must give you an account of the officers in the dock-yards.

"A shipwright gets work as journeyman in a dock-yard, and if he is a fairly good workman and keeps good time, he is, after a year or two, put upon the establishment, that is, that after a certain number of years, he becomes entitled to a pension. It is a system which works well, and should be introduced to the engineer class of men. When there is a vacancy for a leading man, the most intelligent established man, who passes the best examination, is promoted. This gives a most excellent set of men for leading hands, each of whom has a gang of about twenty men under him, and his duty is to see that these men do their duty. The foremen are appointed by competitive examination from the class of leading men. Their duty is to give instructions to their leading men, and see that they do their duty. The foreman being in charge of the whole of the work on his ship, should be really responsible for everything. The constructor's duty is to receive orders and instructions from the Admiralty, and to have them faithfully carried out, to make suggestions during progress of the work, and see that all the foremen know what they have to do and give them every information required and see that all orders are executed and the work is well done; they have another very difficult and troublesome duty, they receive all the representatives of contractors, settle all disputes and see that contracts are fulfilled; they have also to revise and forward to the Admiralty all estimates for repairs, and prevent all unnecessary expenditure of money.

"There are the same grades and duties in the engineer branch, but the head of that department is called chief engineer instead of constructor; the chief engineer and constructor are independent of each other, but of course have to work together.

"Last of all is the admiral superintendent; he is a rear-admiral, and is head of the dock-yard, and on him depends everything. His duties are not clearly defined, he is simply the head, and is responsible to the Admiralty alone.

"You now know the duties of the different officers, you must next learn how they are performed, and the reason why it is impossible that the different grades should attend to the work especially set apart for them. You remember that it is always the senior officer who has to take the responsibility, as it is termed, for every mistake; in other words, to take the blame without being punished, and the junior has to take the punishment for having got his senior blamed for neglect of duty, the result of which is that the juniors adhere as closely as possible to the written instructions laid down for their guidance; these instructions are frequently being issued and are for the purpose of preventing imaginary abuses; they entail so much unnecessary work upon the foreman and leading men that they are unable to attend to their proper duties; for instance, the foreman has to sign every demand note for stores, and there are often three or four hundred a day for him; of course he should read them through before signing, because he is held 'responsible;' then, his drawings being incomplete, he has to find out the best way he can the positions proposed for the different engines, cabins, etc., on his ship, then see what alterations are necessary from the original design, then make a sketch of what he proposes and take it to the constructor, explain and talk the matter over, then have moulds made to look at; all this time he should be on board his ship looking after the work, but he has so much office work that if he can manage to spend a quarter of the day or at most a half on board, he is very fortunate.

"Next the leading men, who should always be with their men to look after them and keep them at work; they have to make sketches, or rather get their men to make them, of every little thing they require from the smithy or other department, then send these sketches to the workshops, and go themselves repeatedly to see that the work is not forgotten; then, as the foreman has so little time to be on board, they must do much of his work for him, they must make a note for his clerk of all the stores they require, which the clerk copies out on the storekeeper's demand note for the signature of the foreman. This necessitates giving an office to the leading men, in which you may generally find most of them, one or two remaining on the lookout for the foreman or other senior officers, so that the newspapers may disappear should there be nothing else in the office. Meanwhile the men are left to themselves and do just as much work as they please, or as little; they cannot take any interest in their work, because, owing to alterations, they have often to undo their work as soon as it is finished; besides having constantly to wait for the approval of the senior officers, or for some trifle which is being made in another department, or perhaps a bolt or nut from the stores, for usually it requires at least twenty-four hours to get a demand note written and signed, and obtain the article from the storekeepers.

"For years past we have been devoting over ten millions annually to our Navy; war is declared and we have to send every vessel we can to the Mediterranean to protect the Suez Canal, where our fleet is destroyed by that of the enemy, which is far stronger than ours. While this is going on, the enemy send out a second fleet from Cherbourg, to which we have nothing to oppose, and which has command of the English (?) Channel, burning the towns and levying contributions, until the Germans are so good as to send their fleet to protect our coast and shipping. Our Navy list told us that we had nearly fifty iron-clads, and the Admiralty constantly repeated their assurances that we were stronger than any two of the Continental powers together.

"Although we paid heavily for our experience, we may yet derive some advantage from the Battle of Port Said."

THE DESTROYER.

It is well known that Captain Ericsson has been at work for many years past upon a novel vessel, which combines the ram and the torpedo boat. In principle it is wholly unlike any other, and the peculiarities of construction are embodied in the subjoined paragraphs:

"The shape of the vessel is very similar to that of a monitor. Its dimensions have been ridiculously misstated. These are the exact figures: Length, 130 feet; depth, 11 feet; extreme beam, 12 feet—thus presenting the unusual proportions of eleven times greater length than beam. Both ends are precisely alike, the terminations being very fine wedges, that are sharper than those of any vessel of deep draught yet built. The rudder required special attention, and is wholly unconnected with the visible part of the stern. The tillers consist of thin plates of iron, riveted on opposite sides of the rudder a few inches from its bottom. These tillers are operated by straight rods connected with the pistons of horizontal hydraulic cylinders attached to the sides of the keel. The top of the rudder is four feet below the water line, and the steering gear ten feet below the water line. The tillers are riveted on each end of the rudder, and are worked by rigid rods connected with little special engines inside the boat.

"At present seventy feet of the center of the boat is incased above the deck by a plate iron deck house. This is simply intended for convenience, and would probably be removed when the boat is engaged in actual warfare. She is, of course, to be fought bow on, and is not supposed to sail into a fleet of vessels where shot could be poured into her from all sides. There is an arrangement for deflecting any shots that may strike her in the bow. A heavy armor plate is placed transversely to the line of the keel, thirty-two feet from the bow, inclined at an angle of forty-five degrees and separated from the afterside by a wood backing four feet six inches deep at the base. It is claimed that at that angle this piece of armor will deflect the largest projectile when the boat is fought bow on. This latter is a necessity, for her only gun is placed in the bow, ten feet below the water line. It points downward at an angle, the shot describing a curve before it strikes the object at which it is aimed."

SETTING WOOD-WORKING MACHINERY.

In the first place, you should see that the foundations on which it is to stand are firm and unyielding beyond a doubt. It is a lack of good judgment to set down a heavy planing machine on a common floor without any additional support more than the other parts of the floor of the mill. If there is a basement room it would be well to dig down from three to five feet, according to the nature of the soil, and put in a solid stone foundation, and on that put up a strong trestle work coming up under the machines, so that instead of the machine standing on the floor it stands independent of it on the trestle work.

The main lines of shafting, if under the floor, should be treated in the same manner, and instead of hanging on the floor timbers they should be independent of them altogether. In this way you can load your mill down as heavy as you please and all your machines are yet in their places and keep in perfect line all the time. I know all this involves expense, and I also know that it gives perfect satisfaction after it is done. Great care should be taken in putting up the main line of shafting. First-class work and first-class adjustable hangers for your shafting, instead of a lot of wooden frames fastened up with gib and key, whose only virtue is to wiggle back and forth to accommodate a line of crooked shafting.

No machine should be considered ready to use until the belt runs perfectly fair without the aid of anything to keep it on the pulley, and when the conditions are just right it ought when partly shipped to draw itself fair on to either tight or loose pulley. What I mean is, if you are starting up and throwing the belt on to the tight pulley, after you have thrown it over two-thirds of the distance it ought to draw itself on fair, and the same should be the case in shipping on to the loose pulley when you stop running. It is the general custom to make the leading pulley a little crowning so the belt will draw on even if the shafting is a trifle out of line, and here is where a great many make a mistake and let work pass if it goes *middling* or *tolerably* well. There are a great many who, if they can get a belt on so it will make a machine go around, seem to be satisfied even if they have to fasten the shipper whether the machine is running or not. The result of this is in a little while one edge of the belt is worn out while the other is comparatively good, and even when it is new it does not do anywhere near the amount of work it ought to because it draws on one edge on the driver and on the other on the leading pulley. There are many that get a machine of any kind *about* where they want it, and look at the line of shafting and then at the machine, and then guess it's about where it ought to be, and put the belt on. If the belt runs fair, all right, and if it runs off an inch or more either way, they put something in the shipper to hold it where it ought to stay without any assistance, and the result is that in a little while one edge of the belt is ripped up half the width of it, and things have a general demoralized appearance.

There is only one way to have the work come out right so your belts will always run fair. After your main lines are up either above or below the floor, make a line on the floor exactly above or below it, as the case may require, and then draw an exactly parallel line just where the counter-shaft of your machine comes. Be sure you get these lines perfectly right, and there is no trouble about the belts running fair, providing the shaft is level and your machine stands level. Of course this is a point not to be overlooked. The main line and counter on your machine should form two perfectly parallel lines.

One great trouble in setting up machinery comes from employing incompetent men to do the work. All the faults and sins caused by bad running planing machines ought not to be laid to the builders. Many of them have brought through patient toil and care machines which, if properly put to work produce as nearly perfect work as can be expected from machinery. Perhaps I ought to explain a little here, for all mills may not be used to work that I am. We take plank oftentimes that come from the first cut of a southern pine log; and as likely as not one end will be an inch or perhaps more than an inch thicker than the other, and the thin end will furnish the thickness we want and the other will have to be planed down an inch, and in lots of 15,000 or 20,000 feet we find a great many such planks. And just so in our large dimension mill, where we often plane timber 60 feet long, 16 × 16, and find the timber varies an inch or more in the length of the stick.

Reckless running and careless handling are the prolific causes of more bad work than all the faults of manufacturers put together. We find some things to blame them for, but not a tithe in comparison to the amount that we ought to lay to the recklessness of men using them. In setting machinery no builder can be blamed if the mill is set so that the belts run part way off the pulleys, and fails because it is not properly put to the work. We must take this responsibility upon ourselves, and use care and judgment in setting up machines so they will give the best possible results.—*The Wood-Worker.*

* * *

THE MAN WHO INVENTED THE STEAM WHISTLE died recently in Montreal. Henry C. Buckley was his name. "Concerning the dead, nothing but good," but it is no doubt true that Mr. Buckley has been, in the person of his invention, about as much cursed by mankind in general as was the inventor of sleep blessed by Sancho Panza. Like its progenitor, however, the steam whistle must sooner or later "go." Detroit has virtually had it abolished since 1873, but other cities still inwardly writhe under the infliction. Cleveland has her full share, and periodical outbursts of indignation appear in the daily papers, but without result. Suppose the opponents of the whistle devote some of their surplus energy to devising a more musical and less noisy substitute. The bell and the triangle do not seem to have filled the "long felt want."—*Trade Review.*

* * *

An English Engineer, in speaking of American locomotives, says: "Nearly every engine is fitted with glass oil cups on the rods and bars, worsted siphons being dispensed with, and a species of needle, permitting of an adjustable feed, being substituted. A driver can thus ascertain at a glance whether his oil cups require refilling or not, while if a bearing requires a more liberal supply of oil, the feed can be altered in an instant. Glass oil cups are of course more liable to breakage, but Americans generally (with a marked exception as regards the gentlemen who handle the baggage) are lighter handed than the proverbially horny-fisted English driver, who would be much astonished to see an American *confrere* driving an express train, seated in a comfortable spring arm chair, and equipped with a neat pair of stout gloves. As every true American rigorously avoids any unnecessary physical exertion, it need hardly be said that drivers and firemen are at perfect liberty to sit down whenever they like, provided the work is done; though on many lines, especially in the West, a visit to a drinking bar or saloon when off duty insures dismissal."

WOMEN AS INVENTORS. PETROLEUM AS FUEL.

"'The article on 'Women as Inventors,' in a recent issue of the *Trade Review*, has called out some interesting remarks by The Mechanical Engineer. If it be true that woman is incapable of inventing anything useful, as held by our contemporary, there must be some psychological explanation of the fact. Will The Mechanical Engineer kindly supply it? Or would it not be a more plausible explanation to say that woman has never yet had the chance to enter the inventive world unhandicapped, but that in proportion as obstacles have been removed, the value of her inventions has increased?"—*Trade Review.*

We fear that we shall have to back out if this is to be a controversy on the subject, for we have so great a respect for the sex that we cannot bring them into question in any way. Our native gallantry will not permit it! At the same time, our friends impute expressions to us which we did not use. We did not say women were *incapable* of inventing anything useful. That is going beyond the record, and more than we would aver. We said they generally got hold of some obsolete device, and so far as our recollection extends we do not think we were far out of the way. We know of no other obstacles to success in the way of women as inventors.

In another part of its issue our friends direct our attention to the fact that more experiments are to be tried with crude petroleum in Cleveland. This substance has been experimented with most carefully by capable observers, trained to the business of experiment, and without pecuniary interest in the result. It has never yet been proven economical in competition with coal. Petroleum burners crop up every few weeks with as much regularity as perpetual motions; they form stock subjects, but there is not one to-day in successful operation anywhere in the world. In Southern Russia crude petroleum is to-day, or was a few months since, used on locomotives, but in a recent English paper it is stated that the combustion was so imperfect that everything was foul with soot.

The process is so apparently simple and easy and the end so apparently successful that for years to come the same route will be gone over. All there is about it is that petroleum has not the same calorific value as coal, and is not so readily used as fuel.

AS SEEN BY ENGLISH EYES.

The Exhibition of Railway Appliances is reviewed by a candid writer in the *London Engineer*. He is honest enough to tell the truth without prejudice. We quote:

"The display of locomotives and rolling stock generally was very complete, both in number and quality. No less than twenty-seven were shown, seven being by one maker. While no very important departures from established practice were shown, there was a noticeable general tendency to employ larger bearing surfaces, better material, more strongly proportioned parts, and a plain and simple exterior finish.

"But one example of the old style of American engine was exhibited, its vermilion wheels and chimney, polished frame, and bright brass dome and cylinder cleading standing out in marked contrast to its competitors, all clad in sober black, relieved by a little gilding, presenting a remarkably neat and dignified appearance, which might be well imitated on this side of the water. Russia or planished iron is universally used in America for cleading boilers, and as it can neither blister nor change color by heat, and being very smooth is easily cleaned, might be found worth a trial by some of our enterprising English locomotive superintendents.

"The display of both wood and iron-working machinery was very complete, but was distinguished more by good workmanship, excellent design, and strong proportions than by any novelties. Some fine specimens of steel rails, tires, axles, plates, and sheets of American manufacture were exhibited, one rail measuring 130 ft. in length, and one plate $\frac{3}{8}$ in. thick, being 4 ft. 8 in. wide, and no less than 27 ft. 2 in. long; some excellent forgings, including many complicated forms, chiefly for car work, were shown by Wilson, Walker & Co., of Pittsburgh, and a careful examination of the various products in steel and iron conveys the impression that America has little to learn from this country, and that her natural disadvantages in the great distance apart of iron ore, coal and flux alone prevents competition with us in the matter of price. The wages, though higher per man, are no more per ton, while, as usual in America, an enormous product is turned out with a comparatively small plant.

"Praise from Sir Hubert Stanley is praise indeed!"

* * *

The prospect for fall trade is good in Pennsylvania. The Pennsylvania Railroad is adding six engines per week to its present supply, and has placed a large order with the Baldwin Locomotive Works. The Reading Railroad has given an order to the Baldwin Locomotive Works for 30 engines, to be built within the next six months, and has its own shops engaged upon new locomotives. The Baldwin Works now employ 2,800 hands and will turn out 240 engines during the next six months. This activity in railroads is accompanied with renewed inquiries about rails. The Bethlehem Iron Company last week received an order for 1,000 tons, and the Cambria Iron Company expects several large orders. The Edgar Thomson Works, the Pittsburgh Bessemer Steel Company and the Pennsylvania Steel Company are in receipt of numerous inquiries, aggregating about 50,000 tons, which, when turned into orders, will keep them comfortably busy and add stability to the iron market.

* * *

A curious machine has been devised way out West by an ingenious miner. He had some arastras—stone wheels rolling round in a trough—for crushing ore, but no power to drive them except a wind-mill, so he rigged up a lot of elevator buckets on a belt which was driven by the wind-mill. These buckets dipped into a heap of dry sand at the bottom and discharged it into a "tank" at the top. From the tank the sand was let out on to a breast-wheel, which it drove the same as water would.

The presumption is that the wheel had the best of it, for it would take the wind-mill a good while to carry up sand enough to run the wheel for any length of time and give out power; 33,000 pounds of sand must fall one foot every minute to produce one-horse power.

* * *

Getting up steam on a boiler or a battery of boilers is thought to be a matter of no special importance in most manufacturing establishments, and when it has to be done in the night is commonly entrusted to the watchman, whose knowledge is limited to building a fire and keeping it a going until an engineer gets there in the morning. This is a great mistake that already has cost many lives and thousands of dollars expenditure repairing damages to property caused by their inexperience or recklessness. How many boilers have been injured by watchmen under such circumstances only those familiar with such matters can tell.—*The Locomotive.*

* * *

The Lowell machine shop, says the *Manufacturers Gazette*, has a luncheon room for those of its help who carry, or have brought, their dinners; and it has further manifested its interest in the men by providing this room with fixed racks, on which it keeps files of six or seven newspapers and periodicals, for imparting instruction gratuitously to those who wish to avail themselves of the noon hour for that purpose.

* * *

It is now made a condition in some western saw mills that filers shall be able to hammer saws as well as file them; that is to take kinks out of them when they get buckled. Straightening a saw in this way is a specialty only learned by long practice, as every machinist knows who has ever tried to "straighten" a flat plate of iron or steel.

* * *

The Mallory rocket torpedo is fired from a tube, and after leaving it commences to burn under water like a common rocket in the air, thus adding the impulse of the gases to the original force of the gun. It is expected to go at the rate of a mile in a minute for a short distance.

* * *

Steel nails are becoming very popular with box makers and are also largely used by builders. Box makers prefer steel nails to iron, as they can be drawn and redriven.

FOOLS QUESTIONS.

Members of the Littlewit family are in great force on the Brooklyn bridge, and the questions asked of the police are amazing. A member of the force says in the *Sun:*

> This morning a man from Connecticut asked if the large cables were hollow and used to carry water from Brooklyn to New York. I assured him that they were, because that seemed to be the reply he expected. A few days ago a man asked me when the cables were to be taken down. I told him I hoped not until after 4 o'clock, when I was to go off duty. He had an idea that the cables were used as a sort of scaffolding, to be removed as the bridge was finished.
>
> A short, blink-eyed man, with a tall hat and a strut, asked: "Is this the center of gravity?" pointing to the plates in the middle of the bridge. Being assured that it was, he passed on apparently satisfied.
>
> "A young girl," said the policeman, "asked me the other day whether the middle of the bridge was about half way across Nearly every one asking questions goes through the regular list in regard to the size of the cables, their length and weight, the height of the towers, when the cars are going to run, and so on. The machinery that runs the endless cable has been a source of much question asking. The only really absurd question on that subject was asked by a man over here in Brooklyn. He wanted to know whether the cable was used to strengthen the bridge."
>
> "Do people betray any nervousness about the strength of the bridge?"
>
> "Not exactly nervousness, but they do strange things. They take hold of the cables and try to shake them. They jump up and down on the bridge, with the idea that their weight will cause the cables to sway. They ask minute questions about the way the cables are anchored, and whether there is any danger of the anchorage giving way. A man over on the Brooklyn side makes a point of feeling of the foundations every time he goes across, apparently to see if there are indications of their crumbling."

ELECTRIC MOTORS.

Constant mention is made of the fact that electricity can be made to propel steam launches and experimental railway cars, but it seems scarcely worth mentioning in view of the present cost of electricity. Until that force can be brought down to something near the price of other motive power, it is unavailable commercially. It cannot compete with steam or with water power, and in the hands of unskilled persons it is by no means safe. At the present day electric machines are no better than clockwork which depends upon the winding of a weight for its power. Dynamic electricity must be wound up by some other motor before it can exist. Electric railways are good schemes for stock companies, but if the fluid used is derived from dynamos charged by steam engines they will be found costly affairs, for the power of the electricity will not equal that of the steam used in its manufacture. If expense of maintenance is only secondary, then our objection is invalid.

* * *

According to a French experimenter, the strength of steel rails depends as much (more he says) upon the temperature at which the rails are rolled than the amount of carbon in them. He argues that the temperature, more than the carbonization, changes the structure, and that brittleness arises from rolling rails at low heat. This discovery is somewhat invalidated by the fact that in this country, at least, rails are not rolled at low heats.

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New York, September 29, 1883.

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THE MASON REGULATOR.

The Mason Regulator, described in the accompanying cuts, is designed as a governor for all kinds of direct acting pumps, engines and water-wheels. Its great advantage lies in the fact that it is attached directly to the piston-rod or working parts of the machine without the use of belts, pulleys or gears. The working parts being wholly immersed in oil, and no packing being used, with the exception of one bearing, the machine will never wear out or get out of order.

The regulator consists mainly of a cylindrical shell or reservoir filled with oil. A plunger, *C*, connected by the arm, *I*, to some reciprocating part of the pump or engine to be governed, works horizontally and in unison with the strokes of the main engine into the pump chambers, *JJ*, thereby forcing the oil into the chamber, *E*, whence it returns through the orifice, *C*, to be re-pumped as before. In case the engine acts more rapidly than is intended, the liquid is forced into the chamber, *E*, faster than it can escape through the orifice, *C*, thereby raising the piston, *F*, which shuts the throttle through the action of the lever, *L*. As the orifice at *C* can be enlarged or diminished by means of the screw valve, it will be seen that the action of every portion of every stroke can be controlled at the will of the engineer.

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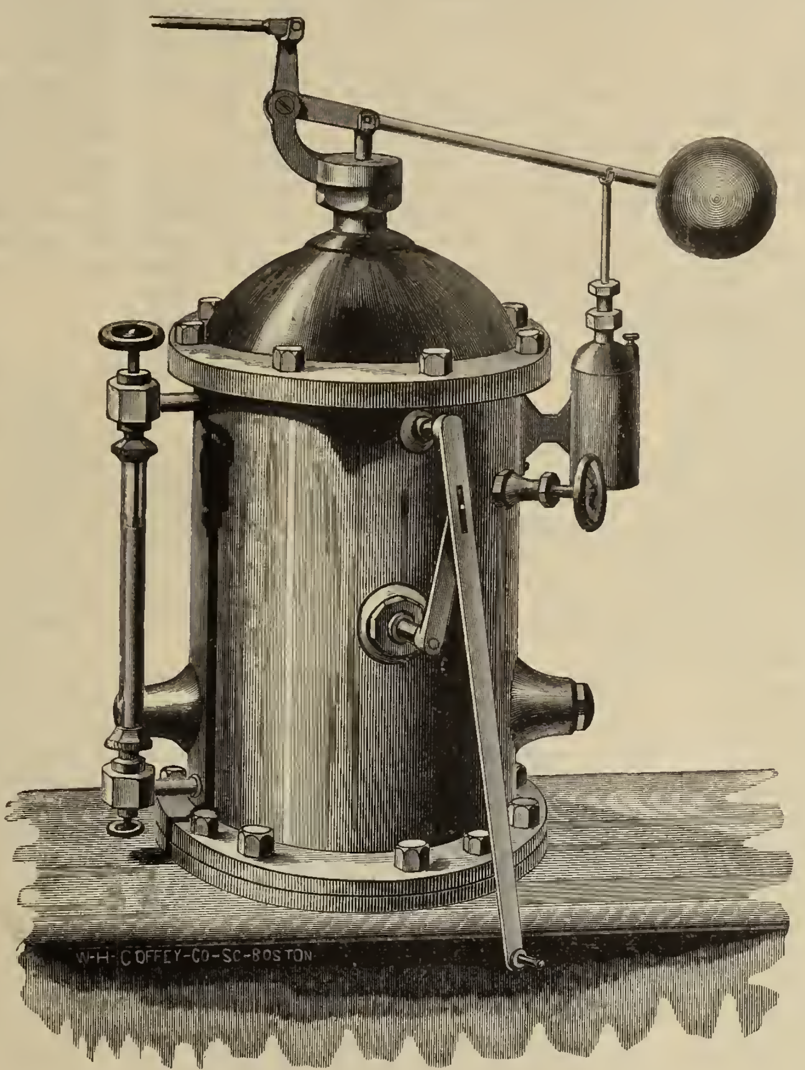
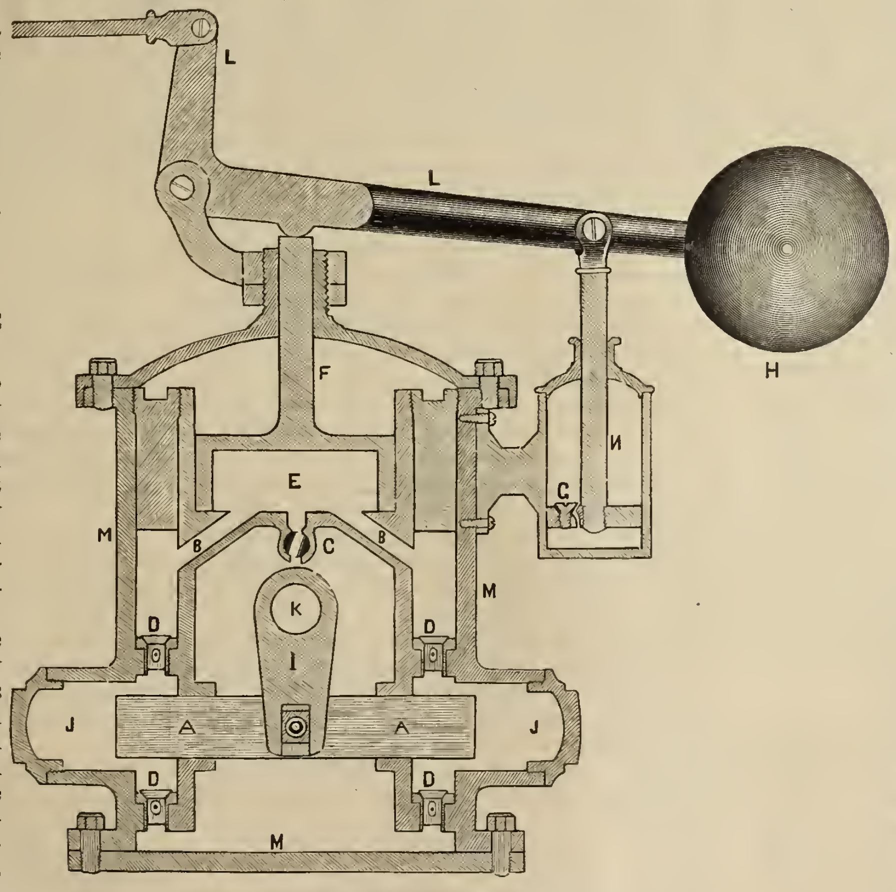




THE MASON REGULATOR.

WHERE ENGLISH ENTERPRISE EXCEEDED AMERICAN.

As a people we have reason to pride ourselves upon our energy and enterprise in procuring the earliest and fullest accounts of all proceedings of public interest, but in some instances we are beaten by foreign papers, who, by reason of remoteness, would not be expected to have as complete accounts as domestic publications. We refer, as an instance, to the Chicago Exposition of Railway appliances. No accounts of this have been published in American papers which approach those in the *London Engineer* and also in *Engineering*. These reports are admirable in all respects, are versatile and embrace all likely to interest engineers, both in text and illustration.

TYPE-METAL FOR LINING BEARINGS.

Recently in some experiments, we melted a lot of type-metal several times, say half a dozen. When cast in a plate one fourth of an inch, it was exceedingly tough and ductile, while the fracture, when finally broken, resembled the best crucible steel, being very crystaline and fine grained. This is due to the antimony, type-metal being three lead to one antimony, but as this latter is a volatile metal, it would seem to be burnt out by repeated meltings, but enough of it still remained to change the constitution of the lead.

It struck us at the time that this remelted type-metal would make a superior lining for bearings where high speeds are in use, and as such it is worth a trial. It seems to be much tougher and closer grained than babbitt-metal and what is of importance is much cheaper. In large cities type-metal is readily procured for 6 to 8c. per pound.

The American Miller says :—

> The Mechanical Engineer doubts the assertion that pumpernickel is easily digested. Bro Watson says he has a vivid recollection of pumpernickel, and it seems to him as though he had swallowed a lot of cast-iron borings. It all depends on what you take with it, Brother W. With water, it solidifies in the stomach because the gastric juices of the epigastriculum are repulsed by the hydrogen in the water and refuse to attack it; but the maltose-hopeine in beer acts as a disintegrant upon the nitrogenous compounds in the pumpernickel and the absorption processes proceed with rapidity. We know The Mechanical Engineer likes a lucid explanation such as this.

Yes, Yes, we even prefer it to pumpernickel. The latter seems to us must have been the leading feature in the breakfast the man complained of in the country hotel. Its sign read—"Entertainment for man and beast," and when they sat his breakfast before him he said, "that's all right for the beast, but where is mine?"

A steel shaft made by Krupp, the famous German steel worker, was put into a Western tow boat and broke or cracked after two years service, and it is argued by the *Pittsburgh Telegraph* that the breakage was caused by the torsional strain induced by one engine taking steam before the other—there being two engines coupled to it. No twisting strain is set up thereby. The shaft is going the same way all the time, and the forces are at work urging it in one direction. If one engine worked ahead and the other back there would be torsion, or if one engine was idle and the other at work there would be torsion, but only that due to natural work, for which the dimensions should be ample protection.

The Schenectady Locomotive Works are now quite busy, having orders on hand that will keep them going for some time. The work in progress comprises four consolidation engines, with 20 × 24-inch cylinders and 50-inch drivers for the Kentucky Central Railroad, and eight passenger engines, weighing 45 tons each, with 18 × 24-inch cylinders, for the Canada Southern Division of the Michigan Central Railway. The company have lately taken orders for seven mogul freight engines with 19 × 24-inch cylinders, for the Lake Shore & Michigan Southern Road, and 45 freight engines, having 17 × 24-inch cylinders, for the Chicago & Northwestern Road.—*Car Builder.*

HOW TO GAIN KNOWLEDGE.

Although we do not learn all we know from others we are indebted to them to some extent for the resources which enable us to extend and elevate ourselves. The failures of others prevent us from cherishing their theories or ideas and following in their footsteps, hence we are taught much that is of value, without which we might be as susceptible to blunder, or err, and grope in darkness as our predecessors. Yet there are some who imagine their craniums are the receptacles of all mechanical knowledge. It would be hard to convince them that the world would not miss them if they should die. If a young man pulls through without their help his success is attributed to "cheek," or the influence of some capitalist.

Some years ago a young man went out into the world to learn engineering. He was intelligent, and had a decided preference for mechanical pursuits. He apprenticed himself to an engineer for a term to learn the business, and spent his evenings in the study of natural philosophy, mathematics, etc., etc. Long before his apprenticeship expired he could compute the strength of materials, the capacity of pumps, boilers and engines. He had also acquired some knowledge of heat, combustion, electricity, etc. When his term expired he had accumulated considerable information by close observation and hard study. It was obvious to him that cause and effect are closely related, and having his natural ability enabled him to reason by common sense methods. Without conceit, he had due consideration for the opinions of others, and would impart information as freely as he would receive it; this perhaps was one of the secrets of his rapid advancement.

One thing puzzled this tyro—that was the why and wherefore of the workings of the steam boiler injector. He sought information from engineers and others who had them in use, the manner of operating them was explained to him by engineers, but on the natural laws governing the operation of the injector no information to augment his knowledge could be derived from this source. Information on this subject he perceived could be derived by the study of pneumatics, dynamics, and a better understanding of fundamental principles or laws of natural philosophy. He disbursed considerable sums of money for books on these subjects, denying himself little luxuries which many consider indispensable to happiness. As time went on and others perceived his abilities he was advanced step by step to a position of considerable responsibility, here then was a young man who by strenuous effort had qualified himself to execute duties requiring special knowledge and skill.

The object of this is not to point out a course of study necessary for young engineers, but rather to convince them that there is no short cut to fame and nothing gained without an effort. Merely cramming the brain with rules and formulas, so that the individual can repeat them by heart, does not constitute knowledge, but an *understanding* of natural laws, governing existing conditions, is necessary. In no way can we familiarize ourselves with these laws except by diligent research and hard study. An accumulation of facts is useful, but it does not constitute knowledge, because we do not know personally that such and such things are true, we only accept them because others, who are supposed to know, assert that they are, but if we have acquired information by careful research it is valuable because we know for a certainty that it is true.

If many of our otherwise intelligent mechanics were more familiar with these laws it would save much valuable time, thought and experiment, as well as money uselessly spent trying to bring about impossible conditions and fruitless research for perpetual motion and other absurd inventions.

Smoke Arch.

Earthquakes and cubebs seem to have no direct connection with each other, but the recent upheaval in the island of Java, by destroying plantations, has had the effect of creating a corner in that pungent spice.

FALSE ECONOMY IN REMOVING SCALE FROM BOILERS.

Practical engineers, says the *Indiana Manufacturer,* are growing more and more adverse to the use of compounds in the prevention of boiler scale. Experience has proven that while the scale is directly and effectually removed, the strength and efficiency of a boiler is materially reduced by the corrosive action of the chemicals on the plates and tubes. The use of compounds is certainly a "false economy," and the only true course in the prevention of boiler scale is the use of a reliable feed-water heater and lime extractor in connection with the boiler.

We think our contemporary's remarks misplaced, and contrary to facts. There are "boiler fluids" in the market which are injurious, doubtless, but there are others which are of great value. and have been employed for years with decided benefit, instead of injury. Anything that will loosen scale without attacking the iron is beneficial. It all depends upon how it is used.

A NEW FIRELESS LOCOMOTIVE.

Mr. Moritz Honigmann, of Grevenberg, Germany, has invented a traction engine, intended for use wherever the absence of noise, smoke and disagreeable gases is desirable. The salient feature of his invention is the use of caustic soda to absorb the exhaust steam, and to liberate a part of its latent heat to be employed in the production of additional steam to drive the engine.

If exhaust steam at a temperature of 212 deg. be injected into a solution of caustic soda, of a specific gravity of 1·7, the temperature of the mixture will rise to about 374 deg., while the vapor tension will not exceed one atmosphere. Supposing the hot solution to replace the fire in a boiler, it is evident that a part of its heat will travel through the plates to the water, if the temperature of the latter be lower than that of the solution, and will evaporate a portion of it, and that this action will continue as long as the soda maintains its power of absorbing the exhaust steam without giving rise to any great back pressure.

Mr. Honigmann's engine is at work as a tramway locomotive, and will run continuously for five hours with a charge of 500 kilos. of caustic soda of 1·7 specific gravity. The motor has a small boiler, but no chimney. The boiler is a cylindrical reservoir of water heated to a temperature corresponding to the pressure desired, and surrounded with another reservoir filled with caustic soda, either in a state of solidity, or of highly concentrated solution. Mr. Honigmann has drawn up tables of the boiling points and corresponding effective pressures of different strengths of the solution of caustic soda, from which it appears that a solution of 60 parts of water to 100 parts of soda can absorb vapor at a tension of 7·1 atmospheres, given off by water at a temperature of 167 deg. Cent. (332·6 deg. Fahr.), without in its turn giving off vapor having a greater tension than one atmosphere. It is therefore possible to absorb, by means of caustic soda, considerable quantities of exhaust steam, without creating behind the piston a counter pressure exceeding one atmosphere. Suppose, therefore, that the supply pipe of the steam cylinders communicates with the reservoir of water heated, for instance, to 166 deg. Cent. (330·8 deg. Fahr.), and therefore at a tension of 7 atmospheres, and that the exhaust pipe passes into the reservoir of caustic soda, itself heated by the vicinity of the water to a temperature of about 140 deg. Cent. (248 deg. Fahr.), it will follow that as soon as the valve is opened the pressure will diminish in the reservoir which contains water and steam; the water will give off a certain quantity of steam, which, after it has done work in the cylinders, will pass into the reservoir of caustic soda; the steam will heat the solution and be absorbed by it, a certain amount of heat being liberated in the process, which will raise the temperature of the solution, and the general result will be that the temperature of the solution will rise, and that of the water fall. The difference becomes constant as soon as the amount of heat returned by the solution to the water, through the partition that separates them, becomes exactly equal to that converted into work in the cylinders. The full work is obtained from the engine, and all the heat which is not transformed into energy is stored up in the caustic soda, while the water is vaporized without any notable variation in the pressure. When the locomotive first starts, the pressure falls rapidly for about one atmosphere, and then remains fixed; but if the engine is stopped, it falls a little, and rises again as soon as work is resumed. In order to put the engine in working order again after the caustic soda has ceased to be sufficiently concentrated, all that is necessary is to re-fill its reservoirs with water and soda solution under the original conditions. The moisture absorbed by the caustic soda can be driven off again by evaporation, and the solution thus restored to the necessary degree of concentration.—*Engineering.*

PATENTED COMPOUNDS.

A writer in the *Oil, Paint and Drug Reporter* says: "Persons who take out patents for compounds make two mistakes. The first is, instead of keeping their mixture secret, they publish it to the world. The next mistake is, their patent is virtually not worth one cent.—for this reason, where a patent of a mixture is taken out, you have to state what per cent. of each article it is composed. The man who takes out a patent for lubricating compound that is composed of 25 per cent. tallow, 50 per cent. rosin, 25 per cent. paraffine oil, making 100 per cent., is not infringed upon by the man who makes a compound of 26 per cent. tallow, 48 per cent. rosin, 26 per cent. paraffine oil; and the compound may be better than the one that has taken out the patent. Most of these patents are taken out by persons who think they have obtained a patent for the combining of the articles. It is only the percentage of these articles when they take out a patent for a mixture. The above information may not be new to the most of your readers, but it cost the writer about six hundred dollars to find it out. A party came to me one day with a patent for a certain article where 25 per cent. of one product was used and 75 per cent. of another, and it made a valuable article. I invested six hundred dollars with the expectation of investing more. When speaking of it to a friend he explained to me how I had been taken in, and that if he manufactured the same article and used 26 per cent. and 74 per cent. he would not be infringing on the patent. I found out later that the parties who sold to me were posted, and had realized a large amount of money by selling stock in the company when they knew it was swindling to do so."

It is absurd to assert, as an English contemporary does, that in our remarks upon foreign locomotives, we are influenced by feelings of nationality. We do not know whether an engine is Jew or Gentile, American or English, and any comparisons instituted by us are solely upon the basis of facts. Concerning this latter, we shall, at no distant day, publish some which, to those who are unbiased, are irrefutable as to English and American locomotive power.

In a recent test of screenings as fuel with the Babcock and Wilcox boiler, the evaporation, from 212°, per pound of screenings was 6·90 pounds of water, while from lump coal the average was 9 pounds of water. This appears to be in favor of coal, but when the relative values of the two fuels are taken into consideration, the balance is in favor of screenings.

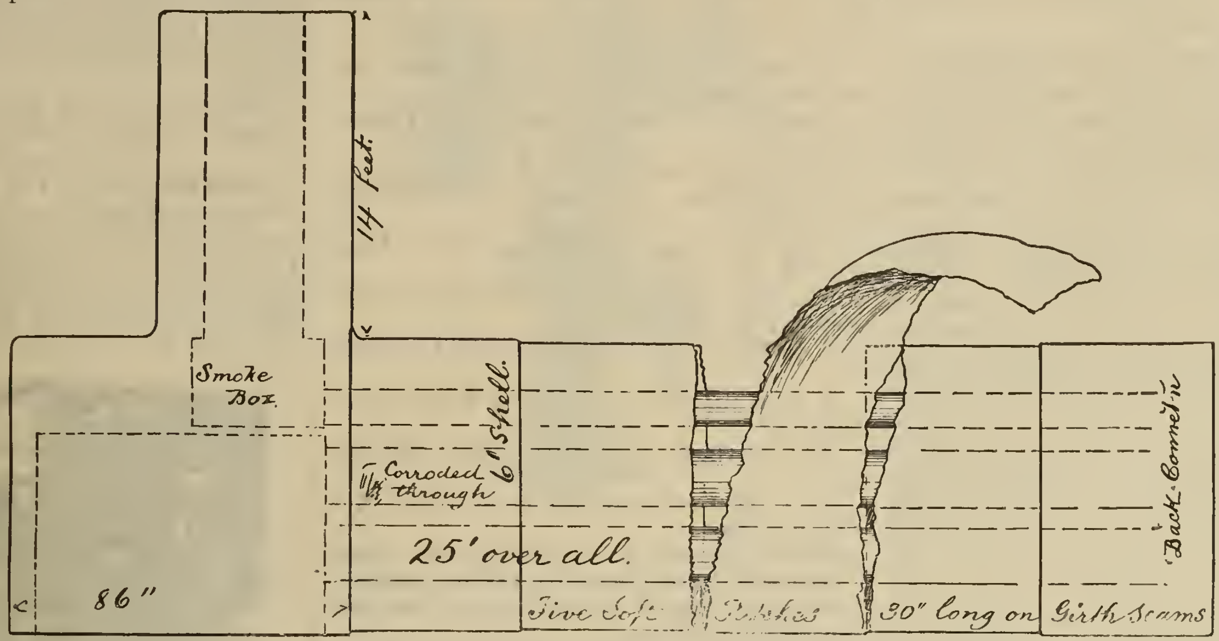
Blasting paper consists of unsized or ordinary blotting paper, coated with a hot mixture of 17 parts yellow prussiate of potash, 17 of charcoal, 35 of refined saltpetre, 70 of potassium chlorate, 10 of wheat starch and 1,500 of water. When it is dried it is cut into strips which are rolled into cartridges.

According to D. K. Clark, 43 per cent of the heat generated in an open grate goes up the chimney, while in a stove but 24 per cent escapes in that way.

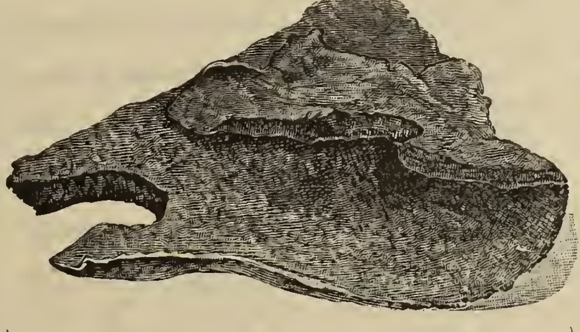
THE RIVERDALE'S BOILER.

The explosion of the boiler of the steamer *Riverdale* on the 28th August, last, has attracted wide-spread interest, and we have been able to secure a sketch of the boiler, not as it lies on the dock, but as to its plan, the locality of the rupture, and its general appearance. Owing to the short time at our disposal, we are not able to furnish a picture of the disaster for engineers. Our sketch will answer quite as well as perspective views of the debris with a wall-eyed spectator in the foreground.

In this article we shall simply state facts as we found them, and let every one draw their own inferences. The boilers are ordinary return flue, 6′ diameter of shell, 25′ long over all, and with a steam chimney about 48 or 50″ diameter, 14′ feet high. The upper course of flues is about 9″, the lower course, about 12″; the exact size is not material to this account. The shell is of $\frac{1}{4}''$ iron, and so far as could be seen of the best quality. The boiler generally seems to have been in good condition, except where it broke—for this was not an explosion but a rupture. The bottom of the boiler has 5 soft patches on the girth seams about 30″ long, and the iron at those points covered by the patches is corroded away to the thickness of sheet iron—say number 18 gauge. The small engraving is taken from a fragment near the rupture, and is a good sample of the bottom of the boiler. It does not seem to require any comment at our hands. The "thickness" of the "thin" portion shown in the foreground is $\frac{1}{16}''$. The rupture began apparently on these thin portions, and followed right around the girth seams, and across the solid metal in one course, separating it into two nearly equal parts. As the boiler lies on the dock, these portions are distorted and thrown out of place, so that no picture or photograph taken from it would give any idea of its position in the boat after the explosion. It was simply dumped where it lies, and just how much of the ripping and tearing was done by the explosion it is also impossible to say, for in hauling it up from the bottom of the river, 60′ deep, no very great care was used, and it may have been further broken. In their original condition these boilers were amply strong enough for their work, and it seems almost impossible that the weaknesses pointed out should not have been discovered and prevented.



SKETCH OF THE RIVERDALE'S BOILER.



* * *

As EVIDENCE of the astonishing accuracy and quickness marksmen can attain, the following is not out of place:

> Captain Stubbs, the Arkansas sharp-shooting expert, gave an exhibition of his skill with the rifle and pistol last evening that astonished the spectators. After breaking a few balls thrown in the air as though for practice, he shot at and broke a ball swinging from a line at the end of a fish-pole while holding his rifle upside down, and then did the same trick with a small glass vial that many in the audience could scarcely see as it dangled in the air. A swinging ball was broken by a bullet from the rifle while the weapon was pointed backward over the Captain's shoulder, sight being taken from a small hand mirror. A more difficult form of the same shot was equally successful. Holding the weapon upside down over his shoulder with one hand, without any rest upon the shoulder, and holding the mirror and pulling the trigger with his other hand, the Captain broke a swinging ball with apparently the same ease and confidence that he would have had if some one had held it against the muzzle of the rifle. The same shot was made with one of the tiny glass vials.
>
> The most difficult shot, and the only one that Capt. Stubbs did not make at the first trial, was at a ball swung rapidly around the fish-pole at the end of the line, and he explained that the shortening of the line by winding around the pole caused the miss. On changing the rigging of the line he made the shot. A ball dropped from the hand four feet above the stage was then broken by the Captain in both forward and backward shots.

* * *

THE LONGEST BRIDGE in the world is over an arm of the China Sea. It is 5 miles long, 70 feet high, with a roadway 70 feet wide, and has 300 arches.

IN ORDINARY PRACTICE the pressure in compound engines is so distributed as to make the indicated horses-power developed by each cylinder the same, the purpose being to equalize the strains upon the mechanism of each cylinder, a purely mechanical effect and a useful one, but not necessarily producing the maximum economic effect. The delicate point is to combine the proper mechanical effects with the maximum economic effects in such a manner as, with a given boiler and condenser pressure, to produce the required power from cylinders of the least dimensions. To accomplish this, the results of many experiments from many compound engines must be carefully and intelligently studied, and the labor will be profitably bestowed, for the difference in the money expenditure involved for the production of a given power from a compound engine skillfully or unskillfully designed is very great.—*Isherwood.*

* * *

A WRITER in the *Builder and Wood-Worker* says: "I have seen a notice of the trial of oil between glass, and do not, on general principles, doubt the value of the experiment, but glass, iron, steel and babbitt, are very different things in structure, and oil would behave differently on the different surfaces, and the entirely different conditions to which it is subjected. No test would be conclusive unless it should be brought under similar conditions to which it would be brought in daily use. The fact of an oil running freely between two glass surfaces would not be a guarantee that I could trust it on machinery."

* * *

THE PORTRAITS on the new postage stamps that come in use October 1 are: 1-cent, Franklin; 2-cent, Jackson; 3-cent, Washington; 5-cent, Garfield; 6-cent, Lincoln; 7-cent, Stanton; 10-cent, Jefferson; 12-cent, Clay; 15-cent, Scott; 30-cent, Hamilton; 90-cent, Perry.

* * *

IN ENGLAND, $1.80 per ton is paid for puddling iron; in this country, $5.50.

POUNDS OF VACUUM is an incorrect expression. Vacuum is nothing, space, and there cannot be a pound of nothing. Inches of vacuum is correct.

* * *

THE DEAD SPINDLE in a lathe is called a "shoot" in some parts of England.

* * *

PERSONS WHO FEEL that an invention can overcome the difference between the heating value of petroleum and coal, will do well to read the article on another page, entitled, "Petroleum as Fuel." It is rather a trite subject, to be sure, for it must of necessity traverse the same ground that has been many times traveled before, but there may be some who are devising schemes for the use of petroleum as fuel to whom it will be useful.

BOOK NOTICES.

American Locomotive Engines. Their construction, detail and management. A practical work for practical men, by Emory Edwards, M. E. Illustrated by seventy-eight engravings. Philadelphia: Henry Carey Baird & Co. 810 Walnut street.

This book is chiefly a collection of articles, by popular mechanical writers, concerning the locomotive, its construction and management. These articles are written in most cases by men of experience and detail at some length all the ills and derangements that locomotives are liable to. In the preface the author acknowledges his indebtedness and gives due credit to his selections. There are also full particulars of various experiments with locomotives at high speeds, and a dissertation by the author upon the mechanical powers. Setting of valves, the link-motion, the various injectors in use, the construction of boilers, all have much space devoted to them, and the locomotive engineer will find the work of great value for reference and instruction. It contains nothing that cannot be readily understood by any man fit to be on an engine, and is wholly devoid of mathematical formulas.

GEO. S. BLAKE MANUFACTURING CO., of New York and Boston, have issued a neat pamphlet of their improved pumping machinery, beautifully illustrated, containing in addition to the list of pumps, a great deal of useful information for engineers and others, on steam and water. Under the head of steam, pressures, temperatures, and relative volumes at various pressures are given; as also mean effective and terminal pressures, saving by heating feed-water, etc., etc. Under the head of water, similar data are given, as the friction of it in pipes, etc., etc. This is useful to engineers at all times, and saves a great deal of calculation and search. The pamphlet will be sent on application to the company, at 97 Liberty street, New York, by mention of this paper.

WE HAVE from the Pratt & Whitney Company, Hartford, Conn., an illustrated catalogue of machinery made by them. It is very handsomely printed, and will be of great service to all who intend purchasing new machinery.

* * *

IF ALL MEN were equally gifted as to the acquisition of knowledge, there would still be jealousies, for those who were touched with a streak of egotism would still feel that other lights were pale beside theirs. All are not equally constituted in this rspect, but possess qualities of varying excellence.

* * *

A NEW TORPEDO BOAT, only 113 feet long, by 12 feet 6 inches beam and 6 feet draught, is to have 800 H. P. in her.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

CORONERS' JURIES AND BOILER EXPLOSIONS.

Editors Mechanical Engineer:

I notice in a late issue you ask for evidence from engineers of the way in which their boilers have been inspected, promising to suppress names and localities. I would like to bet something that you never received a single letter, and what is more you will not receive one, for the reason that such things in print are liable to create unpleasantness sooner or later.

If you want to do the public a service, Mr. Editor, just draw attention to the foolish questions and the farce that is gone through on every boiler explosion by the authorities who do the examining. It makes an engineer feel like a fool to read them. It is no wonder they never get to the bottom of anything, or find out anything, for no one who is authorized to do so knows how. How should a man who does not know a boiler from a soap kettle be able to question witnesses as to their knowledge of the disaster? How can he put leading questions to the proprietors? He can't do it, and for this very reason no inquest or coroner's jury on boiler explosions is worth a cent. They generally succeed in covering up all the clues and hiding the clues. Often they get hold of some crank who has a theory about the matter, and allow him to throw in his mud. Sometimes there are two or three such cranks, and when the jury gets hold of the case they might as well bring in a verdict of explosion by visitation of Providence as anything else.

Mr. Editor, if the law called for the selection of two or three competent engineers, of long experience, and made them examiners, under oath to put leading questions without fear or favor, you would soon see a change. You would hear the truth about these boiler explosions, and you would see a change for the better in this respect.

The public, Mr. Editor, are very anxious to have boiler explosions end some time, but when they read a lot of stuff about "expansive gas," and "sudden rushes of steam" and the like of that, they don't know what to think. No more do some engineers.

Mr. Editor, I say it from an experience of a lifetime, and from careful and conscientious investigation of all theories for and against, there never was an explosion of a steam boiler that could not have been prevented. Not one. A steam boiler can't think and don't know when it is time to burst, but by the way some men talk you would suppose it had brains in the dome and did all its mischief out of pure malice. A steam boiler, if it is only decently made and taken care of, is as safe as a silk hat, but the trouble is that in many cases they are not taken care of. I live in hopes to see this matter looked at in the right light; when it is boiler explosions will cease, but not before.

New York City. J. McCaulley.

◆

FLANGING OF STEEL PLATES.

Editors Mechanical Engineer:

Noticing some interesting letters from boiler makers in your paper, I thought I would ask through it for instruction from them about flanging steel boiler plates. I am foreman in a small country shop, and have never done any work of this kind before, and would like to be told by some one who has what kind of a fire to use. I mean whether charcoal, pea-coal, or wood. The flanges are straight, for fire-box plates. I would like to know also whether the whole plate must be annealed all over after flanging. I read somewhere that if the plate were not annealed all over it would be likely to crack. Can you turn as sharp a flange on steel plate as on iron?

J. M. Roberts.

◆

MEAN EFFECTIVE PRESSURE.

Editors Mechanical Engineer:

Will you please inform a young reader of your paper what the term mean effective pressure means applied to a steam engine. I have seen it many times in your paper and, being a beginner, would thank you for information.

Brooklyn, N. Y. J. R. S.

[The mean effective pressure in a steam engine is the average pressure throughout the stroke.—Eds.]

◆

SLIP OF PADDLE WHEELS AND SLIP OF SCREWS.

Editors Mechanical Engineer:

Please state in your next issue whether the paddle wheel or the screw propeller has the most slip, on the average. A friend contends that the screw has, and that a paddle wheel has practically none at all.

Engineer on a River Boat.

New York.

[Slip of wheels, whether paddle or propeller, differs with the circumstances. Some have more and some less. Theoretically there is a greater loss by the paddle than by the screw, the slip of the former being from 28 to 30 per cent.—Eds.]

SECRETARIES OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

John J. Hughes, 57 Wyckoff street, Brooklyn, N. Y.

George A. Grover, 88 Clinton street, Boston, Mass.

William Ponsonby, 244 West Monroe street, Chicago, Ill.

Henry Reed, 348 West Lake street, Chicago, Ill.

W. H. Davis, Box 250, Carthage, Mo.

George G. Minor, 424½ George street, Cincinnati, Ohio.

James A. Platt, 1027 Upland street, Chester, Penn.

Jesse King, Canton, Ohio.

H. F. Howard, 498 Asapahoe street, Denver, Col.

John H. Clark, 167 Mercer street, Jersey City, N. J.

Benjamin F. Smith, 1310 Baltimore street, Kansas City, Mo.

J. F. McEnnis, 615 Shelby street, Louisville, Ky.

P. R. Hull, care Harrison Red Works, Leadville, Col.

William Gage, 243 Crown street, Meriden, Conn.

H. A. Sanford, 26 South Front street, New Haven, Conn.

William Conroy, 239 Broadway, New York.

Andrew Jackson, Box 112, Owasso, Mich.

George F. Peifer, corner Johnson and 20th streets, Phila., Penn.

A. H. Warner, New Court House, Providence, R. I.

J. B. McClure, 212 Elliott street, Baltimore, Md.

John F. A. Cullinan, 23 Exchange street, Rochester, N. Y.

Charles H. Tracy, care Merchants' Mill, Rome, N. Y.

James Sweeny, care Forepaugh & Tarbox, St. Paul, Minn.

Joseph Ball, 1314 Pine street, San Francisco, Cal.

E. T. Ivester, 818,Beaumont st., St. Louis, Mo.

John. D. Clark, west side 3d, bet. Usson and Prime streets, South St. Louis, Mo.

C. W. Parsons, care Maclaren & Sprague, Toledo, Ohio.

L. G. Bronson, Urbana, Ill.

M. J. McNelly, 1006 Poplar street, Wilmington, Del.

D. B. Duryea, 103 Beach street, Lynn, Mass.

George F. Merrill, 82 Canal street, Boston, Mass.

F. A. Nickerson, Springfield, Mass.

F. D. Wheeler, 23 Hermon street, Worcester, Mass.

Charles H. Hare, Salem, Mass.

◆

FROM THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Charters have been issued since Aug. 1st to South St. Louis Association, Mo., John H. Clork, Sec.; Kansas City, Mo., B. F. Smith, care Gate City Mills; Twin City Association, L. G. Bronson, Urbania, Ill.; Leadville Association, P. R. Hull, care Harrison Red. Works, Jersey City; John H. Clark, 167 Mercer street, Toledo, Ohio; C. W. Parsons, care Maclaren and Sprague.

The Missouri Locals, of St. Louis, surrendered their charter on Aug. 17th, and on the same day application was made for charter under the title of St. Louis Engineers' Association.

There are now 35 associations working under the jurisdiction of the National Association.

The delegates to the National Association will be entertained at the Briggs House, corner Fifth avenue and Randolph street, Chicago, Oct. 2.

A. M. Davy, Sec. Nat. Association,
175 Elmwood avenue, Detroit.

◆

MARINE ENGINEERS' ASSOCIATION No. 41.

Portland, Oregon.

The above Association has been organized by Bro. J. S. Richards, with 41 members, all first-class Marine Engineers. The officers are Frank McDermott, Worthy President, 210 Alder St., Portland, O.; A. H. Fostner, W. V. P.; W. H. Marshall, W. I.; Joseph Colyer, Rec. Sec., care Capt. Kellogg St. Toledo, Portland, O.; Lewis Burt, F. S.; Henry Pape, Cor. Sec., care Williamette Iron Works; W. J. Maher, Conductor; William Lewis, Doorkeeper; Jerome Palmatier, Chaplain.

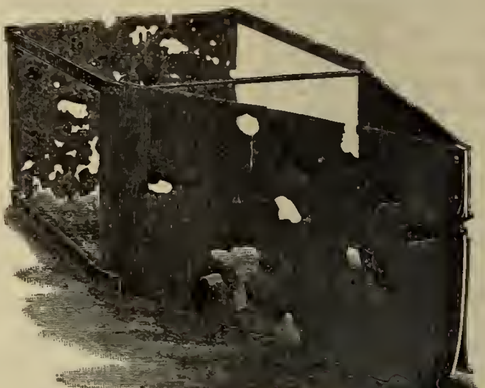
This is certainly a very handsome membership for a new society, and shows that engineers on the other side of the continent are fully alive to the benefits accruing from uniting their forces.

President James H. Reid, of the National Association, has our thanks for prompt advices.

◆

TORPEDO BOATS AND MACHINE GUNS.

The engraving herewith shows the effect of a machine gun on a torpedo boat at a distance of 1,000 yards. It is described as the result of shell fire in *Engineering*, but we were not aware that machine guns fired shells. The plates are very light, not much thicker than sheet iron.



◆

LARGE VS. SMALL DRIVING PULLEYS.

Shrewd manufacturers make their steam engines and water wheels with comparatively small driving wheels or pulleys, and let the steam or the water get up a good rate of speed of themselves, and generally these men get credit for making smart engines and smart water wheels. This plan also makes much less pressure upon the bearings, as the belts need not be strained so tight as upon large, slow-moving driving pulleys.

To give a case in illustration, and state some actual results, Mr. L. had an engine in his planing mill which had given a great deal of trouble.

He had taken great pains to have it kept up in good order, but it would not do the work without the steam was kept very near the blowing off point, and then it labored and quaked as if in the throes of dissolution. Mr. L. had made up his mind that there was something radically wrong about the valve, the cylinder, the piston, or some internal part of the engine, when the case came under my observation by his request.

I found the engine choked with a large driving pulley, the piston moving slowly under a heavy pressure of steam. There was room on the engine shaft to leave the large pulley on for a fly wheel, and put a smaller driving pulley by the side of it, and then speed up the engine. I recommended this plan to Mr. L. He said it was no such simple thing as that which ailed the engine; it never had been good for anything and never would be, and forthwith bought a new engine, and put the old one aside, with little hopes of ever getting more than the price of junk for it.

Not long afterward Mr. V. was inquiring where he could get an engine at once, when I told him of Mr. L's. "But," said Mr. V., "I have looked at that, and they say it will not do my work." He told me what he wanted an engine to do, and knowing the size of the cylinder, I produced figures to show him that the engine would do his work, if so arranged that it had a fair chance to work. He bought the engine for a trifle, put on a small driving pulley, and it did the work with ease. One day Mr. L. came over to see the "old engine" run, and after looking on for a time, he came up to me and said, "I was a fool to throw away that engine."—*F. J. Masten in American Miller.*

POWER RECORDER FOR STEAM ENGINES.

The indicator diagram, as a means of exposing the interior working of the vital parts of a steam engine, and of estimating the power of the latter, is of great value, but it has the disadvantage that it is not in itself sufficiently complete to allow of the power of an engine being read off at sight. To obtain the power exerted by an engine from an indicator diagram certain calculations must be entered into, which, though simple, are at least troublesome, and, together with the measuring up of the diagram, form loopholes into which errors of more or less magnitude may creep. Further, all practiced engineers know that for winding engines, hydraulic pump engines in warehouses, and other cases where the work is suddenly variable, it is practically impossible to find the correct average duty with the ordinary indicator. To obviate the necessity for the above calculation, and to give a constant record of what is being done by an engine, continuous indicators of different types have been devised; and what we have particularly to describe in this article is a continuously recording machine, invented and patented by Mr. C. Vernon Boys, and called by him an engine power meter—a name which in its use it fully bears out. It keeps a continuous automatic record of the power given out by an engine, and by referring to the dial the actual performances during different intervals can readily be read off. The meter under notice has also a simple attachment for taking small indicator diagrams, and for the purpose of ascertaining the working of the valves. It thus fulfils the work of an indicator in a neat and accurate manner.

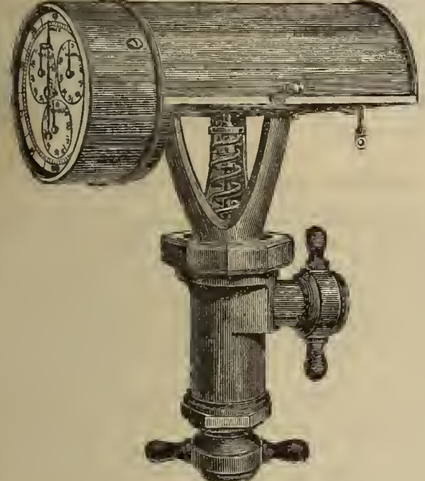


FIG. 1.

Figs. 1 and 2 represent the instrument complete, the latter having the attachment fixed for taking diagrams, and the former being in the form for the simple recording of power. Fig. 3 is a simple diagram to show the parts in an elementary form, and to show the action clearly; and by comparing the latter figure with the other two the corresponding parts will be readily identified. The instrument is mounted so that the branch, *U*, on the under side of the piston, *N*, is in connection with the engine cylinder at the end opposite the piston rod, and the branch, *T*, is put in communication with the other end of the engine cylinder. Fig. 4 shows its application to a cylinder. The wire, *W*, Fig. 3, is connected to some piece of mechanism which is made to reciprocate with a motion corresponding to that of the engine piston, but of course reduced down to a short stroke to suit the instrument, and the alternate pulls of the wire, *W*, and the spring, *L*, move the "integrating" cylinder, *AB*, to and fro simultaneously with the engine piston. At the same time the piston, *N*, of the instrument is moved up and down by the alternate pressing and exhausting of steam above and below it, the amount of motion being governed by the strength of the spring, *S*. At the top of the piston rod, *M*, a swivel socket, K, is mounted, through which the arm, *H*, is free to slide during the vibrations of the piston. The arm, *H*, is rigidly connected with the fork, *ab*, which carries a small wheel, *D*, called the "tangent" wheel. A flat spring, *G*, presses against the end of the spindle, *EF*, upon which the fork, *ab*, turns, and keeps the tangent wheel in contact with the cylinder, *AB*.

We have pointed out that a reciprocating motion, exactly similar to and simultaneous with that of the engine piston, is imparted to the integrating cylinder, *AB;* but this cylinder obtains also a rotary motion, by the following means. It will be understood that if the arm, *H*—and therefore the plane of the wheel, *D*—is in its normal position, *i. e.*, horizontal, as shown in Fig. 2, the line, *ef*, is that along which the wheel will roll when the cylinder is pulled forward by the wire, *W*, and that no rotary motion of the cylinder will result. This is exactly what happens when there is no pressure of steam either above or below the piston, *N*, of the instrument; but supposing both the branches, *T* and *U*, are in open connection with the engine cylinder, from which at the end open to *U* steam is being exhausted, and into which at the end open to *T* steam is being admitted, then the piston, *N*—and therefore the end, *H*, of the arm—will be depressed. The plane of the tangent wheel, *D*, will now be inclined as shown in Fig. 3, and during the forward motion of the integrating cylinder, *AB*, the friction due to the contact between the polished surfaces of the wheel and cylinder will be sufficient to compel the latter to rotate on its axis, the line of contact being *eg*. This rotary motion will be greater or less according as the angle, *feg*, is greater or less, and is always proportionate to the work done during the corresponding stroke of the piston. The spindle, *PQ*, by means of mechanism with which it is in connection, thus registers, on the dial shown in Fig. 1, the amount of work continuously being performed by the engine.

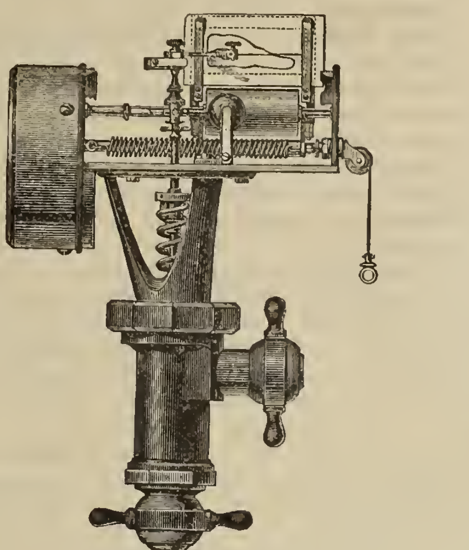


FIG. 2.

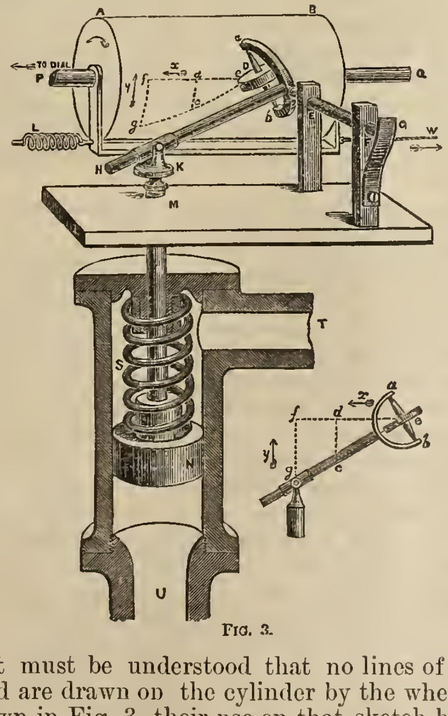


FIG. 3.

It must be understood that no lines of any kind are drawn on the cylinder by the wheel as shown in Fig. 3, their use on that sketch being simply for our purposes of illustration. The line, *fg*, being a tangent to the angle, *feg*, gives to the wheel, *D*, the position of which determines it, the name "tangent" wheel, and inasmuch as this tangent of the angle of rotation is proportional to the displacement of, and therefore measures the pressure on, the meter piston, and the horizontal motion of the integrating cylinder is proportional to the motion of the engine piston, it follows that the amount by which the cylinder rotates is exactly proportional to the product of the pressure on the engine piston, multiplied by the distance through which the latter moves, and is therefore an exact measure of the work done by the engine. At first sight it might appear as though the return stroke of the integrating cylinder would reverse its rotation and undo the record; but this is not so, because at the end of every stroke the inclination of the tangent wheel is of necessity reversed by the admission of steam to the opposite side of the piston, and thus the rotation of the integrating cylinder progresses continuously at a rate proportional to the work done in the engine.

By comparing the number of units registered on the dial in any given time with the number registered during a similar period when the engine was known to have been working satisfactorily, the performance of the latter can be watched and controlled; but in order to obtain the amount of work, in foot pounds, done in any given time, it is necessary to obtain the number of foot pounds represented by one unit of the meter, which number of necessity varies with the dimensions, etc., of the engine to which it is applied. This, however, when once found is found for all. The makers determine for and mark on each instrument a constant *c* (=0·105), which is used in the following formula for obtaining the number of foot pounds just mentioned:—

$$W = \frac{M}{n} \times D^2 \times s \times c =$$

the number of foot pounds represented by one unit of the meter; when *M*=stroke of engine, *n*=stroke of the integrating cylinder (a ready means for obtaining which is provided on the instrument), *D*=diameter of engine cylinder, *s* =a number or constant given to the spring by the makers, and *c*=the constant already referred to. When the number *W* is found by this formula, it is only necessary, in order to determine the amount of work in foot pounds done in any given time, to multiply it into the number of units registered during that given time. To determine the horse-power of the engine at any particular time, the number *W* must be multiplied by the number of units registered in a minute, and the product must be divided by 33,000.—*The Mechanical World.*

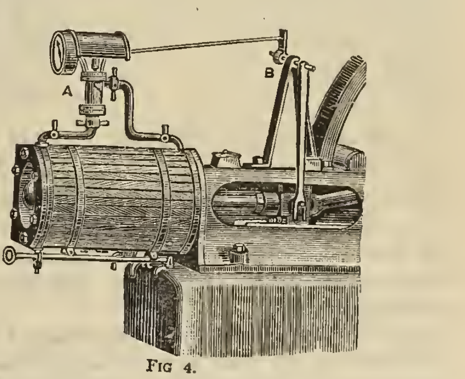


FIG 4.

THE NECESSITY of frequent and careful inspection of all machinery under strain, and especially steam engines, is shown again by the breaking of a strap on a connecting rod of a steamer in this port. By this accident the cylinder-head was knocked out and a great deal of costly repair entailed, all of which might have been prevented by inspection.

ACCORDING TO A GERMAN WRITER, salt mixed with lime wash forms a sort of glaze which is not only water proof, but becomes as hard as cement in time. If this is correct, it is valuable in many places.

THE

Mechanical Engineer,

FORTNIGHTLY.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, where possible.

NOT AN ORGAN.

Not long since an Eastern contemporary insinuated that our frequent references to and zealous prosecution of the interests of stationary engineers was instigated by a desire on our part to become the "organ" of the National Association—meaning thereby that we wished to be a parasite, clinging to the skirts, and toadying to this or that man, or body of men, for support. Those of our friends who know us personally need not be told that we have never had any such intention, but there may be others, strangers to us, who have had the same idea as the Eastern paper alluded to, and to them a few words on this subject may not be amiss.

THE MECHANICAL ENGINEER is not now, and never will be, the announced organ of any body of men. It will always have its own opinions, and when occasion arises will not hesitate to express them. It was originated for, and is now carried on with the expressed intention of serving the best interests of all mechanical pursuits in its line of trade, and it would be quite inconsistent with its purposes to devote itself wholly, or in great part, to any one branch of it. The policy of the publishers is now and always will be a broad, comprehensive and liberal one. They have never paused to think whether they would gain or lose by any special line of inquiry, except in so far as its moral value or its social influence is concerned.

THE MECHANICAL ENGINEER will continue to advocate the cause of engineers everywhere on the habitable globe. It is chiefly concerned with those in its own domain and territory, and it will put forward their claims to public recognition and respect to the very best of its ability.

It has given great prominence to the doings of the National Association of Stationary Engineers for the simple reason that this body is in its infancy as yet, and needs all the countenance and support that can be obtained. It is composed of most worthy men who are trying to elevate themselves and their calling in every way in their power, and with such objects and aims they should command the good will of all.

But in putting forth their best efforts in behalf of this association, the editors have never sought, in any way, a recompense for it. They have never employed canvassers to go among them, or attended but one meeting of the Stationary Engineers' Association. They have not endeavored in any way, direct or indirect, to trade upon their good will. It would seem mercenary and mean to do so. If the prosecution of stationary engineers' interests and public mention of their doings in THE MECHANICAL ENGINEER is merely merchandise, governed in its quantity by the amount of direct patronage returned in the shape of subscribers, it would have no value beyond that of an advertisement, but as before stated, the editors have not been actuated by any such motives. Their efforts are wholly disinterested, and not a line exists on paper to show that they have endeavored in any way to "lay pipe" to control the subscriptions, or the good will of stationary engineers.

The production of a single word, or hint to any one to this effect, is challenged.

THE MECHANICAL ENGINEER is not an organ, but is an earnest worker in its field. It does not wish to be chosen as an organ, and it will decline any such office if it should ever be offered it. It will continue to exert its best efforts for engineers of all callings, and if at any one time it seems to give prominence to any special branch it will be because that one in its opinion needs support.

The very name "Engineer" is a great deal to the editors, and any worthy man bearing it can be assured at all times of their interest and regard. The pursuit of a lifetime becomes, by long association, part of a man's life, and as such is cherished and supported with but one object and aim, and that is its advancement.

If the National Association of Stationary Engineers wishes to have a paper wholly devoted to its interests, it is of course at liberty to choose one, but the body must bear one thing in mind in taking such a course, and this is, in that way, they limit the circulation of their doings to one paper, and its distribution wholly among members of the profession, for few outsiders care about trade organs, and fewer still ever read them.

It is important that all professions should know what stationary engineers are doing, for they are a most indispensable class in the community; if their concerns are printed or published in one paper only (as they must be if there is an organ) they get but a tithe of the publicity they would have if circulated generally through the technical press and trade journals. We merely state this as a hint, not as dictation.

THE EFFECT OF "HOOKING-UP" A LOCOMOTIVE.

What seems anomalous in a locomotive at high speed is that she is hooked back as far as she can be and do the work. The less steam that can be let in the cylinders, the higher the speed. An old engineer said to us recently: "After I get under way, every notch I pull her up makes her jump." "Jim Hood," a well-known engineer on the N. Y. Central Railroad, said to us, many years ago, when we asked him where he carried his lever in making fast runs, "As close to me as I can get it and make the time. I generally follow about four and a half to six inches, when making 45 miles an hour. If I want to smother her, all I have to do is to throw her over." By this he meant that the further the steam followed, the less the speed. Many hold quite the contrary view, supposing that pressure on one side of the piston is all that is necessary for any speed, but what is equally important is pressure on one side *only*. Back pressure is a very great obstruction, and is the result of too large a volume, and too short a time for it to get out of the cylinder after it has done its work.

TAPPING THREADS IN CAST IRON.

It is singular how long the belief has obtained among some mechanics that half a thread cut in cast iron is better than a full thread. In days long past, when cast iron was much weaker than it now is, and when screw-threads were different from what they now are, this view as to half a thread in cast iron was forced upon machinists, for the reason that the tops of the threads crumbled; the taps were badly made, and the fragments of iron catching between the threads, very often stripped them. This led to drilling larger holes for tapping cast iron as the easiest way out of the trouble, but a hole so tapped has not the endurance of one properly tapped—that is, with a full thread in all cases where the iron is of good quality. Standard taps are now "topped off," so to speak, that is to say, few are made by regular makers with acute angles on the tops and bottoms, and this change alone admits of cutting full threads in cast iron without difficulty. Moreover, the metal itself is very much tougher and more tractable. so that the old objections, quoted previously, do not apply. There is no trouble in cutting and holding full threads in cast iron.

THE VALUE OF MODELS.

Mistakes are generally the result of being too confident of one's infallibility, and it is so easy to make them, that many are made. Successful men are only very cautious men, who make assurance doubly sure by constant inspection and verification of their plans. It is but recently that some heavy machinery was designed by an experienced man; before it was built the plans came under the attention of another engineer, who, after glancing over them, saw some serious errors. These he pointed out, but it was only by the construction of a model to scale that he could prove his assertions. The defects in question were radical, involving disability of the whole costly plant, and the model revealed what the experienced engineer saw at a glance. We cannot always have such mentors at hand, and it is safer and simpler in all respects, where new and untried machines are to be constructed, to make an inexpensive model in wood of the principal features, so as to fix their relation.

We are not permitted to reveal the character of the machine, or its purpose, but one of the defects we may mention was that, owing to the plans in question, a very large shaft could not be got out after it was first put in.

CALLING STATIONS.

If persons in authority on railways who are pestering engineers about color blindness and giving the public to understand there is great danger of accident from this cause, would turn their attention to the brakeman and his language, they would be doing a great and real service. Calling of stations at every stoppage, and announcing the next, would be of much benefit to travelers if it were not done in such a way that even those who know the station cannot recognize it. There seems to be a professional way to do this thing which is adopted all over the country, wherever we have traveled, and it is quite time that railway superintendents gave it serious attention. For many years we have traveled on a railway out of this city, and but seldom have we ever heard a brakeman call a station properly.

"*N-a-x-tation Lees bet!*" *N-a-x-tation B-o-r-g-e-r pi!* means nothing in any language, and the translation is that the next station is Elizabeth, or "the next station Bergen Point." The names are drawled out in a loud nasal tone, with the announcement of the fact and the name of the place all jumbled together, and this in such a hurry that it would seem that the man was in danger of his life from some cause.

The brakemen should be examined as to their ability to make a simple announcement in a loud, clear voice. They should be told to shut the door behind them when doing so, and to take time enough to speak plainly. By attention to these simple matters, calling of stations would be a public service, instead of, as now, merely a piece of silliness.

EXCURSIONS INTO THE INFINITE.

What may be called excursions into the realms of the infinite seem to us of slight value. Speculations upon matter, what it means, what it is, what affects it, have so little to do with the work of the world, that they may be safely left to idle dreamers, whose time is of no value to themselves or others.

There is so much that is tangible, that is absolute, that yields return for mental labor, both to the seeker and his fellow-men, that, to our thinking, abstract theories, like the above, are waste of mental force. All such speculations are of necessity worthless, for they travel in circles; they return upon themselves. They start from nowhere, and end in the same place. Derived from nothing, they result in nothing, and the language in which they are sometimes presented is as vague and involved as the speculation itself. Here is an example:

> "It has frequently happened in making a measured arrangement of facts whose values are known, with the view of obtaining the measure of facts whose values are unknown, that the value of the facts believed to be known have been corrected, and new facts, whose existence was unlooked-for, have been discovered. The value of facts obtained in this way, generally exceed the value of facts obtained by experiment; for the method by which they are found out implies that they are the complements which unite systems of facts, and generally they give the laws which unite and govern the whole, and so render available facts and observation that have been known for generations."

This is taken from a semi-philosophical pamphlet issued by a manufacturer, whose name, as well as the title of the pamphlet itself, we avoid giving, lest our remarks might seem to have a personal direction.

There are some natural phenomena which will doubtless always elude analysis, since they present no starting points, possess no known constitution, and are wholly impalpable and evasive from any aspect. Familiar examples of these are light, heat and electricity. In the pamphlet we have alluded to, the author groups heat and gravity together, and says in his preface:

> "The object of this essay is to prove that the ultimate atoms of all matter constantly give out those actions known as light, heat and gravity, and that they are but different manifestations of the self-same thing, and that the combined action of these primitive acts produce all the other changes we see in nature."

Strictly speaking, light is not action, but the result of it; it is a manifestation of action, and our object in quoting the paragraph is to show again how confused and profitless researches like these alluded to are. "The combined action of these primitive acts," is, in itself, an unhappy form of expression, and so redundant as to compel analysis before it can be accepted. Action implies motion, movement, vitality; and, if we use any one of these synonyms in place of it, the weakness is still more apparent.

But mere synthetical criticism is not our object. While we deplore researches, or, as we have called them, "Excursions Into the Infinite," as of no advantage to practical workers, they are of some benefit to the speculator himself, as inducing mental action and exercise, with always the danger of perpetuating error by asserting mere visions to be discoveries. Between the two there is a vast gulf. The discoverer is the growth of a century, the visionary exists at all times and everywhere.

DECREASED LABOR OF MACHINE-TOOLS.

Discussion of feeds and speeds for machine tools which omits the amount of metal in pounds that can be removed per minute, or which they are capable of removing, lacks something of completeness. If for each kind of metal worked, and each shape of tool shown, it could be asserted that a given weight of metal was taken off, we should have facts in lieu of assertion, or mere personal predilections for one shape or another.

As for shapes, it would seem difficult to improve any upon the wedge, but the manner of presenting it to the work, its acuteness or obtuseness, are fit subjects for discussion, upon this principle we depend wholly for cutting; if we wish to abrade or scrape, it is unavailing.

While the shapes of cutting tools have undergone but slight change in the last fifty years, the amount of work they have to do is much less. All classes of mechanics work much closer than formerly and there is less stock to remove. We recall very clearly the indignation of a mechanic, some years since, at a blacksmith who only left half an inch to turn off of a three inch shaft. The mechanic insisted that this was not stock enough to true it up. As forgings were then made, and as blacksmiths worked at that time, our friend was not so far out of the way as we might now think him. All cuts are much lighter than they were a quarter of a century ago, and while the work of machine tools has decreased, the weight of them has increased. The lathe and the planer remove ounces where they formerly took off pounds of iron, and, except where stock is left in for the purpose of securing sound metal, the work of machine tools is comparatively light. Save in exceptional cases, and special localities, their full capacities are never tested. Where the closest work is done and the finest and best machine tools that can be produced are demanded, the work done by them is of the lightest description. It costs too much in stock and in time to hew off a heavy weight of metal, and sixteenths of surplus now answer where but a few years since quarter inches seemed too little.

COMPOUND ENGINES AND BOILERS.

Very good results have been obtained from vessels having engines fitted with the compound principle. In this country some of the latest steamers are using higher pressures and more expansions with success. These pressures, however, rarely exceed 100 lbs. above the atmosphere, because of the style of boiler used, which is commonly known as the Scotch type. It would seem that the boiler, having a small diameter of cylindrical shell, and without water legs, fitted with brick furnaces, might be substituted with advantage, say shells of 6 feet diameter, safe to carry 150 lbs. pressure with a thickness of metal less than half an inch. Or what is perhaps better, a water-tube sectional boiler might be used, wherein a pressure of 200 lbs. could be safely carried with a positive water circulation secured; the surfaces exposed to the fire would be less than ¼ inch in thickness. Such boilers have been tried on a limited scale, and have not been successful afloat, for which no good reason is assigned. Perhaps the desire to show how much heating surface could be had in a given space, induced the designers of this type of boiler to provide water-walls for the furnace, to the detriment of the system; it being now a well established fact that the heated brick sides, ends and bridge-walls of a furnace promote combustion to such an extent that, in some boilers so arranged, there is very little if any smoke produced, although using bituminous coal.

In an ocean steamer using anthracite coal, substituting brick-walls for water-walls in the furnaces produced a marked economy in fuel and gave a better water circulation. Also, these built walls of fire-brick prove to be durable, under all the conditions incident to their use on a sea-going steamer.

The present compound engine, with the comparatively high pressure used, has given such good results in our coasting steamers, that those engineers who have advocated a style of engine capable of only two, or at the most, three expansions, have now to admit their mistaken conclusions.

The performance of the engines of the "*City of Puebla*" and other steamers using steam with 15 or 20 expansions advantageously, is getting to be well known. The designer of these engines, Mr. R. W. Peck, told the writer that he would advise, for a similar vessel, a higher pressure of steam with higher expansion. He has designed and built a slide valve and expansion gear which works very satisfactorily, approaching the poppet valve system for efficiency in the movements of the valves.

Most of the successfully working high-speed engines are of the inverted, overhead cylinder type, one cylinder placed forward of the other on the center line of the keel. These engines are unbalanced in their working parts up to the crank-pin, beyond which the crank-arm counterbalance is effective so far as the crank and pin are concerned. Being in pairs, and with their cranks at right angles to each other, these engines have the balance afforded by this disposition of their working parts. That is, the descending weights of one engine are partially balanced by the ascending weights of the other for a portion of the stroke. These counterbalancing forces must unfortunately be passed through the crank-pins and one shaft journal, alternately in opposite directions for each stroke of the piston. This objectionable feature applies with greater force in that type of compound engine which adds the weight of the piston and piston-rod of a high pressure cylinder (by placing it over the larger one,) to the other unbalanced parts, compelling the use of a large and heavy fly-wheel outside the main journal, so that the counterbalancing force is transmitted through the main journal in addition to those journals affected in the first-named type.

These are serious objections in an engineering point of view, because these forces, while adding to the strains upon the working parts, also increase the friction upon the journals in proportion as the revolutions are increased. As these forces act and re-act between the piston and counterbalance, they are not utilized in propelling the vessel.

The only type of vertical cylinder engines which are balanced in their moving or working parts is the overhead beam engine, having its high pressure cylinder connections and the connection rod at one end of the beam, and the low pressure cylinder connections attached to the other end. This, in effect, relieves the beam and its center pin of a large proportion of the strains, and is undoubtedly the type which, more than any other, "has the variation and balance of turning forces most favorable to efficiency of mechanism."

An engine, so relieved of the strains just described, will be capable of many more revolutions per minute without heating journals, and as high piston speed is not a troublesome matter to the engineer of to-day, we may look to the beam engine so arranged as the coming machine for screw steamer propulsion.

Vertical single cylinder engines of six feet stroke of piston, pressure of steam 70 lbs. above the atmosphere, cutting-off at 5 inches of the stroke, averaging 60 revolutions per minute during a 5 days' voyage, have been in successful use on steamers for the past 9 years, and cylinders of a compound beam engine having seven feet four inches stroke of piston, average over the same route 58 revolutions per minute, giving no trouble. On occasions 71 to 73 revolutions have been maintained for several consecutive hours, without difficulty from the friction of the packing rings upon the cylinder. Durability under this wear is provided for by proper design and good workmanship.

Four feet stroke is the shortest that should be used for even a high number of revolutions. Engines work to a disadvantage at shorter strokes if any considerable power has to be developed. The tendency of our best engineering experience is to increase the stroke of engines. Before long 8 feet stroke will be used, especially for high powered engines.

Miers Coryell.

THE PROFESSOR IN THE MACHINE SHOP.

NO. XLII.

The letter on friction in the last issue of this paper, signed *Conservative* has given me more pleasure than anything of a similar kind in a long time, for the reason that I gather from the letter which accompanied it to the Editor of The Mechanical Engineer, that it was written by a working machinist in his leisure, and shows evidence of familiarity with authorities on the subject, and also of thought and a capacity to render it into intelligible English. All this is worthy of great encouragement, for the man who thinks is the peer of those who never do.

If I were to write a treatise on friction I am sure it would not have the same value as the observations and deductions of Morin; I hold this opinion and am not afraid to confess it, and the reasons why my opinions or views upon friction possess but little value are that I have never tried any experiments properly, have had little training as an experimenter, and possess no qualifications for it beyond an ability to see a hole in a ladder, and to comprehend the difference between an inch and two inches. These are certainly disqualifications which should prevent me from criticising the work of Morin, and if somewhere in space his disembodied spirit is now floating and glancing reproachfully at me, I beg that it will take this as an apology for anything I may have written which has the appearance of flapping my wings in its face.

I had written a long controversial letter in answer to "*Conservative*" and after it was written I sat down and read it all over carefully. Then I tore it up and threw it in the waste basket; that was the best place for it.

I cannot see, upon reflection, what value there is in controversies, or if this word implies irritating argument, I will say there is no value in "impressions" upon scientific matters. When a man is qualified by education and especial attention to some one branch for investigating phenomena he does well to give the world the benefit of his researches, but to sit down deliberately and pick to pieces the work of trained observers seems to me the height of foolishness, and I am not going to drill in that company. It is easy enough to sophisticate, to introduce plausible arguments tending to overthrow the work of accepted authorities, but what good does it do? It may flatter a man's vanity.

"The youth who fired the Ephesian dome
Outlives the pious fool who reared it"—

but that is short lived. I am not going to fire any Ephesian domes, or fire at them either. Often have I read elaborate disquisitions and treatises on the action of steam engines etc., etc., wherein the writer traversed the work of far abler men than himself, and was at great pains to show how little he knew of his subject.

We all know that there are many conflicting statements made by capable men, we know that errors and omissions occur and that special experiments, so called, by persons who do not know how to experiment, seem to be great discoveries, but this does not justify us in rejecting authorities. So I leave the question of friction where I found it, acknowledging that there are many things which are contradictory and confusing, but also confessing my inability to offer any rational explanation of them.

* * * * *

And now let me say a word on a subject which has always been very near my heart and which I think appeals directly to the interests of every one who works for a living, and that is a fund for self protection in case of sickness, death, or accident to any one about the place.

It is curious that men in general are so indifferent on this subject. In all large shops, where sickness or death occurs in the family of a needy comrade, it is customary to start a subscription list for their benefit. This is not a good plan, for many reasons that will be plain to all mechanics. The well-to-do, and generous minded are able to contribute more than others quite as generous, but who are, at the moment, unable to spare any considerable sum. Thereby they are placed in a seemingly false position, and sometimes subjected to uncharitable comment. What is still more objectionable, the recipient of the bounty is made to appear in some sense as a mendicant—beggar sounds harsh, but that's what it is in plain English. If a man loses his wife after a long sickness, he is often sorely put to it to pay the last offices of respect to her remains, and so it is with any other contingency of a similar kind. I have often talked to the boys about it but while every one acknowledged the propriety and feasibility of such a thing as I have indicated, they never took any steps about it themselves, and the result was that our boys are dependent in case of need upon the old-fashioned subscription list.

"How is it," I said to Jake one day, "that we can't wake the boys up to the importance of this thing; what's the reason?"

"The reason is said Jake," that they are none of them sick now, and never expect to die. I suppose each man says to himself that a scheme which proposes that he must be very sick, or die outright before either he or his folks can get any good out of it, is not a healthy one, and so they don't bother their heads about it."

"But they should bother their heads, because as you and I know, men should be taught to help themselves and in that way help others, for the example of every self reliant man is a direct incentive to all about him. Can't we do something to bring this matter of a general fund for sickness or death directly before them."

Jake thought a minute and said, "Yes, I believe we can," and, out he went into the shop. He was gone about twenty minutes and came back with three dollars in silver and pennies. "There!" said he, "that's what I said to the boys, and here is what I say myself," and he put down a dollar. "You put another one on top of it."

"What's all that about?"

"That's the beginning of our fund, and you want to pen a book for it." I went out to Bill Paul and said to him: 'give me ten cents;' he handed it out. I went to Miles and Lamb, and all the others and did the same thing, and to night I am going to tell them why and what I did it for. Next week I am going to do it again, and that will give us, with your contribution and mine, twenty dollars a month, which is a very good beginning."

"Well now, that is what I call energetic and to the purpose," said I "only you ought to have told them at the time what it was all about."

"No need of that at all. They know well enough I am not going to jump the town. Let them speculate over it. We will arrange the details of relief to suit them, and if we are such a healthy lot that we never get sick, or die outright, why we can vote to use a portion of the funds for mental improvement in the shape of books or papers. In the last issue of The Mechanical Engineer I saw an item which said that the Lowell Machine Shop had a luncheon room for the men, wherein books and papers were placed. This seems to me an excellent idea. We want all the papers published in our specialty, for we want to hear all sides. I take the *Machinist* and the *Scientific American* and one other, which as I don't think much of, I will not mention. I don't propose to hand these around to the boys, for I think every man should take at least one paper of his own, but if we get too healthy for our sick fund, we can lay out a portion of the money in that way; anyhow I am glad we have made a start and I think some decided action like the one you put in force would be a good thing in other shops."

As the men were going home at quitting time Jake asked them to stop a few minutes and then told them why he had taken their money that day, and said that if any one disapproved of it he could have his money back, but the unanimous feeling was that he had done right. "I think," Jake said to them, "it is better that every one should hand the money out in person in preference to having it stopped out of his pay in the office. The latter seems a little arbitrary on the part of the employer, and moreover it deprives the individual of his voluntary act. This point should not be lost sight of. A man cannot demur when his ten cents is stopped out of his pay, but somehow it seems to him as though his boss compelled him to give it, and anything that seems coercive in ever so slight a degree is hateful, particularly in a case like this."

Now if any man gets sick in our shop he knows that he will be well taken care of, not by charity but by self-help, for what he has contributed, though small and insignificant in amount, has by co-operation proved to be a strong staff. As for the details of the scheme I do not think it necessary to give them here, that is the methods of distribution or apportionment of help to each individual, but if any one desires it as a guide in similar cases I shall be pleased to give it.

IN THE ROUND HOUSE.—No. X.

BY L. O. DANSE.

RUNNING.

The engineer is practically the most responsible person on the train while it is in motion. With his hand on the throttle, his eyes ever watching the track ahead, his ear constantly on the alert for sounds that may give warning of danger—which he must constantly expect—and with his mind on his work, he must be ready for instant action at any moment.

His first duty is to keep the water in the boiler at the proper level, for if it gets too low, the crown sheet will be uncovered, and every one knows that a sheet of iron exposed to intense heat on one side, and not covered with water, will quickly become red hot and buckled. To turn on the feed water under such circumstances, would result in the immediate and certain destruction of the boiler. In this extremity there is but one thing to do—drop the fire immediately—which will necessitate being towed in, cold, by another engine. "Burning" a boiler is considered as the greatest disgrace which can fall to the lot of a runner, and usually results in his discharge.

On the other hand, letting the boiler get too full, results in very wet steam, and spray being carried over to the cylinders, they soon show the presence of water by a loud "click" at each end of the stroke; and if the cylinder-cocks are not immediately opened, a broken cylinder-head, or piston, or a cracked cylinder, will surely result. Large quantities of water will also come out of the stack, falling like rain over the engine and train, soiling everything and greatly inconveniencing the crew.

The worst experience I ever had with water "running out of the stack" was on one of the branches of the B. & O. I had jumped a construction train near the summit, to speak to the conductor. A few minutes after we pitched over "the top of the hill," about a gallon of dirty rain, pretty well mixed with soot, dropped down on me, soiling my shirt and collar, and spotting my face so that it had a leopard-like appearance. The entire crew beat a hasty retreat to the caboose, from which I had the pleasure of watching the clouds of wet steam issuing from the drain-cocks and stack.

If you want the good will of the crew, never fill your boiler so that the water "runs" out of the stack.

Most boilers have four gauge cocks, and when such is the case, it is customary to carry three gauges of water. The usual rule among runners is to try the water every three or four miles. Should the water be found down to the second gauge, the lazy-cock must immediately be opened wide, and after a few minutes the gauge cocks should be tried again. If the water has not risen, put on the other pump (or injector). Should this fail to raise the water level, feel the pump connecting-pipe to see whether it is hot. Should it be so, you may feel sure that the check-valve is stuck up. Rap the chamber with a copper hammer, and unless it is badly stuck it will jar down and seat itself.

If the check is all right, open the pet-cock. If the boiler check is stuck, the steam issuing from the pet-cock will be strong, while the plunger makes its inward stroke, and weak during the outward. If the trouble is on the suction side and the checks are all right, the pet-cock will show none at all. In the former case the trouble can often be remedied by closing the lazy-cock, and turning on the heater, so as to produce a heavy steam pressure in the pump and connections, which will frequently blow out the obstruction. In the latter case, first try the same expedient as in the former, and then open the lazy-cock while the heater is still on, so that if the strainer or elbow be clogged, the pressure in the feed pipe may blow the obstruction back into the tank. If you can't get water into your boiler after trying all these expedients, stop your engine and disconnect your tank-hose from the feed pipe, and examine the strainers and elbows. If the latter be clear, a heavy stream of water will issue from the hose when the tank-valve is open. When the trouble is in the strainer, it is readily removed; but if in the elbow or hose, it will require considerable work with a piece of wire to clean it out. If in neither, it is, of course, in the pump or check, and will have been located by the previous trials.

If you cannot remedy the trouble and have no injectors, your only course is to cover the fire with earth and telegraph for help.

The most frequent causes of failure of injectors to work are leaky joints, leaky overflow valves, leaky checks, non-regulation of the combining tube, small cinders, corrosion, and deposits of lime from the water. Hot injectors can usually be made to work by the application of a bucketful of cold water. If the overflow does not show water, and the instrument is not hot, it can often be cured by tightening the unions. When the combining tube is not set properly, the injector usually sputters and makes a great noise. If you fail to locate either of these two defects, shut off the overflow and turn on the steam, so as to blow out the connections. Should this fail, you had better dissect the instrument to see if you cannot locate the trouble. A very small leak on the suction side will entirely prevent working, by admitting air.

There is one cause for lack of water to which I have not alluded, because it is the result of the grossest possible carelessness. I mean an empty tank. The only thing to do under such circumstances, unless you can safely make the run to the nearest water-tank with the water in the boiler, is to cover the fire and telegraph for assistance.

It is fortunate that a coal fire can be dampened by covering it with a heavy layer of wet earth, so as to give out but very little heat. This fact has frequently saved runners the disgrace of being towed in cold; as, when the engine with the covered fire is towed to the water-tank, she can be filled again with buckets, and the time required to get steam enough to proceed with her run will be comparatively short; whereas, if she had drawn her fire, it would require some time to raise steam again.

PETROLEUM AS FUEL.

Since the discovery of petroleum various efforts have been made to introduce it as a fuel for steam boilers, and general heating purposes, but notwithstanding that the subject has been taken in hand by both British and Foreign Governments, as well as by private individuals of ability, it is a fact that not only has no practical progress been made in the use of liquid fuel, but that in those cases where it has been tried, and experiments carried out with the best results as regards evaporative efficiency, it has been abandoned, and a return made to coal. The reason for this is not far to seek, and consists in the fact that the cost of evaporating a given quanity of water by means of heat produced by the combustion of petroleum so far exceeds that when coal is used, as to counter-balance any advantages; always excepting a few countries where from scarcity of coal and wood, and abundance of petroleum, the latter is the cheapest.

One of the earliest investigators into the merits of liquid fuel was Sainte Claire Deville, who carried out two extensive experiments with locomotives, which were specially fitted up, under his direction, with appliances for burning the oil. The results of these experiments were published in the Journal of the French Academy of Sciences for 1868 and 1869; the average evaporation being given as about 11 lb. of water per pound of fuel. In the United States, commissioners were appointed to specially consider the value of petroleum as fuel on board steamers; a sum of $5000 being appropriated for making the necessary tests; but after long and careful trials, the Secretary of the Navy finally reported against its use, on the grounds that convenience, comfort, health and safety were against it, the only advantage shown being a not very important reduction in bulk and weight of fuel carried.

A pound of petroleum may be taken as consisting of 0·85 lb. of carbon and 0·15 lb. of hydrogen, which, if burnt direct to carbonic anhydride and water with the exact equivalent of atmospheric air, would produce 22,700 heat units, with an elevation of temperature of 5,484 degrees Fah., always supposing that combination could take place at this temperature which is doubtful. This supposes a thermal value of 17,000 units per pound of carbon, and 55,000 units per pound of hydrogen, the former being somewhat higher than is generally allowed for carbon in the solid state, and the latter a little lower than is taken for gaseous hydrogen. Assuming now that instead of being burnt directly with air, the petroleum is first heated in a chamber in contact with steam, to such a degree that partial combustion takes place, the oxygen of the steam combining with the carbon of the oil to form carbonic oxide, while the hydrogen of the steam, as well as of the oil, is set free. In this case the 0·85 lb. of carbon will combine with 1·13 lb. of oxygen from 1·27 lb. of steam, giving out 5,950 heat units, and setting free the 0·15 lb. of hydrogen in the oil as well as 0·14 lb. with which the oxygen was associated in the form of steam. The separation of this steam into its constituent gases is only effected by the expenditure of heat, as much heat being absorbed as is given out in its formation, so that to supply the 1·13 lb. of oxygen, 8,680 units must be communicated from the outside. After this partial combustion there remains 1·98 lb. of carbonic oxide and 0·29 lb. of hydrogen, which, on issuing from the retorts through suitable nozzles and meeting a proper supply of air would be burnt to carbonic anhydride and water, producing 25,430 heat units. Adding to this the 5950 units from the formation of carbonic oxide, and deducting the 8,680 units required for the dissociation of the 1·28 lb. of steam, there is left a net total of 22,700 units as the result of the complete combustion of 1 lb. of petroleum, which is precisely the same value as was found in the case of direct combustion with air. It will thus be seen that no advantage as regards increase in heating power is obtained by the use of steam. In practice, however, there seems to be an advantage of another kind, inasmuch as the steam is found to promote combustion by bringing about a proper intermixture of combining particles, so preventing the formation of the smoke which nearly always accompanies combustion with air alone, and which is the cause of considerable loss from waste of carbon and reduction in the efficiency of the heating surfaces. Steam also promotes the draught, and so permits of a lower temperature of escaping products than when the draught is entirely dependant on the chimney. Taking this temperature at 300 degrees Fah., and assuming the temperature before combustion at 60 degrees Fah., each pound of petroleum will give 21,460 available units of heat which is equivalent to an evaporation of 22·21 lb. of water from and at 212 degrees Fah.

Turning now to coal—which we may take as being composed of 83 per cent. of carbon and 5 per cent. of hydrogen, the remainder being chiefly ash, with a little oxygen and nitrogen—and taking thermal values of 14,500 and 50,000 units respectively for 1 lb. of solid carbon and hydrogen in the condition in which it exists in coal, we find that the combustion of 1 lb. to carbonic anhydride and water will give 14,535 units, while, if only the exact proportion of air be admitted, the rise in temperature would be 4,845 degrees Fah. Allowing an initial temperature of 60 degrees Fah., and a temperature of 500 degrees Fah,, for the escaping products, this represents an evaporation of 13·5 lb. of water from and at 212 degrees Fah. The evaporative efficiency of 1 lb. of coal to 1 lb. of petroleum is, therefore, as 1 to 1·64 under the conditions taken; but as with petroleum the admission of air to the combustion chamber can be controlled with much greater exactness than with coal, there is less loss from the cooling effect produced by more air entering than is really necessary to support combustion, and allowing for this, we are disposed to place the possibly actual efficiencies as 1 to 2. With this as a basis it is easy to arrive at the relative cost of the two fuels. Taking coal at 15s. a ton, the value of 100 lb. weight will be $8\frac{1}{28}$ pence. Crude petroleum is at present worth 6d. a gallon, but is not fit to be used as a fuel without distillation. We will, however, take it at 6d., and as the specific gravity is ·800, water being 1·0, 100 lb. weight will occupy 12½ gallons, and will cost 75 pence. The relative costs of coal and petroleum, weight for weight, are, therefore, as 1 to 9·3; but as we have admitted the evaporation efficiencies to be as 1 to 2, it makes the actual cost of evaporating a given quanity of water with petroleum to be 4·63 times as much as it is with coal.

Though one form of burner may give somewhat better results than another, there is little prospect of any startling discovery being made which is likely to enable petroleum to compete commercially with coal as a generel fuel for raising steam.—*The Engineer.*

ROLLING SHEET ZINC.

The rolling of this metal at first encountered very great difficulties. These arose from the fact that its malleability is confined to very narrow limits of temperature. For this reason, it will always remain a delicate operation, only entrusted to experienced hands. The most suitable temperature is about 100° Cent.=212° Fahr., and this must be maintained through the whole of the process. Below this point the metal opposes too great a resistance to the squeezing action of the rolls and must be reheated, a matter of much inconvenience. Above this point it becomes brittle; at 200° Cent.=390 Fahr. it can be brayed in a mortar.

Whatever its method of manufacture, zinc ought to be re-melted before being rolled into sheets. The heat of fusion varies between 400° Cent. and 500° Cent. 750° = Fahr. and 930° Fahr. Re-melting is generally accomplished in a reverberatory furnace. Its first advantage is that it rids the zinc of the impurities, especially lead, which almost always accompany it. Again, the thickness of the ingots must vary with the final dimensions required; this is another consideration which renders re-melting indispensable.

The re-melted plates are first roughed down or rolled between heavy rolls; then, after being cut down to a fixed weight, they are conducted to the finishing train, where the rolling is completed. There are, therefore, two distinct operations—the roughing down and the finishing. Between the two the sheets sheuld be re-heated in annealing boxes placed upon the melting furnace. Each of these operations gives rise to a production of scrap, which is more or less large according to the quality of the metal and the thickness of the sheet. This scrap, as well as any defective sheets, are re-melted with the ingots coming from the foundry.—*Engineering.*

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. X.

By J. P. Mullin.

MOULDING LARGE HOLLOW CASTINGS IN DRY SAND.

Fig. 56 is a general drawing of a hopper for Walker's Patent Sulphurizing Furnace, and it will serve as a good example for this subject, viz.: moulding in dry sand.

A side and end elevation of the pattern is shown at fig. 57. The body of the pattern has four strong draw-irons as shown at *B* and the feet *A*, and all the facing pieces and points are loose and held in position by screws and dowels.

Figs. 58 and 59 are the different side and end sections and elevations of the center, or body-core box. As will be seen by the drawing, the ends are made loose, and held in place by the screws *C* and the four $\frac{5}{8}$ bolts shown at *D*.

When the core is made and ready to lift from the box, the four bolts can be taken out and the sides removed. When this has been done the screws *C* may be taken out and the ends lifted away. This leaves the core standing in the bottom section of the box shown at fig. 58, from which the core can be lifted without the slightest danger of breaking.

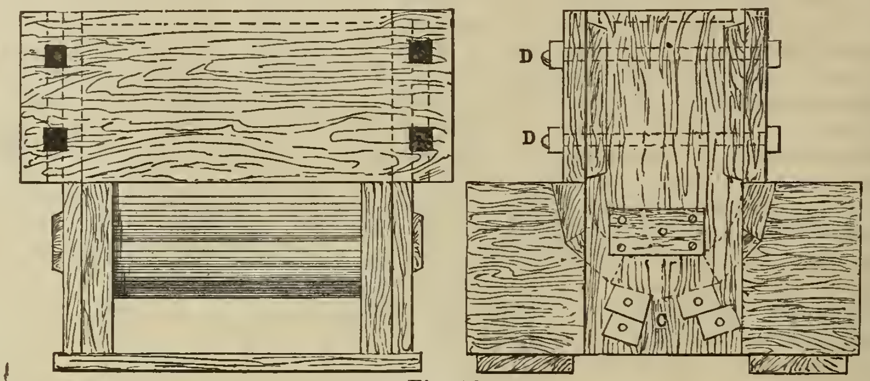


Fig. 59.

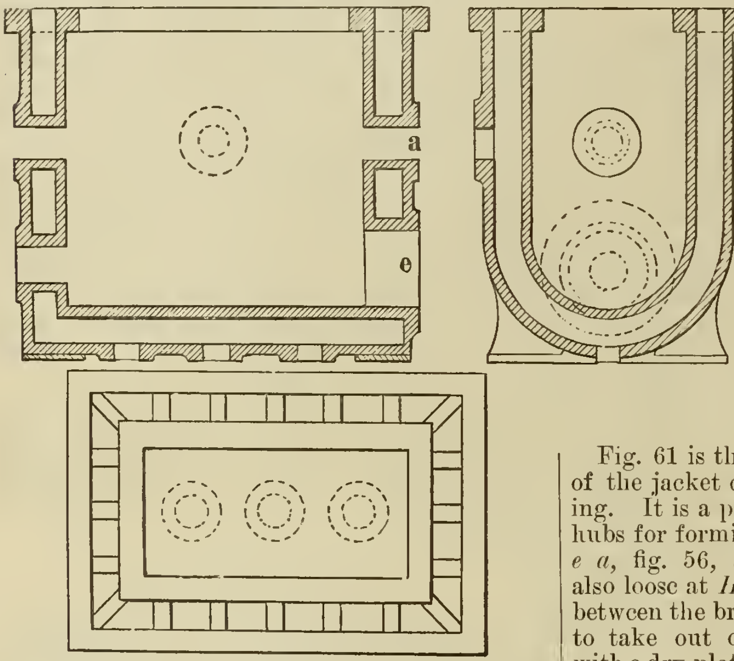


Fig 56.

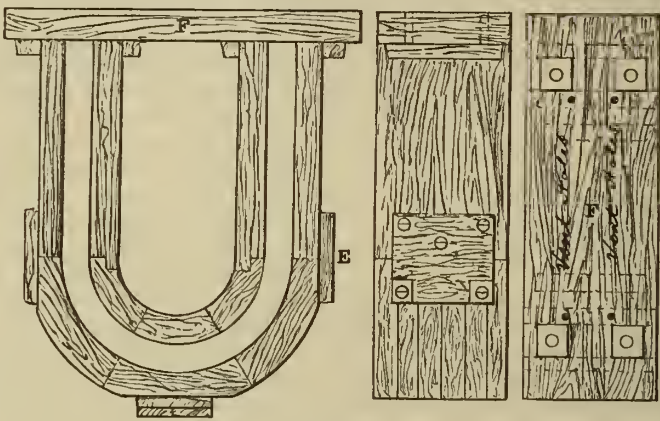


Fig. 60.

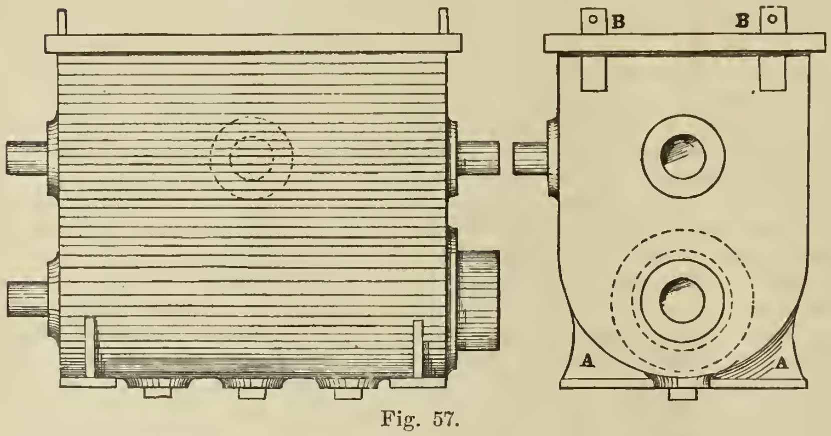


Fig. 57.

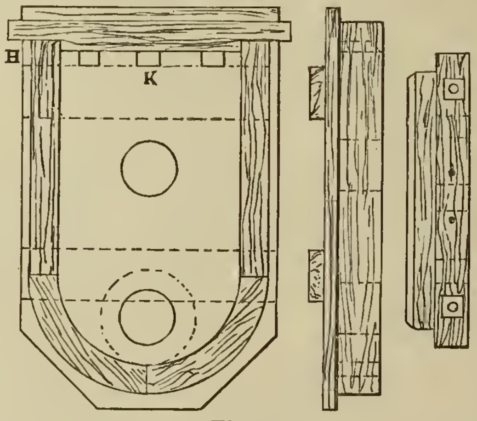


Fig. 61.

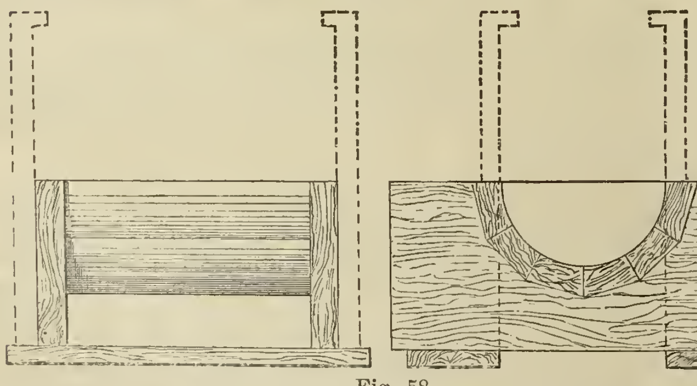


Fig. 58.

The jacket core for the sides of the casting had to be made in three sections. The plan, side and end elevations of the box are shown at fig. 59. By referring to the drawing, it will be seen that the box is made open top and bottom, and parted both sides at *E*, and also at the end *F*, all the different sections being held in place with screws. The square end of the box should have four $\frac{7}{8}$ vent holes bored as shown at *G*. When making the core, the box should be set upon the dry-plate upon which the core is intended to be baked. Then when the core is made and ready to draw, the screws which hold the box together at *E* and *F*, may be taken out and the different sections of the box removed without disturbing the core. When this has been done the dry-plate and core can be lifted and placed in the oven to dry.

Fig. 61 is the plan, side, and end elevations of the jacket core-box for the ends of the casting. It is a plain box open on the top and the hubs for forming the wall around the opening. *e a*, fig. 56, are loose, and the square end is also loose at *H*, and has two $\frac{7}{8}$ vent holes bored between the bridges, *K*. When the core is ready to take out of the box it should be covered with a dry-plate and turned over. When this has been done take the screws out at *H* and draw the square end and bridges, *K*, then lift off the body of the box and draw the hubs, *a*, finish *e*, the core, and it is ready for the oven.

MOULDINGS.

Fig. 62 is an end view of the mould showing the pattern, gas vent-pipe and steam vents. When the proper excavation has been made in the floor, the bottom must be covered with a layer of cinders, about six inches thick, and then five or six inches of sand, and upon this make the bed for the bottom of the pattern. This part of the mould should be well vented downwards to the cinders, which will take away all the gas from the bottom of the mould by way of the 4″ pipe shown in the figure.

When the pattern has been set in position and is ready to mould, set three $2\frac{1}{2}''$ vent pins at each side as shown. When this has been done fill in and ram up the sides square with the ends and level with the top of the pattern, leaving an opening of about two feet at each end. Cast iron drawback plates may then be set in the position shown by dotted lines, *M*, fig. 63, and rammed up as shown at *N*, making the two $1\frac{1}{2}''$ feed gates shown at *P*. The cope flask, *R R*, figures 62 and 63, may then be put on and rammed up, using $\frac{3}{4}$ gas pipe for venting the body and jacket cores. When the cope has been rammed up, it may be lifted off, and the ends of the mould drawn back to the position shown at *M P*, and, as one end has to be dried in the core oven, it may be lifted right out of the mould; finish and put in the oven at once. Having taken off the cope and ends of the mould as stated, the body of the pattern can be drawn from the sand, and the feet and facing pieces which will remain in the mould can then be drawn in towards the center.

The method of drying the mould is shown at fig. 64.

Having set the end, *M P*, and the cope back in place, build the temporary fire-box, *S*, and kindle the fire, and the heat will dry the mould as it passes back from the fire to the smoke flue shown in the figure.

When the mould has been dried and finished, the cores set and the mould closed as shown at figure 65, it is then ready to cast.

INDEPENDENT WHEELS.

Next to car coupling there is probably no mechanical problem pertaining to steam railway operation more attractive to inventors than that of an independent wheel movement; and it may also be said that the problem has probably been worked out to the utmost practical degree of perfection. Yet there are no loose wheels or divided axles running on any of the steam roads, so far as we know; or, if there are any, the cases are extremely exceptional. It may be asked, Why is this? when some of these devices have been tested, and severely tested, in passenger train service without revealing any serious defects in practical running, but exhibiting on the contrary the most decided advantages in the matter of economy as compared with the performance of rigid wheels and axles. All railroad men would like very much to get rid of wheel sliding, flange wear on curves, spreading of track and sundry other things inseparable from the use of rigid wheels on rigidly parallel axles, but they do not seem to take kindly to any arrangement by which one wheel can revolve independently of the other on the same axle. And in this we think they are right. An independent movement necessitates either a loose wheel or a divided axle. There must be a loose joint somewhere which no inventive ingenuity can make equivalent to no joint; and however well this class of devices may work on street lines, there is a rooted prejudice against them for steam cars, and a distrust of any claims put forth in their behalf as being applicable to such cars. No running tests, however favorable, can eradicate from the minds of railroad mechanics and managers the idea of rattle-trap piece-work. They know that upon all the great lines of steam roads where 20° curves are the minimum, the cost of repairs or the damage caused by accidents that loose wheels might have prevented, does not amount to a very large percentage of the aggregate of such cost and damage, and they are consequently slow to favor any plan that proposes to substitute complexity for simplicity, piece-work for solidity, lest the advantages gained might not be a sufficient compensation for what would be lost. The curves of the New York Elevated Railway tracks are some of them only 90 feet radius; and yet the independent wheels that were tried on some of the cars when the lines were first opened have all given place to rigid ones.

For these reasons it may, we think, be considered settled that upon steam lines any construction of running gear in which one wheel can move independently of the other on the same axle is inadmissible, and that drawbacks and disadvantages inseparable from rigid wheels will be reduced to a minimum in the future by the gradual straightening of curves so far as the financial condition of railroad companies will warrant an expenditure for that purpose.—*Car Builder.*

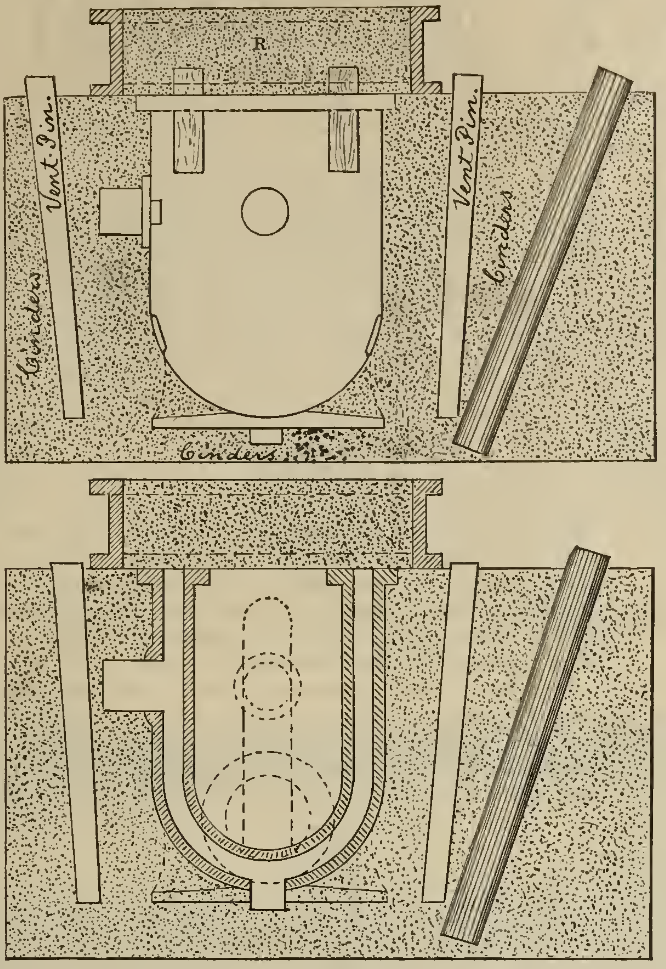


Fig. 62.

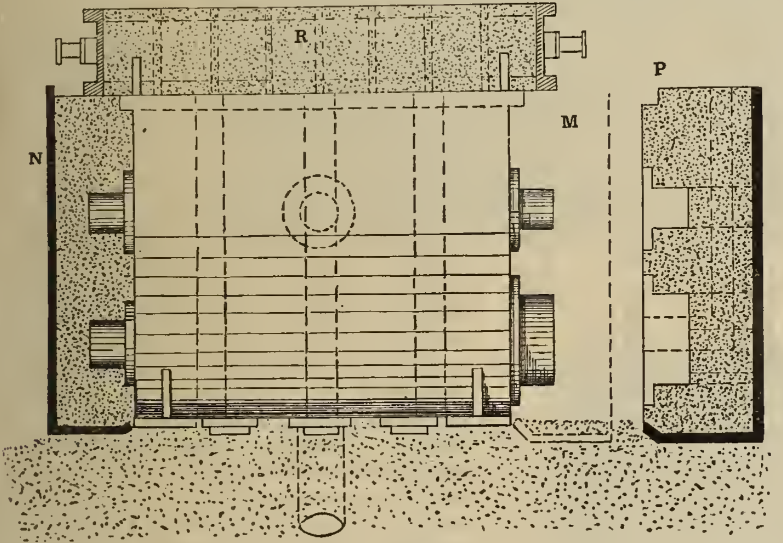


Fig. 63.

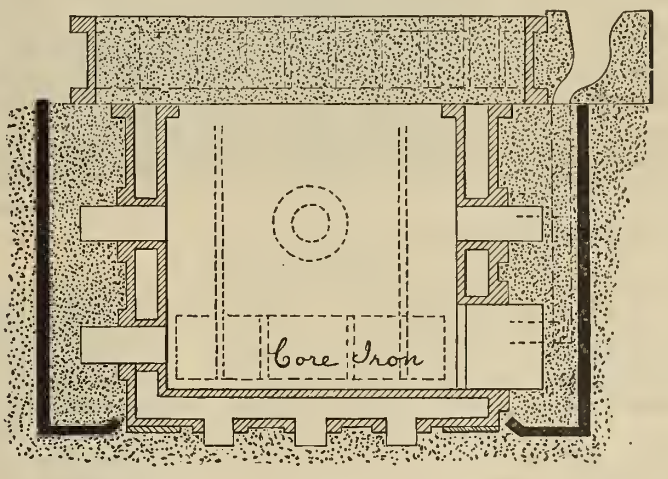


Fig. 64.

A PLEA FOR A NATIONAL LABORATORY OF PHYSICS.

Arguing for the necessity of greater accuracy in experimental research, particularly in the field of mechanical engineering, a writer in *Science*, says:

"There are many physical problems, especially those requiring exact measurements, which cannot be carried out by one man, and can only be successfully attacked by the most elaborate apparatus, and with a full corps of assistants. Such are Regnault's experiments on the fundamental laws of gases and vapors, made thirty or forty years ago by aid from the French government, and which are the standards to this day. Although these experiments were made with a view to the practical calculation of the steam-engine, yet they were carried out in such a broad spirit that they have been of the greatest theoretical use. Again, what would astronomy have done without the endowments of observatories? By their means, that science has become the most perfect of all branches of physics, as it should be from its simplicity. There is no doubt, in my mind, that similar institutions for other branches of physics, or, better, to include the whole of physics, would be equally successful.

"A large and perfectly equipped physical laboratory with its large revenues, its corps of professors and assistants, and its machine-shop for the construction of new apparatus, would be able to advance our science quite as much as endowed observatories have astronomy. But such a laboratory should not be founded rashly. The value will depend entirely on the physicist at its head, who has to devise the plan, and to start it into practical working.

"Should any popular element enter, the person chosen would be either of the literary-scientific order, or the dabbler on the outskirts who presents his small discoveries in the most theatrical manner. What is required is a man of depth, who has such an insight into physical science that he can tell when blows will best tell for its advancement.

"Such a grand laboratory as I describe does not exist in the world, at present, for the study of physics. But it cannot always be so, and the time has arrived when such a grand laboratory should be founded. Shall our country take the lead in this matter, or shall we wait for foreign countries to go before? They will be built in the future, but when and how is the question."

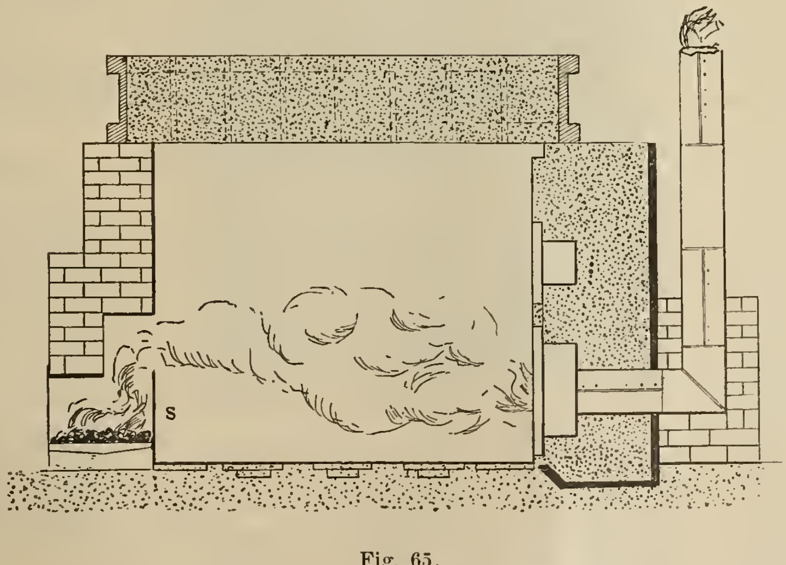


Fig. 65.

FEW TEETH OR MANY IN CIRCULAR SAWS.

I will say to those who think the fewer teeth the lighter the saw will run, to try the experiment of laying a board down on some solid foundation, and then take a quarter inch chisel and place it just far enough from the end so that it will cut a chip and not scrape, and they will find the chisel can be pushed through any common wood very readily; then take the same chisel and board, and place the chisel two or three times as far from the end, in some other place, and they will find, instead of being able, as before, to push it through by hand, it will require several blows on the chisel, with a mallet or something else. This seems to me proof enough that it does take more power to each tooth of the saw that has less teeth to do the same work. Now, they will all probably admit that, but claim that it does not take double the power to each tooth of a 20 tooth saw that it does to a 40. There is reason in all things, and if the feed is enough, say 3½″ or 4″, so that the 40 tooth saw can get a firm hold on the timber and cut, the teeth of the 20 tooth saw will each take more than double the power, and besides will require a heavier saw, as the strain is not so easily divided on the rim; in fact, it would scarcely run at all on that feed in hard wood. But if the feed is not more than 1½″ or 2″, so that the 40 teeth could not cut but scrape, the 20 teeth would cut and consequently run lighter.—*Cincinatti Artisan.*

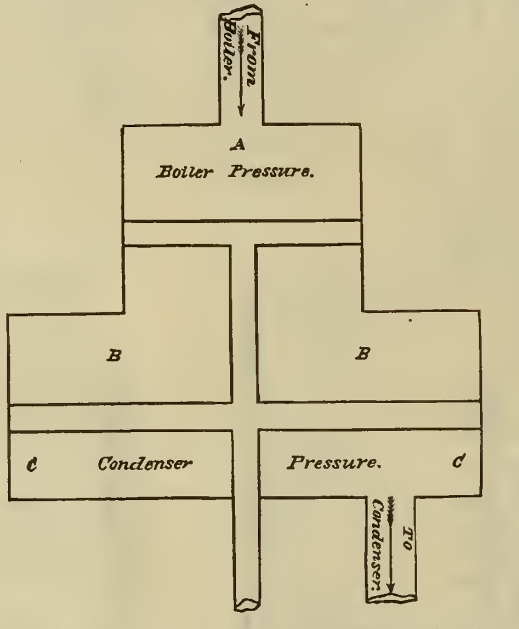
THE VALUE OF HIGH PRESSURES.

The effect of the increase in the working steam pressure is to enable a given power to be obtained with a cylinder of smaller diameter, and thus to reduce the size and weight of the engines. The volumes of the steam-pipes and of the steam-spaces in the boiler may also be reduced, because the *relative volume* of the steam is decreased, that is to say, a given *weight* of steam at the higher pressure occupies less space than at the lower pressure. For example, at a pressure of 5 lbs. above the atmosphere 1 lb. of steam would occupy 19·6 cubic feet, at 20 lbs. pressure 11·6 cubic feet, at 60 lbs. 5·7 cubic feet, and at 100 lbs. pressure, only 3·8 cubic feet. The boilers, steam-pipes, &c., can be further reduced, in consequence of the collateral advantage gained by the use of high pressure steam, viz., that *less weight* per I. H. P. is required, in consequence of the more economical working of the engines. All these parts may therefore be reduced not only from the decreased *relative volume* of the steam, but also the total weight of steam required to be generated is likewise diminished.—*Richard Sennett, C. E. Royal Navy.*

CALCULATING THE HORSE POWER OF COMPOUND ENGINES.

In calculating the indicated horses-power for a compound engine, the common practice is to take for factors the area of each piston and the indicated pressure upon it per square inch as given by the indicator diagrams from the respective cylinders. Thus the indicated horses-power is obtained for each cylinder and their sum is the indicated horses-power developed by the engine. In fact, however, the indicated horses-power developed by the engine are not thus distributed, although the aggregate is correct. This method assumes that each cylinder of the compound engine acts independently of the other, as is the case with the simple engine, which is not true. The compound engine is necessarily composed of two cylinders of unequal capacity, while the simple engine is composed of one cylinder only, and if two be used they constitute two independent engines, although coupled to the same shaft and having boiler and condenser in common. The combined cylinders of the compound engine are, in effect, one cylinder only, and their pistons are, in effect, one piston only, nor can their action be separated in reality, however it may be in appearance, by the arrangement of mechanical details adopted. The interiors of both cylinders of the compound engine are always in common, that is, the spaces in the two cylinders between the inner surfaces of the pistons are in common for one stroke, and those between the outer surfaces of their pistons are in common for the return stroke. The accompany very simple diagram, which exhibits the compound engine in its most elementary conception, will illustrate these ideas. The diagram shows the two cylinders of the compound engine arranged tandemwise with their interiors between the inner surfaces of their pistons in common, and with their pistons rigidly connected to the same piston-rod. With this arrangement the pistons could make only one stroke downward, which is all that is necessary for explanation. To make the return upward stroke, the two cylinders would have to be separated by a partition and the interior of the small cylinder above its piston would have to be made in common with the interior of the large cylinder below its piston by a communicating pipe. In a working engine the valves controlling the alternate flowings of the steam from the bottom of the small cylinder to the top of the large one and from the top of the small cylinder to the bottom of the large one are movable partitions supposed in the diagram. The space, *A*, is supposed to be filled with steam of the boiler pressure; the space, *BB*, is supposed to be filled with steam of the boiler pressure expanded with pressures decreasing according to approximately a hyperbolic curve, from the beginning to the end of the stroke of the pistons, the terminal pressure being as much less than the initial pressure, as the capacity of the large cylinder is more than that of the small one; and the space, *CC*, is supposed to be filled with steam of the condenser pressure.

Now, evidently, the pressure beneath the piston of the small cylinder and above the piston of the large cylinder being the same, and the two pistons being rigidly connected, this pressure is entirely neutralized against the piston of the small cylinder, and upon so much of the piston of the large cylinder as is immediately opposite and equal to the area of the piston of the small cylinder; hence, the only portion of the piston of the large cylinder that can produce power is the ring remaining after the subtraction of the piston of the small cylinder. As a consequence, the indicated power exerted by the expanding steam in the large cylinder is represented by the indicated pressure there multiplied by the area of the ring remaining after substracting the piston of the small cylinder from the piston of the large one. This is the true indicated power developed by the large cylinder, and is as much less than the indicated power as habitually calculated for that cylinder, as the area of the ring referred to is less than the area of the piston of the large cylinder. Of course, the true net power and the true total power developed in the large cylinder are represented by the product of the ring area referred to into, respectively, the net pressure and the total pressure, the net pressure being what remains of the indicated pressure after subtraction of the pressure required to work the large cylinder and its concomitant parts, *per se*, or unloaded, and the total pressure being the sum of the indicated pressure and the back pressure against the piston of the large cylinder.



The two pistons of the compound engine being rigidly connected, and the steam pressure between them being the same per square inch of piston, the true back pressure acting against the piston of the small cylinder is evidently the back pressure acting against the piston of the large cylinder; that is to say, the condenser pressure in the space, *CC*, and not the pressure of the expanding steam in the space, *BB*, between the pistons; hence, to obtain the true indicator diagram from the small cylinder, the indicator must be placed in connection with the space, *A*, or steam side of the piston of the small cylinder and with the space, *CC*, or exhaust side of the piston of the large cylinder. The indicated pressure for the small cylinder thus obtained would be as much greater than the indicated pressure habitually calculated for that cylinder, as is due to the mean pressure of the expanding steam in the space, *BB*, between the pistons of the two cylinders. Now, this pressure expanding steam being what is habitually known as the indicated pressure for the large cylinder, the true method of calculation herein described makes the indicated power of the small cylinder exactly as much greater than what is obtained by the habitual method of calculation as the indicated power of the large cylinder is made smaller, the aggregate indicated power of both cylinders being the same by both methods. The true net pressure for the small cylinder is what remains of the true indicated pressure after subtraction of the pressure required to work the small cylinder and concomitant parts, *per se*, or unloaded, and the true total pressure for the small cylinder is the sum of the true indicated pressure and of the back pressure in the space, *CC*, against the large piston.

The indicator diagrams habitually taken from the small cylinder of the compound engine do not correctly represent the effective pressures upon its piston nor does the habitual co-relation of the indicator diagrams habitually taken from the two cylinders give a correct idea of the true distribution of the pressures. The true co-relation of the diagrams is as follows:

Suppose a straight line taken as base and divided into two parts which have the same relation to each other that the volume of the small cylinder has to the volume of the large cylinder less the volume os the small cylinder. Now, having taken a true indicator diagram from the small cylinder, that is, a diagram made by putting the indicator alternately in connection with the space, *A*, or steam side of the piston of the small cylinder and with the space, *CC*, or exhaust side of the piston of the large cylinder, lay off this diagram on the first part of the base representing the volume of the small cylinder. Next, having taken an indicator diagram from the large cylinder by putting the indicator alternately in connection with the space, *BB*, or steam side of the piston of the large cylinder, and with the space, *CC*, or exhaust side of it, lay off this diagram on the last part of the base representing the volume of the large cylinder less that of the small one; then the two diagrams will form one showing the true action of the steam and the true distribution of its pressure during a stroke of the *combined* pistons, the total length of the base representing the length of the stroke of a piston. Such a diagram, and only such an one, is comparable with the diagrams taken from the cylinder of the simple engine. All other arrangements or combinations of diagrams from the cylinders of compound engines are factitious and misleading.

[TO BE CONTINUED.]

A POSTAL NOTE, says *Bradstreets*, is, in effect, a draft payable to bearer, issued by one postmaster upon another, designated on the face of the note, ordering the payment of a certain specified sum less than $5 in amount. A fee of three cents is charged for issuing the note. The time of payment is limited to some day within three months from the last day of the month of issue. It is payable either at the office upon which it is drawn or at the office of issue, the same limitation of time being observed. The note must be signed by the person receiving payment. If lost or destroyed no duplicate thereof can be issued. If the note be not paid within the time limited it becomes invalid. In such case the holder, to obtain the amount of the note, less an additional fee of three cents, must receipt the same, deliver it to the postmaster at the paying or at the issuing office, and sign an application for a duplicate payable to him by such postmaster, to be issued by the superintendent of the money-order system at Washington. Every postal note contains a notice that, after having once paid the same, by whomsoever presented, the United States will not be liable for any further claim.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. JOHN BECKER, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering. Send for catalogue before pur chasing. F. Keppy, Publisher, Bridgeport, Conn.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgb, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

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THE MECHANICAL ENGINEER.

New Series. Vol. VI.—No. 8.
Enlarged 1883.

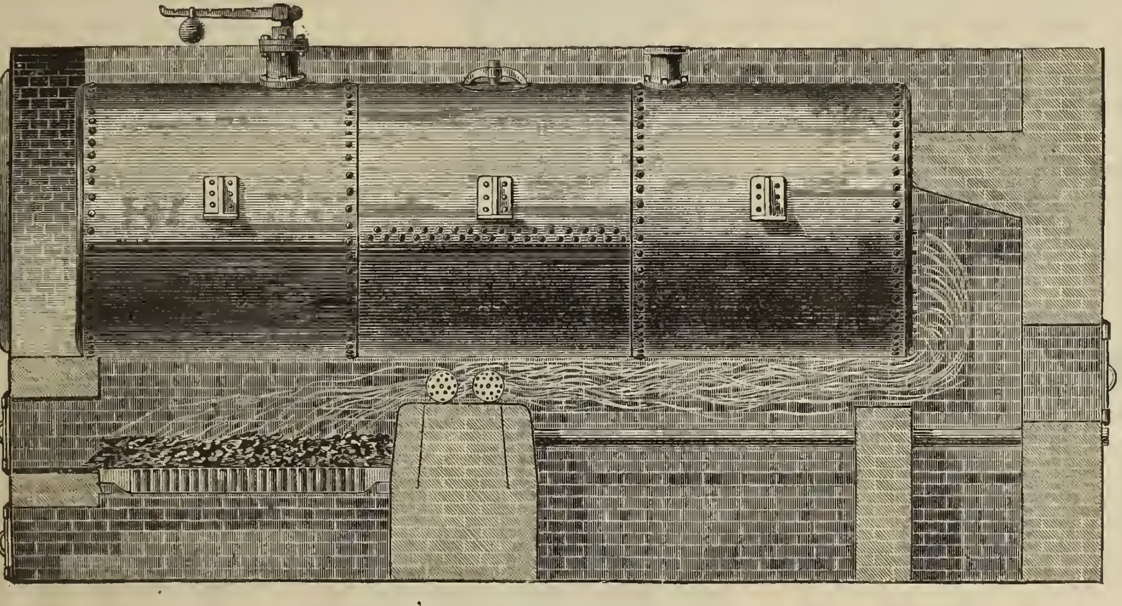
New York, October 13, 1883.

Single Copies 8 Cents.
$2.00 per Annum.

MAHONY'S UNIVERSAL PATENT FURNACE.

Of late very active and earnest efforts have been made by steam users to reduce their fuel bills, and anything that promises even a slight benefit in this line is investigated and adopted if found satisfactory. Inventors also, have turned their attention to the subject with the result of a marked decrease in this most serious of the expenses involved in the use of steam. Our columns bear witness to the convictions of engineers upon the waste of fuel, and it is a very common occurrence to have individuals assert, in our office, that they would like to have certain situations on a small percentage of the coal they could save over current bills.

Our engravings represent a device for improving combustion in the furnaces of steam boilers, which is in successful operation in many places, and its introduction is rapidly extending all over the country. Over 300 of these are in use, and a few of the localities are here specified. Within the last three months it has been put under 27 boilers of the Granite Mill, number 2, Fall River, Mass., and under three one hundred horse-power boilers of the Davoll Mills, at the same place. Also, it is under boilers at Cape Vincent, N. Y.; New Britain, Conn.; Buckland, Conn.; New York city, etc., etc.



MAHONY'S UNIVERSAL PATENT FURNACE.

The inventor claims that this furnace will burn all kinds of waste fuel, and that even inferior coal is rendered more valuable. In principle, it effects its end by a thorough mechanical mixture of the gases, in the first instance, and, secondly, by admitting through the perforated globes, seen on the bridge wall, a continuous current of hot air, and a slight steam jet. The result is, as before stated, a very thorough agitation of the combustible gases which, together with the induced current of air and steam, is very efficient.

As will be seen, this device can be readily applied to any boiler without loss of time, or deranging the brick work, and it is warranted to perform the duty claimed for it.

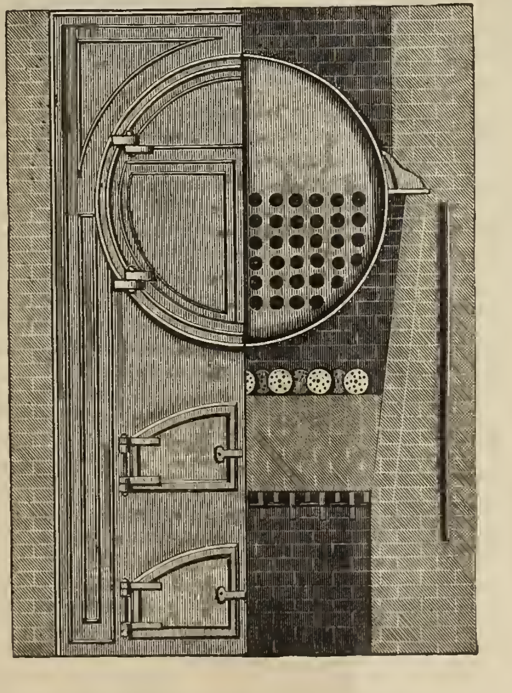
A new descriptive catalogue, containing useful information, can be had upon application to the inventors and proprietors, James Mahony & Son, 73 Astor House, N. Y.

STEEL PLATES FOR THE NEW CRUISERS.

Members of the Naval Advisory Board are elated over the success which has followed the requirements in the contracts for the new cruisers for the manufacture of domestic steel. The tensile strength provided for is not less than sixty thousand pounds to the square inch, and a ductility in eight inches of not less than twenty-five per cent. The present standard in England is 45,000 pounds to the square inch. When the specifications were first printed shipbuilders said the standard fixed in the act of Congress was too high. The manufacturers to whom the circular of the Advisory Board was sent fixing the tests for steel for the cruisers said it could be made, but the cost would be very high. They also decline to say at what price they would be willing to supply it by the thousand tons. It was this uncertainty as to the cost of steel of such high strength that made the estimate of the several shipbuilding firms vary so much. The problem, it appears, was solved by Mr. John Roach, who found that he could produce steel at his own works in Chester that would stand the required test on every plate for five and one-half cents per pound, which was four cents per pound lower than estimated by the Advisory Board in fixing the limit of the cost of the several vessels. This, it is said, is the secret of his low bids and his ability to underbid all the other shipbuilding firms in the United States.—*N. Y. Herald.*

A NOTABLE DISPLAY.

Visitors to the New England Manufacturers' and Mechanics' Fair should not fail to notice the exhibit of drop forgings and machinists' small tools by the Billings & Spencer Company, of Hartford, Conn. The forgings, in particular, give one new ideas of the possibilities of wrought iron and steel and the shapes they can be formed into. To a very great extent, these goods have entirely superseded malleable castings in gun and sewing-machine work; and it is owing to them that American small arms, etc., enjoy such a high reputation for durability. Nothing is too small for the process of drop forging, in the Billings & Spencer Company's hands. Some pieces in this exhibit are not much larger than a steel pen, while others weigh many pounds. Pres. C. E. Billings, of the Company, is the pioneer of commercial drop forgings in this country, and it is owing, in a great degree, to his skill that the art has been brought to such perfection. By all means visit space 1,403, and see what drop forging means.



IN RELATION TO the *Riverdale* disaster the *Trade Review* says:

> "The Inspector General met with diplomatic answers the reporter's direct questions touching the possibility of discovering these evidences of corrosion, had sufficient care been taken in inspection; but it is evident that enough has come out to warrant a searching inquiry."

The reason of the Inspector General's diplomacy is very well known to engineers in this section, and is that he knows nothing about steam boilers himself. He advanced the opinion that the groove along the bottom of the shell was caused by "hoes" or scrapers, used in cleaning the boiler!

A FULL REPORT of the proceedings in council of the National Association of Stationary Engineers will be given in Number 9, the next issue after it meets, on October 2, at Chicago.

PRACTICAL MEN have the greatest respect for theoretical research when they see that some results are achieved thereby, but when the experimenter merely travels in circles, and sets out to prove that a line drawn at equal distances from a common center is a circle, the practical man thinks that the matter is self evident and could be demonstrated without any words to speak of. Theorists ask questions and some times give the wrong answers. Practical men solve the riddles in material form and their solutions are widely different from theorists, but they are correct.

BOOK NOTICES.

A Treatise on Steam Boiler Engineering, being notes on the strength, construction, erection, fitting, and economical management of steam boilers: containing rules and useful information for the safe use of steam, by William Barnet Le Van, Machinist and Boiler Maker, 8,607 Baring Street, Philadelphia.

This is a pocket book for handy reference, and contains as its preface indicates, matters suitable for all engaged in the construction of steam boilers. The thickness of plates required for a given strength, boiler joints, or junction of plates, strength of joints, single and double riveted joints, margins of safety, calking, manholes, steam domes, rates of combustion, heating surface, air supply, calorimeter, transfer of heat, etc., etc., have chapters detailing fully the methods usually adopted in good practice. The price is $1. Sold by the author.

The Eames Vacuum Brake Company, of Watertown, New York, send us a handsome catalogue of their special locomotive brakes. It is beautifully illustrated and clearly written, as to the operation of the devices. It should be in the hands of every locomotive engineer, and we make no doubt, it will be sent to them by addressing the company, although we are not authorized to say so.

A FOREIGN CONTEMPORARY says:

> "The railway accident at Steignitz, near Berlin, *by which about forty people were run over at once,*" etc., etc.

Generally people are run over by instalments. The same paper speaks of a boy falling through the hatchway of an elevator, and says it was caused by the hydraulic lift.

VAN NOSTRAND has just issued a new pocket-book for engineers and machinists; it is advertised in another column, and will be noticed in our next paper.

We acknowledge an invitation to the Chicago Convention of the National Association of Stationary Engineers, to be held October 2d, and also to the Grand Ball, held in honor of delegates, by the Chicago Brotherhood, Nos. 1 and 2.

The order of business for the convention will be as follows:

On Tuesday evening, at 8 P.M., a joint session of both Chicago lodges, Nos. 1 and 2, will be held at Grand Army Hall, when J. G. Beckerleg, engineer, will deliver an address of welcome; Wednesday evening the delegates will visit the Exposition in a body; Thursday evening the grand ball, and on Friday various points of interest will be visited.

* * *

The annual meeting of the American Society of Mechanical Engineers will be held in this city during the week ending Nov. 3. Members who have papers to present at this meeting are requested to send the titles to the Secretary, and to furnish manuscripts as early as possible, that they may be put in type in advance. Drawings for reproduction should be in black and white, and should be forwarded considerably before the date of the meeting. The address of Mr. F. R. Hutton, the Secretary, is No. 15 Cortlandt street, New York.

* * *

Mr. Alexander Thompson, of Glasgow, Scotland, appears to have invented a coupling to protect broken marine engine shafts. It is a very good idea ; we thought so two years and a half ago when we invented it ourselves and illustrated it on page 52, volume I. of The Mechanical Engineer.

THE NEW ENGLISH STANDARD WIRE GAUGE.

The standard (?) wire gauge, and the troubles arising from so many of "it," has been the source of wit in itself, and the cause of wit in others, but in spite of all, the standard continues to have many variations. Now in England they have taken this matter in hand. and, by royal decree, made a new standard, declaring all others null and void after March 1st, in that country and its dependencies.

The *British Trade Journal* says, that on and after March 1st next, no other wire gauge can be used in trade in that country; no contracts or dealings can be legally enforced which are made by any other sizes than those below given. All users of the Birmingham wire gauge would do well, therefore, to provide themselves with gauge plates corresponding to the new sizes.

Denominations of Standards.

Descriptive number.	Equivalents in parts of an inch.	Descriptive number.	Equivalents in parts of an inch.
No.	Inch.	No.	Inch.
7-0	·500	23	·024
6-0	·464	24	·022
5-0	·432	25	·020
4-0	·400	26	·018
3-0	·372	27	·0164
2-0	·348	28	·0148
0	·324	29	·0136
1	·300	30	·0124
2	·276	31	·0116
3	·242	32	·0108
4	·232	33	·0100
5	·212	34	·0092
6	·192	35	·0084
7	·176	36	·0076
8	·160	37	·0068
9	·144	38	·0060
10	·128	39	·0052
11	·116	40	·0048
12	·104	41	·0044
13	·092	42	·0040
14	·080	43	·0036
15	.072	44	·0032
16	·064	45	·0028
17	·056	46	·0024
18	·048	47	·0020
19	·040	48	·0016
20	·036	49	·0012
21	·032	50	·0010
22	·028		

The new standard does not appear to be any better than the old, for it has no fixed progression, but jumps by all sorts of notations from one size to another.

What is to hinder a wire gauge being made in regular progression; ·028 for number 22 wire, and so on upward by regular increments?

YES, SIR.

The verdict of the coroner's jury in the Riverdale explosion case is curious enough. It attributes the disaster to the failure of Engineer Taulman and United States Inspector Caldwell to perform their duties. The jurors were not unanimous in censuring the engineer, but there was no difference of opinion among them as to the negligence and responsibility of the inspector. This seems fair enough at first sight ; but what share has the engineer in the responsibility ? Was it his business to point out to the inspector defects which the inspector should have seen for himself ? He would have lost his position had he done so, and it is doubtful if the inspector would have taken trouble to verify his statements. If the inspectors are supposed to rely on what the engineers tell them, we might as well let the engineers make out the certificates. We are not surprised, however, that the jury find the present system of inspection, as prescribed by the United States law and performed by United States inspectors, "inadequate to the due protection of life." Obviously. Every system which may be tried will be found inadequate until the law is simplified to a single provision, which fixes the responsibility, in the event of an explosion, where it belongs—on the owner or owners who cannot show that they have taken all reasonable and proper precautions of safety.—*Iron Age.*

And we add, until politicians are deprived of any interference with this department, there will always be just as much negligence and inattention. When public safety is made subservient to political dictation, as to who shall have the office of Inspector General, anything may be expected.

INEFFICIENCY OF MARINE BOILERS.

A correspondent of the London *Engineer* sends to that paper the following letter. It omits a very important part and that is, the type of boiler, which is presumably that in general use, namely, the Scotch or cylindrical tubular. The extraordinary temperature, 800° in the funnel between decks, seems to escape comment, but the evaporation was by no means bad :

"In order to show more fully the defects of the modern marine boiler, I inclose the indications I have lately taken on a three hours full speed trial at sea, in one of the first class war ships, in which the coal consumption was from five to six tons per hour. As everything was new and clean, the coals of the best description, and the furnaces worked by skilled stokers, the results, as will be seen, are far from being satisfactory.

Description of coal	Nixon's navigation.
Area of fire grate	20·31 sup. feet.
Coal consumed per hour per furnace	401 lb.
Coal consumed per sup. feet of grate bar	19·74 lb.
Mean velocity of air passing into ashpit per minute	584·33.
Area of ashpit mouth	302 ft.
Supply of air per furnace per minute	1,764·67 cubic feet.
Supply of air per furnace per lb. of coal	264.
Supply of air per furnace per sup. feet of grate bar	86·88
Water evaporated per lb. of coal.	8·333 per tem. of feed.
Mean force of furnace draught indicated in front of fire with door open	651·3 ft. per minute.
Average temperature of boiler room forward	105 deg.
Average temperature in boiler room aft	124 deg.
Average temperature in furnace.	1,900 deg.
Average temperature in middle row of tubes 18 in. down at smoke-box end	700 deg.
Average temperature at bottom row in the middle of smoke-box end	442 deg.
Average temperature in the funnel between decks	800 deg.
Number of furnaces	30.
Description of doors and fire-bars	Ordinary bars in three lengths.
Duration of trial	3 hours.

The temperature in the tubes varies to a very great extent, the highest rows, having the best positions and draught, carry the highest temperature. The bottom rows suffer the most from interruption, and are the first to get stopped up with soot and dust. The same regularity of temperature does not exist in the tubes of marine boilers as in locomotives, which have a command of draught and use thicker fires. One of the faults of marine boilers is that the highest temperature is toward the surface of the water ; all below the line of fire-bars is out of the influence of heat. If steam be raised from all cold water, the bottom water will remain lukewarm for many hours after and never reach the boiling-point."

HOW TO MAKE A CHEAP AND EFFECTIVE FILTER.

John Michels thus describes, in the New York *Sun*, how to make a very much needed article in many parts of the country. Where animal charcoal (bone black) cannot be had on the spot, coke crushed fine will answer the same purpose.

"To make a perfect filter which shall have the double action of arresting the finest suspended matter and removing matters held in solution, and capable of being made by any housewife, has been the object of my study for many months, and, after many experiments and testing various substances in many combinations, I suggest the following plan, which gives very perfect results, and will cost a couple of dollars.

Purchase a common galvanized iron pail, which costs fifty cents. Have a hole cut in the center of the bottom about the size of a five cent piece, and solder around it a piece of tin about three-fourths of an inch deep, to direct the flow of water downward in a uniform direction. Obtain about two quarts of small stones; after a good washing place about two inches of these at bottom of pail to form a drain.

On this place a partition of horse-hair cloth or Canton flannel cut to size of pail. On this place a layer of animal charcoal, sold at chemists' as bone-black at about 10 cents a pound. Select this about the size of gunpowder grains and not in powder. This layer should be three or four inches. A second partition having been placed, add three inches of sand, as clean and as fine as possible. Those within reach of glass makers should purchase the sand there, as it is only with that quality of sand the best results can be obtained. On this place another partition and add more fine stones, say for two or three inches. This serves as a weight to keep the upper partition in place.

Your filter is now complete, but not ready for use. However careful you may have been in washing the material, a residue of dust will remain, and this has to be gradually washed through. For this purpose pass as much water as possible through the filter during the first day without using it. The next day it will be ready for use. Filtered water will be always at command, not only freed from all suspended substances, but from color due to matter held in solution having been removed.

The filtering material, which is cheap enough, and particularly the partitions, should also be renewed at intervals, the time depending on the period of year and the nature and amount of the impurities.

For the benefit of those desirous of filtering water on a large scale with sand filtering beds, I would state that there should be one and a half yards of filtering area for each 1,000 gallons per day. For effective work the descent of the water should not exceed six inches per hour. The term "self-cleansing," applied to some filters on the market, may be correct in a limited sense, but no reliance should be placed on such filters, and none used which cannot be readily taken apart and thoroughly cleansed.

I have often noticed wood charcoal used in filters. The best authorities, however, claim that this material when powdered, acts merely in a mechanical manner as a strainer, and that charcoal obtained from animal matter alone appears to possess the power of removing matters held in solution in water.

There is one filtering material which is little known in this country which has all the properties of animal charcoal, and is said to give higher results. This is magnetic carbide, discovered many years ago, and consists of protoxide of iron in chemical combination with carbon. It is considered that the purifying effect is produced by its power of attracting oxygen to its surface without the latter being acted on, the oxygen thus attracted being changed to ozone, by which the organic matter in the water is consumed.

It is obtained by roasting hematite iron ore with granulated charcoal for twelve to sixteen hours at a dull red heat.

The Water Company of Southport, England, formed their filtering beds of this material, and I understand that after years of use it is still giving satisfaction."

"ANYTHING TO BEAT GRANT."

Rumor asserts that two trade papers have united their forces, and are endeavoring to organize another Stationary Engineers Association, presumably managed under their own auspices. This is as it should be. If any trade paper wishes to run an engineers' association for the purpose of adding subscribers, it is at liberty to do so, but the benefits the members will derive are not apparent.

Foiled in their attempts to manipulate the National Association of Stationary Engineers for their own objects, these disgruntled trade papers intend to have one of their own, which, as we have before stated, is decidedly a wise course, for by this all the lame, halt and blind, and other objectionable parties, can fall into line with the "Tradepaper Engineers' Association," and the legitimate National Association will be strengthened by their absence.

MISCHIEVOUS ADVICE.

When a steam user writes to the *Scientific American* for information, this is what he gets:

> "I have a forty-five horse power tubular boiler, new; my engineer almost every morning, after raising from twenty to forty pounds steam, opens the blow-off-cock and blows out about a barrel of water. He claims that the boiler will make steam faster and it helps to keep the boiler clean. By doing this is steam generated faster? I claim it is injurious to the boiler, as the pumps are worked as soon as the engineer has blown off. *Answer.*—The best time to blow off a boiler is at night or at the time of stopping work for the day. Then the dirt is thoroughly stirred up from the day's steaming, whereas in the morning it is settled upon the tubes and bottom of the boiler. At night when the engine stops the water can be blown down nearly to the tubes with safety, as that is the time for banking or drawing the fires. The pumping up can be done slowly without straining the boilers by suddenly cooling the bottom. Blowing off each day is too often unless the water is very foul with mud, clay, or lime. Twice a week with good water is sufficient. The boiler should be opened and cleaned out once in one or two months, according to the quality of the water."

As a correspondent in another part of this issue remarks, it would be better to say nothing than to give such advice as this. The blow-cock, if it is in the proper place, is in the coolest part of the boiler, and the time to blow-off is in the morning before starting up; not at night as the *Scientific American* states. In the morning the sediment has worked over from the hottest parts, and is readily removed by the blow-cock. Cleaning a boiler once in one or two months may suit the *Scientific American's* ideas of engineering, but it would not find much favor with careful men. The mischief is, with such advice as this, that the engineer, who seems to know his business, so far as blowing out a boiler is concerned, is to be instructed as to his duties by his employer, who know so little that he has to inquire of a paper which, apparently, knows still less. The advice given to this employer will result in increasing his fuel bills in a marked degree.

A BOILER EXPLODED in an iron mill in Pittsburgh and several persons lost their lives. The boiler inspector's clerk, stated that they had no record of the boiler, and that it had not been inspected. Said he: "The law requires all persons operating steam boilers to notify the inspector, but this was not done. The penalty for neglecting to do this is a fine of $5,000 and two years imprisonment, besides being responsible for all injuries and damages sustained by others in case of an explosion."

The penalty may be on the statute book, but the proprietors of the exploded boiler need not be alarmed; they will never be held accountable.

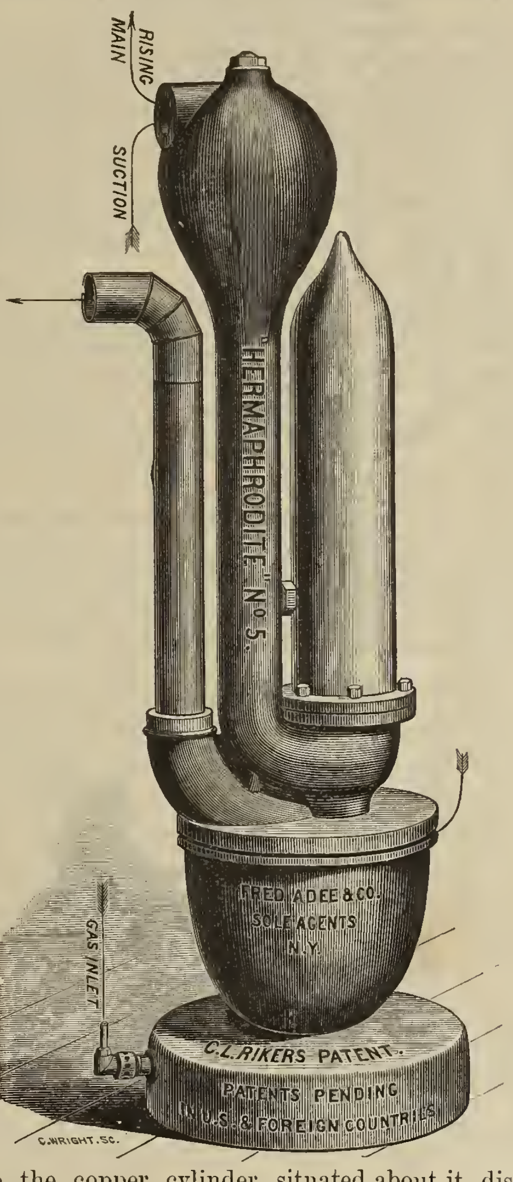
COMMON SENSE would seem to dictate, that of all written words, a man's name should be the clearest, but very often we find the body of a letter well written, while the signature looks like a stroke of lightning. We can guess at words that are illegible from the context, but a scrawly signature may be anything. Write your name clearly.

INSTEAD OF MAKING square joints in belts where laps occur, why not run them diagonally. There would be more holding surface in the lap and a gradual strain on it instead of a double one, where it passed over the pulley.

RIKER'S CALORIFIC POSITIVE PUMP.

The illustration herewith represents a device for raising water automatically, or without the usual mechanism for the purpose. For railway tanks, or similar duty, it will be found very useful; it requires no boiler, being self-contained as regards steam. The details are as follows:

A steam generator contained within the cylindrical base, using gas as a fuel, supplies steam to the copper cylinder situated about it, displacing the water contained therein until about three-quarters of contents have been driven out, when the steam is suddenly condensed forming a vacuum, the result of which is that the cylinder becomes again filled with water from the well, cistern or other source. The above operation is then repeated.



It should be stated that the pump is filled with water before it is started, after which it will always keep itself supplied and, if necessary, will work continually until either the water or gas fails. There are no working parts except the check valves in the suction and discharge pipes, and consequently no friction or wear. It is an alternating vacuum and steam pressure pump, perfectly automatic after igniting the gas. It vaporizes at each discharge about one tablespoonful of water (for No. 5 size), and the construction is such that it is impossible to generate a greater amount of steam than is just sufficient to effect each intermittent discharge.

The consumption of gas is 20 cubic ft. per hour for 200 gallons of water raised 50 ft. high. It can be seen at Fred. Adee & Co., 52 Cliff street, N. Y., where it has been working for several months.

Address the parties above for further information.

RECENTLY, IN THE opening night of an exhibition of electric lights, in Germany, a joint blew out of a steam pipe which served three engines, of course shutting off the light, which, with the noise of escaping steam, created a panic only allayed by the director assuring people that the incident was due to throwing the dynamos out of gear.

THE CONDITION OF GENERAL MANUFACTURES.

The manufacturing industries of the United States are enjoying a better business than might have been supposed. This is shown by reports from about all important industrial centers. The exhibit is the most complete which has been attempted, and made, as it is, simultaneous with the improved movement in wholesale and jobbing commercial lines, comes with added significance. It appears that, with the exception of a few lines of industry, orders are being received by manufacturers quite up to the standard of former years, and in many branches in excess thereof. There is even more uniformity in the reports of a good outlook for a full average demand later in the season. The so-called small manufactures throughout the length and breath of the land, as indicated by the appended reports, are receiving, with some exceptions, a good line of orders, and it is worthy of note that more capital is being invested, new mills and factories and foundries are building, and old ones are enlarging facilities. This is especially true in the Southern and in the Northwestern States, where the rapid progress of the agricultural industries and the attendant prosperity have created an imperative demand for a home supply of small machinery, repairs, and appliances.

In the Northwest and West—particularly west of the Mississippi—industrial communities are springing up on every hand, and, on the whole, are attended with a fair degree of success. In Wisconsin and Minnesota the manufacturing industries are enjoying a full tide of prosperity—notably the agricultural implement works, foundries, machine-shops and establishments for the production of hardware specialties finding ready sale in that region. Chicago industries, under the influence of the demand from the Northwest and the West are, in the main, in receipt of a fair amount of orders and are running on full time.—*Bradstreets.*

HOW MUCH PRESSURE will an egg withstand externally? A writer in a foreign journal makes it stand a good deal, as witness the following:

> "I took three new-laid eggs and placed them separately in an hydraulic cylinder to be tested. Two of these eggs had a diameter of $1\frac{5}{8}$ in. and a length of 2 5-16th in. On the pressure being applied by a force pump, they both broke at 750 lb. per square inch, giving a total pressure on their surface of about 7,500 lb. to each egg. The third egg was $2\frac{1}{2}$ in. long by $1\frac{5}{8}$ in. diameter, and only stood a pressure of 600 lb., giving about 6,300 lb. pressure over the total area. The breakage occurred circumferentially, that is about the smallest diameter. These eggs could, therefore, be lowered to a depth of over 1,500 ft. below the surface of the sea without fracture. These results would, of course, be influenced by the shells being more or less well filled by the contents, but in any case it is curious that an article so proverbially fragile as an egg should withstand such a great pressure."

THE FOSSIL MEAL COMPANY, of 48 Cedar street, are shipping large lots of their material to various parts of the country, and report an earlier commencement of the fall trade than they had anticipated. Perhaps one reason for the popularity of their boiler covering is found in the fact that it can be applied to any surface anywhere by any person, and used over and over again.

JAS. F. HOTCHKISS, 86 John street, N. Y., reports business good. He has just shipped, among other orders, five more of his boiler cleaners to Peru, three to San Francisco, and three to F. Brotherhood & Co. of Charleston. Over fifty have been attached in Peru.

SINCE WE FIRST DREW ATTENTION to the fallacy of putting boiler-feed through the mud-drum, a great many of our exchanges have taken up the matter and are discussing it. We are glad to see it, and hope that the practice of so entering feed-pipes will be discontinued; a little reflection will show its absurdity.

A NEW CLAIM is made for the "hydrogen gas" locomotive, which is, that it will save $600 a year *in repairs!*

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

FROM PRESIDENT JAMES H. REID, MARINE ENGINEERS' ASSOCIATION.

Editors MECHANICAL ENGINEER :

In a letter which you published in THE MECHANICAL ENGINEER, I said that I was in receipt of letters from several engineers speaking of the loose way of granting licenses, and I also said that when some boat's boiler blew up and several lives were lost, that the inspectors would say that it was a mystery and no one to blame. You have that prediction fulfilled in the *Riverdale* explosion in your city. Is it not a well-known fact that the best boiler can be ruined, when in charge of an incompetent engineer? In a very short time no boiler making firm will warrant a boiler unless they have the appointment of the engineer who takes charge of it. I don't wish to say that the engineer in charge of this boiler was incompetent, but I will say that there is no mystery about an explosion of any boiler, in my opinion, and should be none. It is the duty of an engineer to know the condition of the boiler, as well as the engine, that he is in charge of. If this was done there would be fewer explosions, for the reason that the engineer would know how much steam the boiler was capable of standing without reference to the inspector's test. The traveling public should be as safe on the water as they would be on land, as far as the danger from explosion is concerned, and it is for the interest of steamboat owners to have them feel so. They should demand that the law be amended so that they will be assured that when they employ an engineer, or pilot that they are competent men. The public safety ought to be the first consideration.

General Dumont, Supervising Inspector General, gives it as his opinion that a radical change in the law prescribing the method of investigating explosions is needed. Under the present system, the local inspector investigates his own official conduct, for when an inquiry is instituted it is made by the inspector who examined the boiler last. So, also, if there is a collision caused by the inefficieny of the master or pilot, the inspector who granted such master or pilot his license is called upon to investigate the circumstances attending the collision! General Dumont recommends to the Secretary of the Treasury that the law governing investigations be changed so as to provide for a court of inquiry consisting of three supervising inspectors of districts to inquire into the acts of local inspectors in granting licenses to officers causing collisions, etc. I, for one, cannot see that such supervising inspectors are likely to reach the truth better than the local inspector. For this reason: the local is appointed by their recommendation to the Secretary of the Treasury, and it is but fair to suppose that they will cover up any neglect of duty of their appointee. The public would have reason to suspect that it was done.

If General Dumont will recommend the appointment of a committee composed of three pilots and three engineers in each inspection district, for the purpose of granting licenses, the pilots to meet with the Inspector of Hulls to examine and grant licenses to pilots, and the engineers to meet with the Inspector of Boilers to examine and grant licenses to engineers, and all six to meet with the two inspectors for the purpose of hearing all complaints against a licensed officer (who should be served with a copy of the complaint together with the name of the party making it), there would be some chance of a true verdict being reached.

As the law now stands the party making the complaint is both judge and jury. Let this committee also be empowered to make a thorough search into the cause of all accidents to steamers, of whatever kind, and report the same, making their report direct to the Inspector General, and he, as now, to the Secretary of the Treasury. In an accident to a steamer's boiler or machinery, no one can be made a scape goat to cover up the guilty party.

Let Secretary Folger and General Dumont ask the opinions of the licensed officers as to the changes necessary in the law. Who is better able to point out its defects than the men working under it, and who are in no way interested, as owners, in steamers? A licensed officer is afraid now to tell the inspectors of defects he is aware of, in the boiler or equipments of the boat, for if he does so the inspector would then tell the owner that the engineer or pilot told him so or so was defective, and the owner would immediately discharge the engineer or pilot and censure him for giving the information to the inspector.

Some owners are opposed to making repairs until forced to. Also some engineers are willing to take the risk of an explosion of the boiler or break down of the engine to retain their positions. A capable licensed officer should be protected when he does his duty, for the law requires him to report the defects in the equipments of the boat that he is aware of. If the engineer of the *Riverdale* had done this, and the inspectors had done their duty, the owners of the boat would not have lost it, and no lives would have been sacrificed by negligence.

Mr. Editor, the motive which prompts me to write this is not malice or ill will. The present inspectors should not be removed where they are found qualified or are doing their duty. As far as I have had dealings with them in this district they have treated me with due courtesy, and are, I believe, trying to do their duty. I have had no trouble with them, but friendly relations should not prevent any licensed officers from pointing out where the law should be changed to make it more effective. No good inspector will take offence at his so doing.

DETROIT, MICH. J. H. REID.

INTERESTING DETAILS CONCERNING LOCOMOTIVES AND ENGINEERS.

Editors MECHANICAL ENGINEER:

I read you paper with a great deal of interest, especially the Round House series, by L. O. Danse, as I am somewhat interested in that line. However, I do not fully agree with some statements appearing in a late number of the series—No. 10—on "Running," as I have had some experience in the latter line. For instance: "Should the water be found down to the second gauge, the lazy cock must be immediately opened wide, and, after a few minutes, the gauge cocks tried again. If the water has not risen put on the other pumps, etc."

This does not agree with my experience. With many engines, the middle gauge cock is from six to eight inches above the crown-sheet; in others four, etc. Even if it were but two, the crown-sheet is as safe with that amount of water on it, as with twice the quantity. Where, then, is the necessity of putting on the pump wide open, when so few engines will stand it? The result would be that the steam pressure would drop rapidly. As no danger is imminent, it would be much more sensible to pull the lazy cock about half open or a little less, and gain gradually on the water, thus saving the steam pressure and heavy firing necessary when the pumps are wide open. On this one little point many engineers gain a reputation for economy, and our friend Danse's advice, if followed, would knock a big hole in the coal bill against the engine at the end of the month. Such violent haste to fill the boiler would indicate that the runner was easily "rattled."

Again, the first and immediate effect of putting a pump on "wide open" is to cool the engine down, and all runners know that the water falls as the pressure is reduced, and it always follows that in a few minutes after the pump has been at work the water is *lower*, although a great quantity is in the boiler. This may appear paradoxical, but it is nevertheless true, as the dropping of the water, or rather shrinkage from loss of heat, is in greater proportion than the gain from the extra bulk forced in by the pump, so that, under the circumstances, the first thing noticed would be a lower water line, which would remain so for some little time, until by the combined results of heavier firing and the extra water forced in by the pump, the water line would gradually rise again.

If after putting on one pump, as Mr. Danse advises, wide open, and in a few minutes trying the water again, and if this failed to show water (as it certainly would), then put on the other pump, the result would be a dead engine in a short time.

Neither do I agree with the idea so prevalent that the pet-cock is much of an indication as to the working of the pump. "If the boiler check is stuck, the steam issuing from the pet cock will be strong, etc."

If the check valve is stuck or cocked, nothing but hot water will issue from the pet-cock, for there is an open communication from the boiler to the pet-cock, and the "strong steam on the inward stroke" may be due to many causes.

On some engines, where a small air chamber is used, the steam follows the motion of the plunger, strong on the inward stroke, and dying off on the outward, although the pump is working splendidly. On some engines, after long use, the opening from the check to the boiler limes up, and the hole is reduced to ½ inch or less. In this case the pet-cock will show a strong, steady, and continuous stream when the pump is throwing a bare thimble full, so to speak, into the boiler. The many little theories pertaining to pet-cock action, are very entertaining, although hardly instructive to engineers, who, if they have run any length of time, know intuitively when a pump is working.

The writer, several years ago, fired for an old engineer, who would not open a gauge-cock, (there was no glass gauge on the engine,) from one end of the road to the other. Partially by instinct, watching the steam gauge, the color of the exhaust, the working of the engine, etc., he knew as well when to jog the lazy-cock handle, either way, as he did to shut off at a station. After a man has run an engine for a series of years, if he has the qualifications necessary to make a good engineer, the trying of the gauge cocks is instinctive, and is frequently done when the engineer is pre-occupied with other matters. I have often asked engineers after seeing them open a gauge-cock, how much water they had, and found they had not been conscious of the action, and when told they had tried the water they would deny it. They knew they had water enough by instinct.

It is impossible to trust to a pet-cock, and few engineers use it unless to start the pump when filled with hot water from a leaky check. Engineers frequently become so much a part of their engines, as to be amusing to a person watching them. Frequently when pulling a heavy load, with fair chances of stalling, an engineer will brace his feet against the reverse lever, and in proportion as the engine labors harder, push on the lever, as if, by such action, he assisted his engine; also when making a sudden stop, and it is necessary to reverse the engine, he throws his whole weight on the lever when in the back notch, as he is so much a part of the engine that he fancies he adds his own avoirdupois to the efforts of the engine.

REVERSE LEVER.

INDIANA.

CONCRETE IGNORANCE.

EDITORS MECHANICAL ENGINEER:

Years ago I used to read the ——— ——— when, I believe, you were connected with its editorship. It was a good paper then, but of late years it has gone into the different "*ologies*" to such an extent that I have not looked at a copy of it for several years, until to day I saw one dated July 28th, 1883. Turning to the *Notes and Queries* column, which used to be a great favorite with me, I happened to read in No. 6, "J. D. G,." who asks how much coal a good boiler requires per hour, per horse power; how much water ought one pound of coal evaporate, etc.; how many pounds of water required for each horse power, etc., all of them very sensible questions; but the answers to these questions are so far from ordinary practice that one feels ready to believe that the editor consulted a last year's almanac as authority. For instance: "A first class boiler should produce one horse power per hour with the consumption of 6 pounds of anthracite coal; 1 pound of coal should evaporate from 9 to 10½ pounds of water, etc. It requires about 62 pounds of water to the horse power per hour." J. D. G. does not specify the kind of engine he is using, or rather does not give the pounds of water per horse power per hour the engine is using. Probably he cannot do this. A well designed boiler if well set will, day in and day out, furnish steam for a non condensing automatic engine on from 3 to 4 pounds of bituminous coal per horse power per hour. I never had any experience with hard coal, but should expect a much smaller consumption with it. If the engine were a throttling engine and of the right size for the work, it would require from 6 to 8 pounds of bituminous coal per horse power per hour. In ordinary practice one pound of soft coal will evaporate from 6 to 8 pounds of water. A throttling engine would certainly be in horrible condition to use 62 pounds of water per horse power per hour. It might, of course, be too large, or too small, or in bad order, but a throttling engine in good condition can be counted on at from 40 to 45 pounds of water per hour. If the engine is an automatic, 25 pounds of water per horse power per hour would be *good* work.

From this the absurdity of the ——— ——— answers can be seen. How can it rate a boiler at *any* number of horse power, when one just capable of supplying steam for a throttling engine in bad condition, developing, say 50 horse power, at once becomes a 100 horse power boiler when coupled to a good automatic? Unless the ——— ——— can give its readers correct information, it should not attempt to give any on subjects it is evidently unacquainted with. Probably many young men and others will take the reply to "J. D. G." to be correct, and in experimenting will be led to believe their engines are doing better, or worse, as the case may be, than ordinary practice, and thus be led to condemn, through misinformation, good engineering practice.

OHIO. BEN ABOU.

HOW TO FLANGE STEEL BOILER PLATE.

Editors MECHANICAL ENGINEER:

In your last issue is an inquiry from J. M. Roberts, in regard to flanging steel plates. I never used anything but common coal, or slack coke, for this purpose, and don't use any green coal. Take a bright red heat and work it the same as iron. It will make a better flange than iron. He can make the flange as sharp as he wants to, but it is not good to make either iron or steel very sharp, as the stock will not take up in the heel of the flange, and is likely to crack. In regard to annealing, if the sheet dishes too much, let him build a wood fire over and under it, and have the sheet hot all over; then straighten and let it cool, and it will be all right.

I have turned flue sheets with five and six holes, and never done any annealing but that, and they are all right yet. The steel they make now-a-days is better to work than it used to be some years ago. That is, it will take a higher heat.

I think Mr. McCaulley made a sensible hit in your last issue. I saw an account of an inquest where the examiners asked the engineer if he understood the nature of steam. The engineer said he guessed so. When asked to explain it, he said it was "cooked water!" That inquest was held in Buffalo some two or three years ago. In another case a witness swore at an inquest that there must have been 140 lbs. of steam on at the time of explosion, for the gauge indicated 140 when picked up in the street, about 100 yards away from where the boiler was.

I don't take much stock in inquests. If they would put capable engineers in charge of boilers and engines, there would be no need for inquests.

NEW YORK. BOILER MAKER.

A LETTER NOT TO BE READ BY BRO. SMITH!

Editors MECHANICAL ENGINEER:

Allow me to congratulate you on having a very valuable paper for engineers and machinists. In the issue of September 1st, my notice to engineers appears; how you got it is strange to me, unless Bro. Smith smuggled it to you. Now he has always borne the reputation of being very truthful and upright, but seemingly he has gone far from home to expose himself and me also. Mr. Smith is Vice-President of our Engineers' Association here and was one of the organizers, and perhaps I must not use any unbrotherly language towards him. I'll say no more about him, hoping you will not mention to him what has already been said.

I have been a constant reader of the ——— for several years, and was getting pretty well wedded to it. I don't think there will be any rejection, but must say that The Mechanical Engineer has got its grip on me now, and it is good to take. The two papers make a feast for any engineer who is striving to get higher.

Mr. Editor, don't let Bro Smith get his eyes on any part of this letter, or you will get me into trouble.

Owasso, Mich. C. A. Byerly.

BOILER INSPECTION.

Editors Mechanical Engineer:

In answer to your remark in number 6, page 63, current volume, "We wish our friends would send us information of their own knowledge, as to plans pursued by government inspectors of steam boilers," I will say that I was engineer of a boat which was "inspected" by the local inspectors in just forty five minutes from the time we commenced to raise the pressure on the boiler. Their plan was to raise the pressure (cold water test) to a certain number of pounds; the steam gauge was then tested, then the lock-up safety valve. This ended the inspection; no going into the boiler; no sounding with the hammer, nor anything else. The main object seemed to be to see that she stood the test all right. Last summer I saw two boats inspected (?) the same way, with the difference of taking more time.

The Mechanical Engineer comes to me quite as welcome as dinner to a very hungry man, and its contents are as eagerly devoured. I take pleasure, in and learn a great deal from the correspondents' department. I believe there are many good old engineers, who would be a great help to others, by simply relating some of their experiences in the way of breakdowns or accidents which are unavoidable.

I once had charge of double engines on a side-wheeler, on the lakes. The main steam-pipe ran fore and aft, close to the carlins of the promenade deck, to a T, from which two smaller pipes ran athwart ship to two uprights; thence to the engines. There was a union on one upright between the engine and elbow. We happened to have a very heavy tow, and in consequence were running with high steam—five pounds inside the blowing-off point—when the union let go! The noise that this made is easier imagined than described. I always try to be prepared for emergencies, and in this case I was. Handy by was a piece of inch board, 6"×12", which I placed on top of the steam-pipe, and by driving two shingles between the carlin and board, I found I had a good enough joint to make port with. The engines did not stand still two minutes. But all the passengers came down, in all manner of dress, (it being one o'clock at night), asking all sorts of questions.

I know an engineer in this neighborhood, who is competent and understands his business, and here is the work he does: He gets steam to start at 7 o'clock; does his own firing, files saws, lugs his fuel from different parts of the mill, chops slabs, and pumps water to supply the boiler—18 horse power. I don't believe this is right; a man is a human being, not a mule! I don't believe a good engineer is a roustabout. It matters not whether he is running an 18-horse engine or a 1,000 horse engine, he has a knowledge of the business in which he is engaged, which demands respect, if nothing more; his brains and faculties are being exercised, sometimes taxed, when his employer thinks he is having a pretty soft snap. A good engineer hears a clicking sound in the cylinder, and knows in an instant that there one or more springs are loose. He watches to see if it gets worse, and at six o'clock has his tools ready to adjust the rings. And so with everything else connected with the engine and boiler. There is a great deal of work done by an engineer for his employer which he (the employer) knows nothing of.

Michigan. Reason.

[We are always glad to hear from engineers as to accidents, breakdowns and repairs; by narrating them, a great service may be done others. We have made some remarks on boiler inspection in the usual place. —Eds.]

THE EXPERIENCE OF A CALIFORNIA ENGINEER.

Editors Mechanical Engineer:

Perhaps an experience I had as engineer of a large woolen mill, may not be without its value to other engineers. It contains its own moral and it needs no very close scrutiny to find it. The engines were—one 24"×48", and one 30"×60", and to run these there were ten large boilers. Two firemen and two coal passers had all they wanted to do to keep steam up.

The amount of coal consumed was twenty-three tons daily. I should have said, previously, that the small engine was a plain slide valve.

When I came on for the first time, the engineer in charge said to me: "I have been here two years, and when you have been here the same length of time, you will be as glad to leave as I am." On asking him why he was so glad to leave he said, that he did not think he was appreciated, and that the proprietors talked of cutting his pay down.

I answered that if such was the case there was probably a reason for it, and the reply he gave was that the proprietors wanted ten boilers to do the work of twelve, but that after they had spent a few thousand dollars, they would be wiser.

To this I answered that it seemed the proprietors had found out already that something was wrong, and that closed the conversation.

I went into the boiler room, but did not get out of it for some time. Climbing on top of the battery I found on one of the safety valves a lot of bricks in a tin kettle. On another, a broken pulley; on another, a lot of two inch shafting. Every word of this is fact. The safety valves were loaded to 210 pounds for a working pressure of 75 pounds, and the boilers were 20 years old; the valves leaked steam enough to run a twenty horse engine. All the surface blows were leaking steam, and the bottom blows, water.

On examining the engines I found the same state of things, only worse. I took off the cylinder head and steam chest bonnet and it hurt my eyes to see the state the valves and piston were in. The cylinder was badly cut on the bottom and I could stick a piece of pasteboard in between the top of the piston and the cylinder. The rings were of so little use, that the piston might as well have had no packing in it. As to the valves, steam followed the whole stroke on one end, and cut off at one quarter on the other, while the exhaust was so badly cramped that the back pressure was about 700 pounds, which did not help the engine along much. After I had made the necessary alterations, a few days after, I went into the engine room and there were the firemen sitting down, smoking. One of them said that it was the first time in his experience, in that place, he had had such an opportunity. To shorten this story, the consumption of coal was reduced five tons daily, amounting to $17.50. After two or three months I asked for an indicator and got it. I also asked for more pay, and that I got also.

From this I conclude that things in this world are just about as a man makes them himself.

California. A Subscriber.

A GENERAL LICENSE LAW DEMANDED.

Editors Mechanical Engineer.

I see by a letter from a California engineer, that he wanted help to keep the ball rolling in regard to the use and abuse of steam boilers in this part of the world. If all practical engineers would do the same there would be a stop to so many disasters involving loss of life and property. I will state a case under my own knowledge. A new mill has been built in this vicinity this year; the boiler is a cylinder tubular, 16 feet long, 48 inches diameter, 54 2-inch tubes. It is set 24 inches from the grate-bars to boiler, and commences back of the grate bars to slope upward till the bed reaches the back end of the boiler, where it is 10 inches from the same; there they built a good smoke-arch which comes up to the water line. The top of the boiler is covered with stiff potters' clay 4 inches thick, and they exhaust into the smoke stack. Now the engine this boiler has to generate steam for, is 18"x36" cylinder, and runs 100 revolutions per minute. Now they try to make this boiler furnish steam for that engine to cut 40,000 feet of lumber daily! I ask: is it not out of reason to expect that boiler to do the work and last long?

We should not kick, till we have a law to protect us from employers' abuse. If they can't get a good man at their price, they will get a poor one at any price. What we need is a License Law throughout the state, for all classes of engineers.

I read The Mechanical Engineer once every two weeks, and regret I don't get it once a week. I have been a licensed engineer for 10 years and have had some experience.

Chico, Cal. W. B. L.

CLATTERING OF VALVES IN A LOCOMOTIVE.

Editors Mechanical Engineer:

I am a constant reader of your valuable paper, and desire to ask you for some information. I have been firing a locomotive, built by H. K. Porter & Co., and have noticed that after shutting off the valves clatter much more when she is "hooked up" than when in the "corner." The clatter is scarcely audible with the lever in the corner; also, when "hooked up" with the cylinder cocks open. Any information through your paper would be thankfully received by

W. H. Howard.

Winthrop, Mass.

We believe Mr. L. O. Danse knows all about the locomotive in question, as he was for some time draughtsman in the works mentioned.—Eds.

* * *

A full report of the proceedings in council of the National Association of Stationary Engineers will be given in Number 9, the next issue after it meets, on October 2, at Chicago.

JOHN CULLUM TELLS THE TRUTH.

We take pleasure in publishing the press dispatch below. One man tells the truth, and it is to be hoped that something more than spasmodic action will occur from it:

"John Cullum, a boiler-maker of Kingston, who testified on Wednesday in the Riverdale investigation, has had many years' practical experience, and is still working at his trade. He served his apprenticeship in New York city in various well-known iron works. He was afterward in California and other places, and in 1879 returned to New York and worked in the Delamater Iron Works. He was frequently called off to make repairs on the boilers of steamers coming into port. In this way he became acquainted with the condition of many boilers, and he learned of the condition of others from his fellow workmen. He remained in New York until August, 1882, and then removed to Kingston; so that his knowledge of New York boilers comes up only to a year ago.

Mr. Cullum says: The owners of boilers strive to make them last as long as possible, and to make all repairs as cheaply as possible. Engineers run their engines as cheaply as they can, and often risk their lives and those of the passengers in an effort to reduce expenses. Needed repairs are neglected, or are so badly done as to be entirely insufficient. When a boiler begins to corrode nothing is done until a leak or a crack appears. The boiler-maker is then called in and directed to put on a soft patch. Although he may see that a hard patch is really needed, it is none of his business to say so. He must obey orders and put on the soft patch in some fashion. The man who is the cleverest in fixing up these makeshift patches gets the most praise. Often the shell of the boiler is so soft that it will not hold the bolts or the patch cannot be pulled up to it. An iron plate is then put on the inside as well as the outside, and the two are bolted up together.

"A hard patch is a thorough way of repairing a boiler. The corroded iron is cut away until firm iron is reached. A piece of boiler iron is then set in and fastened securely. This insures a complete removal of the weak points. The trouble with this patch is that it takes time to make it, and that it costs three times as much as a soft patch. A soft patch is covered with putty, and is then laid on and bolted to the corroded boiler shell. The putty fills in the holes, but it does not stop the corrosion, which continues until the patch has to be renewed and extended.

"The shell of a new boiler is from five-sixteenths to three-eights of an inch in thickness, and it can corrode down to three-sixteenths and be patched safely with a soft patch. Boilers are kept running as long as possible, until the shell is corroded to the thinness of a wafer. He has patched up boilers that were in worse shape than the boiler of the Riverdale, which exploded. These old patched-up boilers were liable to give way at any moment, and were always in danger of blowing out. Sometimes they blow out into the fire, and scatter the coals all over the engine room. Other boilers which he had been sent to repair were so thin that he could knock holes in them with a hammer.

"Boilers were generally inspected once a year, Mr. Cullum added, and were fixed up for the inspection. A dozen leaks might occur in the boiler during the year of which the Inspector would know nothing, and of which the engineer was not likely to tell him. Mr. Cullum said he had no confidence in hydraulic tests. They failed to pick out all the weak points and were apt to strain a boiler. The best test was the hammer, which was sure to find all weak points. An experienced man could tell the condition of the bottom of a boiler by throwing the light of a lamp upon it. Soft patch after patch is put on until the engineer sees that it is possible to put on no more, and then he puts on a hard patch, if the boiler does not blow up in the meantime.

"Mr. Cullum said that during the last year he had much to do with repairing boilers in Kingston. He knew that many were now in a very unsafe condition. Many had their heads cracked and side sheets corroded. Some were run by boys, and there was no telling when they would explode. It was surprising that there were not more explosions."

These statements are all true; but what will be done about it? Nothing at all.

BACKBONE.

Of timorous, nerveless men it is sometimes said that, "they let I dare not wait upon I would," and nearly every person can give among the list of his acquaintances individuals who are constantly down on their luck, so to speak—and fancy the whole world is against them, when the only fault is a want of backbone.

The history of every commercial undertaking of any magnitude is full of hair-breadth escapes and perilous adventures—financial misadventures more properly—wherein the best calculation and foresight have failed to prevent disaster. Many of these are well known to the world, but by far the greater part are unknown, and will remain so, simply because it is impolitic to make them public. Concerns hopelessly bankrupt, apparently, have retrieved disaster by keeping right on, presenting a bold front, and finally carrying all before them by the sheer force of energy and determination. There are countless instances of this kind, and so long as human nature is what it is, there will be many more. Unto all to whom these presents shall come, notice is given that there is no occasion to sit in sackcloth and ashes because of breakers ahead. That is the time to wear ship and get her about on another tack. Many a battle has been won by troops refusing to be defeated, by keeping right on regardless of defeat until the fortune of war changed. A bank account is a good thing, but in the absence of it a good stiff backbone has been known to supply the place of it—temporarily.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advnce, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, when possible.

COMPRESSION AND HOT JOURNALS.

A certain steam vessel had a route which could be materially shortened by using a channel, through which the tide ran with great velocity. As this vessel was sent out by the builders the engines were not powerful enough to enable the ship to use the short route, and the intention was to build future vessels with greater power for this purpose. The chief engineer of the line overhauled the engines and finding the valves had a large amount of lead and compression, reduced both, with the result that the ship went through the sluice without difficulty, thereby saving four or five hours in time and the fuel required therefor. But this was not all the benefit derived. At full duty, before the alterations to the valve movement, the bearings heated materially and were a source of constant annoyance, but without compression and lead, they ran faster and did not heat. This is a recital of bare facts from actual experience and can, doubtless, be paralleled by others, but incidents seldom occur where the disadvantages of compression are so marked and can be so directly traced as to cause and effect.

Heated journals, as a result of high compression, occur in many cases, and are attributed by engineers to, perhaps, almost every other cause. An engine whose bearings are barely adequate to regular duty, is called upon to sustain an additional and unnecessary one where high compression is employed. Under ordinary circumstances, the crank pin would, at the end of the stroke, experience "a period of repose;" it would approach and pass the center relieved of all strains, and by that brief rest be able to do its regular work without heating, but if in addition to its work the crank pin and connections are suddenly called upon to take an enormous strain in a reversed direction, it is not unreasonable to expect heating. Neither is it unreasonable to expect pounding, for by compression all the back lash, or lost motion is taken up with greater or less suddenness. The engine is, in fact, surged back and forth during every stroke and it is manifest that noise must ensue.

It is an old notion among many that no quick-running engine can work quietly unless cushioned by the exhaust, but it is a mistake, for we have seen engines without lead and without cushion performing with ease, and perfectly noiseless. We own personally to being a firm believer in the error above mentioned and are glad to acknowledge our conversion. We have thought it was next to impossible for large engines to run at 70 revolutions and upward, quietly, without lead or compression, but if we were to set any more valves it would be as above, and we invite all who are sceptical to try the change and give us their experience on the subject.

BOILER INSPECTION.

Recent events in this city, and the revelations at the inquiry into the explosion of the Riverdale's boiler have greatly interested engineers, and turned their attention to the system, or want of it, by which examinations are carried out. A great deal of indignation is felt, that the laxity which is known to exist is permitted, and that more careful attention is not given. It is asserted that many inspectors do not attempt personal examinations, but content themselves with putting on hydraulic pressure and passing boilers which stand it. In other cases reliance is placed upon the personal statement of the engineer in charge that the boiler is in good condition; and an instance of this is given in the proceedings alluded to in the matter of the Riverdale. Naturally engineers are interested in boiler inspection, and their indignation is not directed against individuals so much as it is against the system which allows such a state of things to exist, and while all inspectors may not be so reckless of results, a stigma, unfortunately, attaches to the office and the class. We need scarcely reiterate what we have so many times asserted in these pages—early and late—that the steam boiler, as a structure, is in itself, obedient to natural laws, and that it is only by the want of attention and through bad management, it can ever do any damage. How both of these very great evils can be remedied is well known, but the trouble is to have the remedy put in force. Mere enactments, that is the passage of laws, avail nothing, for they are not enforced. In cases of disaster, the jury condemns some person or persons. What of it? No one moves; no one takes any action on the subject, and the system of inspection goes on as before. Until some marked example is made in such cases, it is useless to look for other than the usual routine, and we hope no appalling catastrophe will occur to spur the authorities to a sense of duty.

CRITICISM.

A friend in the West writes as follows:

> "Allow me to congratulate you upon publishing criticism upon articles in your paper, because it shows you can and will be just; also, that you do not open your columns to ridicule, as some others in your line do"

We know of no reason why we should not, but many why we should print criticisms. One man does not combine all the intelligence and sagacity extant; and the editor of a paper is particularly liable to error, from the multiplicity of his labors, and the interruption incident to them. Some line of inquiry he wishes to open occupies his attention, and he proceeds to consider it. Scarcely does he begin before a stranger enters and desires his views upon the feasibility of a certain cut-off, or some other wholly personal matter. He is succeeded by another, who gives his views, at great length, upon the milky way, and after these, at decent intervals, come printer's boys, engraver's boys, postmen, express men, peddlers, tramps, women selling soap, book agents, men to sell paper, apple women, persons who want to advertise, personal friends, and anybody else left over. Under these circumstances, careful study into matters requiring exact statement, becomes arduous, and sometimes the editor says things that he is sorry for afterward. He manages to live through the odium attaching, and if some kind reader, zealous that his paper shall not suffer from mis-statement, writes a correction of any that appears, the editor is very grateful.

Only the shallow and superficial shudder, and turn hot and cold under criticism. A man with slight attainments naturally wishes to preserve an appearance of infallibility, and so, when he is detected in error, destroys the evidence of it as quickly as possible. We court criticism and are always pleased to receive it. The tone of it makes no difference to us personally. If it is acrimonious we judge the writer accordingly, but we never suppress it. Our readers can tell how often we receive critical letters, for every one that is received is published. Let us have the critical letters by all means.

THE NAVAL ADVISORY BOARD FOR THE NEW STEAM CRUISERS.

In creating a naval advisory board of engineers in connection with the new steam cruisers, now building for the Government, a step has been taken which must lead to the best results. The principal members of the board are engineers of many years active experience in all parts of the world. in view of their good judgment, their acquaintance with all schools of engineering, and wide reading, there is reason to believe that the engines of the new cruisers will be a great advance on any steam machinery previously built for the United States, and we shall look with interest for the completion of them. No untried or doubtful devices will be employed, but what is good in the merchant service must be quite as useful in the navy, where the same end is sought—the highest economy with the greatest efficiency. The machinery of these new cruisers will be below the water line, and yet the stroke of piston and the connections will not be cramped, or any part inconvenient for access. In all other respects the details of these engines will be quite up to the times, and it is to be hoped, mark a new era in naval machinery.

IN OUR next issue, we shall publish a marine engine, recently built in Finland, from the original designs.

FIRE-BRICK FURNACES FOR MARINE BOILERS.

Some years since, a steamer out of this port had water-leg boilers, which were so inefficient and in such bad condition as to the legs, that the expedient of fire-brick legs was resorted to. There was no time to build new boilers, or to put them in, if they were built, for the ship was in active service and could not lose a voyage. The engineer of the line cut off the old legs and put in fire-brick sides, or furnaces, as an experiment, and with the hope of running through the busy season with the old boilers. The arrangement proved so good that it was kept on, and to-day the old boilers, with the fire-brick furnace, are running much better than when they were first built. They make more steam and burn less fuel than when the iron legs were on. This can be readily understood, for the fire-brick, when thoroughly heated, acts as a conservator or regenerator, and ignites the gaseous constituents of the coal as they are given off. The fire-brick has been found unobjectionable as regards durability or accidental injury, and it will be continued in use on this, and other boilers of the line.

We advise all our friends who have water-leg boilers to try this change, assured that they will find it of marked advantage. It will pay to cut the legs off, whether they are in good order or not, in the lessened consumption of fuel. If any desire it, we will furnish a sketch in this paper, of the furnaces as they are arranged with the fire-brick.

THE INDICATOR SERIES.

We owe an apology to our readers for the long delay in this series. The facts are that we had engaged, or made engagements with, three different writers to furnish a series on this subject; but, after agreeing to do it, "they all, with one accord, began to make excuses," like the men in the Bible. The result is that we are still looking for a series of articles on the indicator, treated in a popular way and elementary in character, so that persons who have never used the instrument can learn how to. We do not want articles for persons who know all about the indicator, but for those who know a little and would like to know more. When the principles involved and the methods adopted for calculation are comprehended, it will be easy to go up higher. We shall continue our search, and will commence the series at the earliest moment. All the other articles announced in our prospectus have been published, or are now in course of publication.

THE STORAGE OF WIND POWER.

A contemporary is discussing the possibility of storing power by the use of wind-mills and in its articles affords, unconsciously perhaps, an illustration of how easily one form of it may be attained, but it omits to say to its various correspondents that wherever power could be stored by wind-mills with any economy, it would be so far from markets and from commercial centers, as to be practically useless and of no avail. Imagine a manufacturer competing with steam or water by the use of power stored up by wind! The possibility of a scheme or device is often confounded with its utility.

THE PROFESSOR IN THE MACHINE SHOP.

Mr. Moulton, the writer of the above series, requests us to say to his friends that, for the present at least, he will discontinue the current articles. His time is occupied so much by a constantly growing business that he finds it impossible to devote his attention to outside matters. He thanks all who have written kindly words of encouragement regarding his efforts to entertain them by his experience, and regrets that the circumstances above-mentioned will deprive him of them in future.

For our own part, we may add that no series ever appeared in our columns which were so well received in general. In two instances only have disparaging remarks been made; but there may be many persons who will experience a sense of relief at this announcement. Making no pretensions to reading or learning, these articles were popular because they recounted the simple annals of the shop; the lives of, and incidents happening to machinists and engineers. Often they were light, and sometimes trivial, but in just those aspects they held the mirror truly, for life is nothing else but a round of incidents, grave and gay; the solemn and the ludicrous linked in one chain. We regret the disappearance of "The Professor," and shall long hold him in friendly recollection.

A. M. DAVY FOR SECRETARY.

The National Convention of the Stationary Engineers Association meets in Chicago on the the 2d October, and at that time general business will be transacted. Without prejudice to the interests of other candidates who may be offered, we think that the present incumbent of the Secretaryship, Mr. A. M. Davy, is preeminently fitted for this work. He is ardent in the cause, a hard worker, and assiduous in his duty. He is also wholly without sectional bias, a matter of the very *greatest* importance in this connection. We italicise one word, contrary to our usual custom, for the reason that we wish to direct attention to this point. Although the Secretary is a western man, he cares no more for the interests of that part of the country than any other. It is easy to see how much injury can be done to the cause—and much has already been attempted by outsiders—by fostering sectional interests, and laying pipe for some special object. The whole boundless continent is the field of the association, and, like the true patriot, it knows no special point of the compass. If Mr. Davy is re-elected, as he certainly should be, in justice to his hard work, the Association will be very fortunate. We earnestly hope that every delegate will vote several times for A. M. Davy.

INDICATOR MOTIONS.

"Doctor" R. Grimshaw finishes his article on "Indicator Rigs" in the *Journal of the Franklin Institute* for July, 1883, page 25, by proving mathematically (?) that 2=1 as follows:

"Given, $a=b$; then $a^2-b^2=ab-b^2$.

$(a+b)\ (a-b) = b\ (a-b)$.

$a+b=b$; $2=1$."

The "Doctor" gives this as an illustration of a "leak in the mathematics," given in MECHANICS for June 2d and 9th, on indicator motions.

When a=b, then $(a-b) = (0)$, and the formula becomes $(a+b)\ (0) = b\ (0)$; that is, $0 = 0$.

The Doctor's mathematical demonstration, if properly carried out, gives a correct value of his arguments on indicator rigs.

No true mathematician could be deceived by the "Doctor's" mathematical deception, which should never have been admitted into the *Journal* by the Committee on Publication of the Franklin Institute, because there is nothing in it to learn. Further evidence of this is that the *London Engineer* recently copied it, mistakes and all.

MECHANIC.

A COLLOQUY.

Employer seated at his desk; enter a young man with a new steam packing.

"Good morning, sir! I want to ask you to look at this packing I have, which will reduce your expenses in that line very much. The principle is——"

Employer.—"Oh, I don't know anything about such things! My engineer attends to all those details. Go and see him. If he says it is all right I will look into the matter; he knows all about it and I pay him for that business."

Exit young man, who has learned what older heads found out some time ago—if you want to sell engineer's goods go to the engineer.

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A most interesting session is anticipated, and many points which have caused discussion, will be settled to the satisfaction of all.

POPPET VALVES FOR SEA SERVICE.

"The essential conditions for working steam advantageously in a steam-engine are these:

"First, that the steam-valve should begin to open slowly, so as to impose the strain of the boiler-pressure upon the piston and its connections by degrees, instead of suddenly, as is usually done; and the reason is that the rectilineal motion of the piston is exceedingly small at or near the center for a comparatively long arc of rotation, while the friction incident to the rotary motion of the shaft and crank-pin journals, under a great pressure, is exceedingly large in proportion, and therefore pressure on the piston at or near the center is a loss of power, while, at the same time, the consequence of opening the valve suddenly is to impart a blow which develops heat in the journals by impact, makes it necessary to key up the engine very close, to avoid the jar incident to taking up the slack motion of the connections suddenly, and thus excludes oil, and, in consequence, induces hot journals and abrasion.

"Second, that after the full boiler-pressure has been once imparted to the piston gradually, and it begins to move rapidly, and thus create a demand for steam in the cylinder, then that the opening should be sufficiently rapid and large to supply that demand without wire-drawing the steam.

"Third, that the steam-valve should be shut with intense rapidity when the time for effecting the cut-off has arrived, so as to prevent any loss in wire-drawing the steam by slow closing.

"Fourth, that the cut-off should be accurate and uniform in its action, unaffected by the spring of the parts or the different degrees of pressure or lubrication.

"Fifth, that the exhaust-valve should be opened before the piston reaches the opposite end of the cylinder, at from thirty to forty degrees of the revolution of the crank, (varying with the speed of rotation,) so that the time necessary for condensation shall be taken while the piston is moving the least in proportion to the circular motion of the crank, and therefore while the least loss is sustained by withdrawing the pressure from it; while, at the same time, the exhaust-valve at the end of the cylinder which the piston is approaching shall be held open till the piston reaches the end of its stroke, so that no retardation shall be sustained by compressing the steam and making a "cushion" under the piston."

To develop the "essential conditions," as above quoted, the designer of the engine of the "Hudson," Mr. Jno. Baird, arranged the movement of the valves as follows, the stroke of piston being 72 inches:

UPPER STEAM VALVE.	
Begins to open at	71¾
Open at center	1-16
Open at 5 ins. of the stroke	1½
Full open (1¾ in.) at	20
Closed, in full gear, at	60

UPPER EXHAUST VALVE.	
Begins to open at	66 in.
Open at center	1½ in.
Full open (2 7-8 in.)	16 in.
Closes in full gear, at	71 in.

LOWER STEAM VALVE.	
Begins to open at	71¾ in.
Open at center	1-16 in.
Open at 5 in. of the stke.	1½ in.
Full open (1¾ in.)	16 in.
Closed in full gear, at	56 in.

LOWER EXHAUST VALVE.	
Begins to open at	66 in.
Open at center	1½ in.
Full open (2⅞ in.) at	20 in.
Closes in full gear at	71 in.

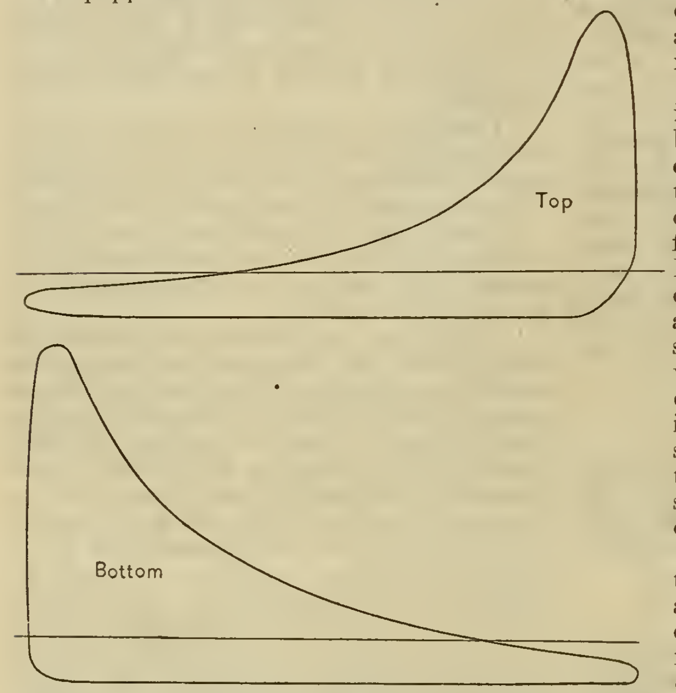
The cards shown herewith are the product of this arrangement of setting valves, after the wear and tear of several years of steady work. It is proper to state that no repairs have been made, or any new parts supplied to the valve gears since the vessel left the works of the builders, "The Pusey Jones Co.," of Wilmington, Del. Indeed, the engines are to-day, an exhibition of the perfect success of a thoroughly well built machine, after years of continuous service, and hard service at that.

There are three vessels in the Cromwell Line alike in the design and construction of their engines, and whatever is said of the "Hudson" applies to the other two. The performances of these engines for a long term of years, fully establishes the superiority of the poppet-valves and the Dickerson & Sickles cut-off gear, over any other arrangement, for controlling the use of steam in an expansion engine. From no other system of valves and gear, can all the "essential conditions" for an economical, smooth working engine be obtained. These engines are superior in economy to any compound engine using the same boiler-pressure, known to the writer.

Of course, when the boiler-pressure exceeds 90 lbs. above the atmosphere, or rather where the expansion can exceed, say 16 volumes, by reason of the higher steam pressure, compound engines are to be preferred if properly designed.

The experience had in these vessels with the poppet-valves and their cut-off gear, proves that, under all the circumstances pertaining to sea voyages, the system is a perfectly reliable one. The idea of its being limited to engines working at revolutions below 70 per minute, is not in accordance with such experience, but just the contrary. There could be no better time selected to bring this experience before engineers than the present, when higher pressures are found to be desirable, but the increase in pressure must be limited, on account of excessive friction and consequent liability to abrasion if slide valves are used, while with the other system any pressure may be reached.

English practice, with high pressures, is to use piston-valves on the high-pressure cylinders, but it is to be hoped our designing engineers will not employ that wasteful device, in preference to the easy working and perfectly reliable poppet-valve.



These latter valves can be set to any required arrangement of steam lead and compression. All the objectionable features of the slide-valve system can be had, if wanted, without entailing enormous power to work them; and they are less liable to leakage. In other words, they are preferable, even upon a badly arranged system.

The valves on the "Hudson" are double, or balanced, but it is simpler and less expensive, with absolute tightness, to use single disk-valves. They also are fitted with the old fashioned, open jaw eccentric-hooks and had a starting-bar, but a link connected to a steam starting-cylinder may be substituted, so that none of the modern conveniences of the engine-room need be left out, on account of poppet-valves.

One very important advantage is obtained on these engines by using the tripper movement, in connection with a marine governor in a heavy sea. The most perfect control is had over the revolutions of the engine, because, in this arrangement, the steam valve is directly acted upon, needing only a small movement, and using very little power, so that the governor acts with great certainty and quickness. Also, the steam valve being nearer to the piston than any other closing arrangement that can be devised, the most immediate and direct effect upon the piston movement is had.

The poppet-valve system has the effect of lessening the friction on the crank-pin and main journals in a marked degree, while the quietness with which all these engines perform their work, proves how well suited the system is to high-speed engines.

MIERS CORYELL.

* * *

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IN THE ROUND HOUSE.—No. XI.

BY L. O. DANSE.

RUNNING.

Keep a sharp look out for signals! The train ahead may have had some mishap which requires it to stop on the main track; in which case, a flagman will be out. One winter morning, about six o'clock, the "local" was running as fast as she could for B——, where she had a good deal of work do. When about half a mile east of there, a red light suddenly appeared in the gloom, about two hundred feet in front of me. Instantly, I shut her off, but did not reverse. As we passed the flagman, he jumped us, and told me that "42" was stopped just around the curve; and sure enough, we had not gone more than four hundred feet past till we were almost on "42's" caboose. Here, again, the flagman had neglected his duty.

When a torpedo explodes under the wheels, you must immediately bring your train under full control, as that indicates that there may be a train in the way. At any rate, the preceding train was stopped near there. If you do not meet a flag, run slow for half a mile, but if you do meet one, stop instantly. You must act quickly. A slow man has no business with a locomotive.

While on the road, the runner's ear is ever on the alert for sounds which betray defects of his engine. The sharp click which gives warning of water in the cylinders, is the signal for instant opening of the drain cocks. A squeak from the rods mean a lack of oil. Pounding may be due to slack brasses or driving-wedges, loose follower nuts, a loose cylinder, or a broken driving spring. In the latter case, the jolting will immediately render the cause evident. The same is true of slack driving-wedges. When you hear a pound, step out on to the running board and try to locate it. If it is very severe, stop and try to remedy it. Flat places on the drivers often make a bad pound.

The exhaust is the best criterion of the condition of the entire valve gear, and of the cylinders. By watching the drivers, you will find that there are four beats of the exhaust to each revolution, and that they take place just before the crank reaches the "centers." Those at the "dead centers" are made by the cylinder on your side; those at the half centers, by the other cylinder. When everything is in perfect condition, all of the beats are equally spaced, and each is perfectly distinct and clear. When the valves begin to leak, the clear-cut beat changes to a sort of blow; and when the pistons leak the blow assumes much greater proportions. Leaky valves usually make a continuous blow, while leaky pistons generally only blow during the first part of the stroke.

Put your engine in such a position that the rocker on the "blowy" side stands straight up and down. Open the cylinder cocks and give a little steam. If steam shows at the cocks, the valve leaks. If not, move your engine until the main pin is on the dead center, and notice whether she shows steam at both ends. If she does, the piston is the seat of the trouble.

When the engine beats irregularly ("goes on three legs"), you may be sure that there is something wrong with the valve gear, and you had better stop and find out what the trouble is. A broken valve yoke produces a sort of wheeze. A loose nut on an eccentric strap bolt will make an irregular variation, running a while on three legs and then bracing up for a moment. A slipped eccentric will throw the beats into pairs, and may merge the four into two. Fortunately the slipping of an eccentric usually stops the engine, so that the runner *must* remedy the defect. When anything much out of the way shows itself in the exhaust, you had better stop immediately, and inspect the entire valve gear, repairing the damage before going any further. Many a boiler has had a hole punched in it through the neglect of the runner to heed the warning of the exhaust.

Not long ago, Jim Carson was pulling a heavy train up the "big hill" when his engine began to "exhaust as if she was crazy." He said she began to "beat in every kind of style;" but he wanted to make the summit before stopping to fix her. After running about a mile there was terrific rattle of the machinery, a hoarse blow of the exhaust, and the engine was enveloped in a cloud of steam and spray. A link bolt had worked out, and the eccentric rod had punched a hole in the fire-box. Jim declared he would never neglect to stop and repair damages, when his engine got on three legs again.

Hen. Bush, of the B. & O., had an eccentric strap bolt work out one afternoon, when he was running the 256 as a shifter in the Pittsburgh Yard. He was just starting up the hill with a lot of cars for the Pan Handle, when he heard his engine exhaust in a peculiar way. He stopped right where he was, and got down under her, found the trouble, and remedied it. "If I had not stopped I might have had a hole in my boiler before I did stop," he afterwards said.

Never take any risks when your engine gets out of square. Stop right where you are and fix her in good shape before you proceed, no matter what may be behind you, or how little time you have; but be sure to whistle the flagman back, to protect you, the moment you shut off.

* * *

WHAT IS FORCE?

It would seem a very simple matter to define this word and fix its application with regard to mechanics, but it is not simple, and not of definite application, or else learned men are strangely muddled upon it. A writer in the *Engineer*, says:

> Webster says all words denoting force, power, strength, are from verbs which express straining, driving, or rushing, and this word has the elements of the Saxon *faran* and Latin *vireo*. Force to the ordinary mind is the complement of resistance; without resistance there could be no force. We cannot push if we have nothing to push against, and this is, no doubt, the first, obvious orthodox sense of the word. A force is that which overcomes, or tries to overcome, a resistance. This is the sense in which the word was originally used by all, and in which it is still popularly used.
>
> After a time, however, it was said by a certain school of thinkers that this sense was too limited. They said that it implied the necessity for the complementary idea of resistance, but they at least admitted at the same time that a force might exist without a resistance, and they started a new definition of the meaning of the word, which is very well given by Weisbach, "Force is the cause of the motion, or of the change in the motion, of material bodies." Here we have no mention of resistance.
>
> Now if we examine the definitions we see that they really convey nothing. They are definitions of the meaning of a word, but they are not explanations. In short, they are translations, so to speak. If I turn to a French-English dictionary for the meaning of the word *maison* I find house, but a man who did not know what a house was would not rest satisfied with this. He would turn to an English dictionary and look up the definition of house, and would find, to quote Walker once more, "House: a place wherein a man lives, any place of human abode, &c." The definitions of Newton, Rankine, &c., are simply translations, and leave us just as wise as we were before The student wants to know what causes motion and is told that it is force, and if he asks the meaning of force, he is told that it is that which causes motion, and thus we go round and round in a vicious circle.
>
> Tait, Spencer, and others have tried to get out of this circle, and instead of giving a bare definition of force, to explain what it is that changes or causes motion. Herbert Spencer takes one view of the matter which is in a sense quite intelligible, but is not, I think, to the point, being not only extremely metaphysical, but very unpractical, or rather unphysical.
>
> The fact that such a great diversity of opinion exists among able men forces one irresistibly to the conclusion that the word is quite out of place in the stated connection, and should not be used at all. Let it retain its popular meaning and its popular use, and let it be abandoned altogether by physicists. As it is, it only does mischief, because Newton and others have attached to it a meaning it was never intended to convey.

* * *

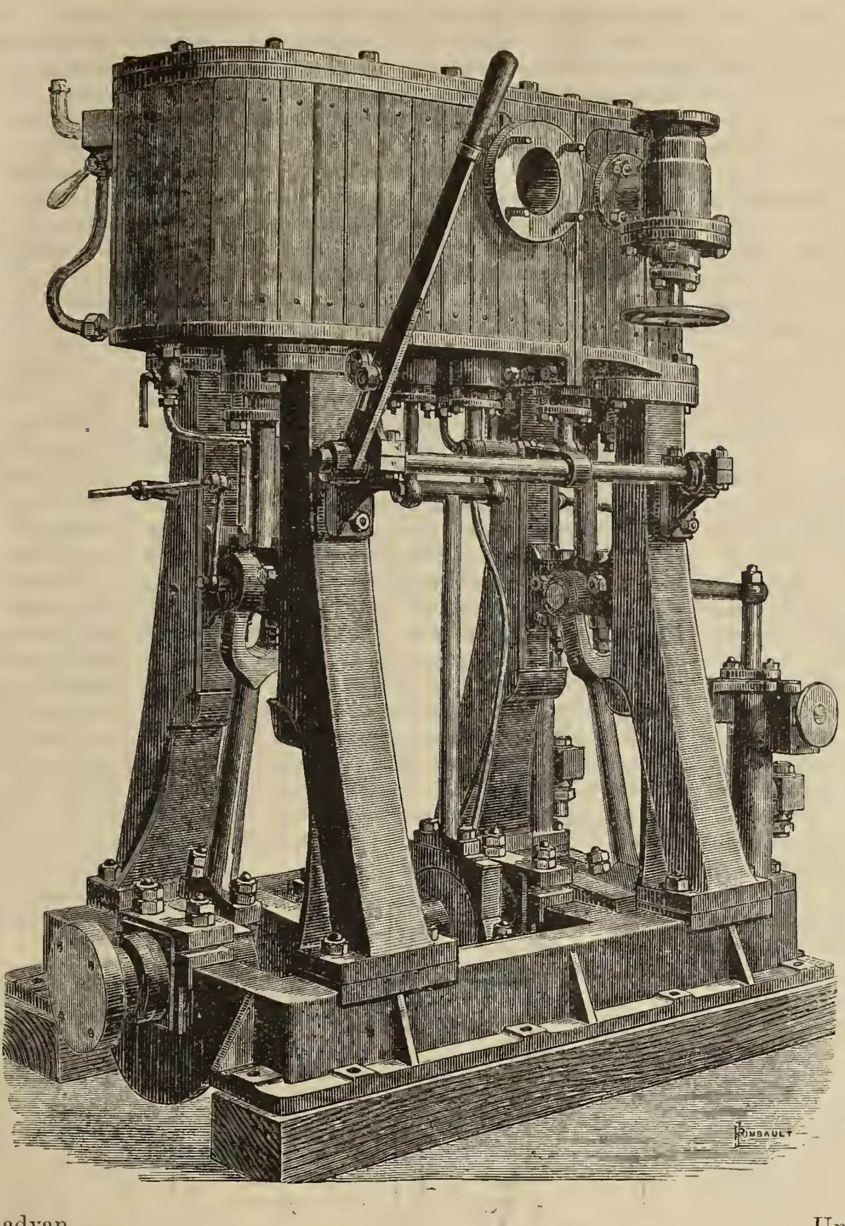
CERTAIN SCIENTIFIC SMATTERERS who have nothing else to do, are always prowling about food and drink. They find worms in vinegar, monsters in water, and danger in everything eatable. Says one :

> "All foods sold in tin, especially if of a fatty nature, public water supplies, wines, beers, effervescing drinks, the glaze of earthenware, enamels, and especially culinary utensils lined with tin, may introduce lead into the system."

So may a pistol. If men never died until they were poisoned by canned goods, they would vie with Methuselah in years.

A LAUNCH ENGINE THAT RUNS EITHER WAY WITH ONE ECCENTRIC.

The complexity and constant wear and tear of the link motion have led to many attempts to dispense with its use, particularly in small engines, and to effect the reversal of motion by other means. A method, which has gained great popularity of late, particularly in steam steering engines, is one in which the offices of the steam and exhaust passages are alternately varied, that which serves for the inlet of steam when running in one direction, serving for its outlet when running in the opposite direction. If any ordinary slide valve of *D* form is arranged to work with steam on its outer or convex side, and with its cavity connected to the exhaust pipe, then the engine will rotate in such a direction that the eccentric will be ahead of the crank. If the same slide be so arranged that the cavity is connected to the steam pipe, and the valve casing to the exhaust pipe, the engine will then rotate in such a direction that the eccentric will follow the crank, and therefore the direction of the motion will be the reverse under the former conditions. In order to get the same distribution of steam in each case, however, it is necessary that the eccentric shall stand at right angles to the crank, a disposition which precludes the presence of lap on the valve, and admits steam through the whole stroke. In steam steering engines, cranes, and such like machines which work intermittently and develop but little power, the advantages of simplicity may be cheaply bought by the expenditure of a little extra steam, but in a continuously working engine, particularly when employed to drive a boat, economy is a matter of great importance, and hence this form of reversing gear has been usually considered inapplicable in launches.



To avoid this difficulty Mr. Robert Duncan, of Glasgow, Scotland, has brought out a compound engine in which the reversal is effected in the manner indicated above. The steam is admitted during the full stroke to the small cylinder, and is then expanded in the larger one, the admission being again, of course, continued through the whole stroke, so that the degree of expansion corresponds to the capacities of the two cylinders. A perspective view is shown where it will be seen that the absence of link motions gives great simplicity, and adds to the accessibility of the various parts.

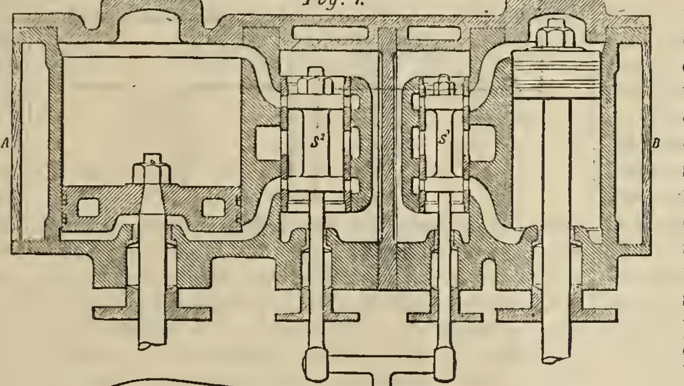


Fig. 1.

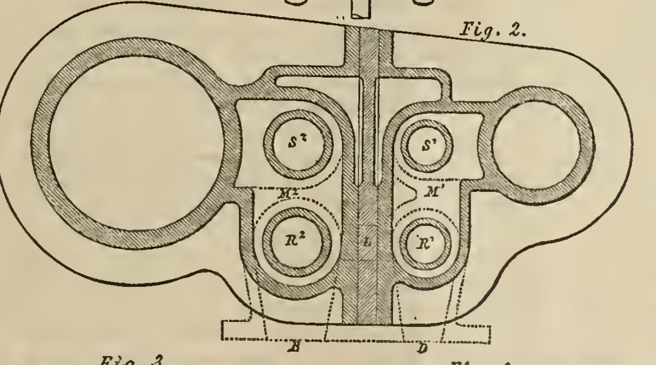


Fig. 2.

Figure 1 is a vertical section through both cylinders and distributing valves, Figure 2 a horizontal section showing both the distributing and the reversing valves, Figure 3 a vertical section through both valves of one cylinder, and Figure 4 a similar view through both reversing valves. The steam is distributed by piston valves *S*¹ *S*² working in casings with ports all round them, so that the valves are in in equilibrium. There is but one eccentric. The eccentric rod has a crosshead which is connected to both valve rods and imparts similar motions to each. To render this possible it is necessary that the cranks of the two cylinders should be either together or separated by 180 degrees, as steam will be admitted to both cylinders simultaneously. The latter arrangement is the one adopted, as it provides for the easy balancing of the parts, the motion of one crank and piston being contrary to that of the other, thus tending to reduce vibration. There is no lap on the valves, only a little cover, the steam entering until the termination of the stroke in both cylinders, and flowing direct from the smaller to the larger without the intervention of a receiver. The reversing valves are exactly alike, and but for constructive reasons, might as well be in one. They are stationary except at the moment when the engine is being reversed, when they are moved simultaneously by a lever and a rock shaft. The steam enters first one of the reversing valves, then flows past or through it into the distributing valve of the high-pressure cylinder. After doing its work there it returns through the distributing valve to the second reversing valve, and thence to the low-pressure cylinder. When the valves are in the positions shown steam entering at the branch, *D*, has access to the center of the valve *R*¹, Figure 2, and thence by the passage *M*¹ to the center of the valve *S*¹ by which it is alternately delivered to either end of the high-pressure cylinder. The exhaust from the cylinder escapes past the end of the valve into the casing, and gains access to the valve casing of the other cylinder through the passage *L* (Figures 2 and 4). It is delivered to the cylinder by the valve, *S*², acting like an ordinary slide valve, and when exhausted it passes from the cavity of that valve, through the passage, *M*, into the cavity of the reversing valve, and thence by the branch, *E*, into the air or the condenser, as the case may be.

Under these conditions the eccentric follows the crank, but if the reversing valve be moved downward until the steam entering at the branch, D, blows into the casing instead of into the cavity of the valve, then the direction of motion is changed and the eccentric goes in advance of the crank as usual. The high-pressure valve then distributes the steam by its ends and receives the exhaust in its cavity, while the low-pressure valve operates in the opposite manner. For work in which it is necessary that the cranks should be at right angles, Mr. Duncan proposes to employ two tandem engines, each controlled in the manner we have been describing.—*Engineering*.

Fig. 3.

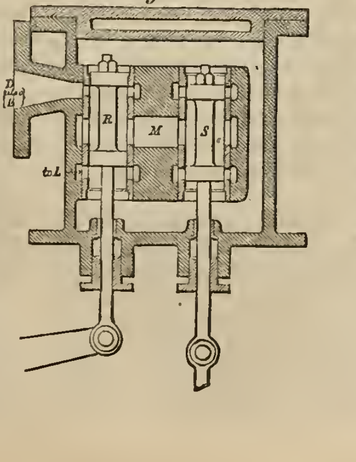
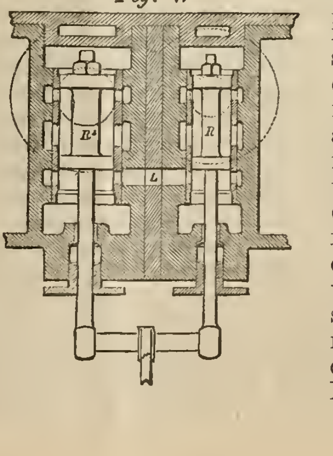


Fig. 4.



CALCULATING THE HORSE POWER OF COMPOUND ENGINES.

(Continued from last Issue.)

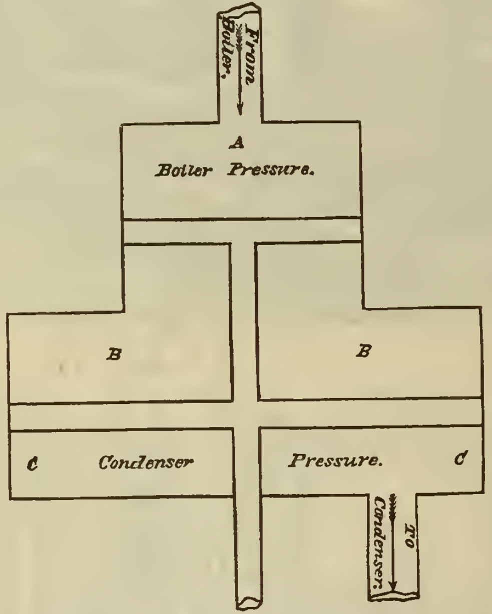
In the diagram, which has the partition between the two cylinders omitted, the pressure in the space, *BB*, must have been uniform throughout at any instant, making the back pressure per square inch against the piston of the small cylinder exactly equal to the pressure on the piston of the large cylinder per square inch; but in a working engine, where the large movable partition between the cylinders is replaced by comparatively a very small valve with contracted openings, this equality of pressure upon the two pistons no longer exists, and the back pressure against the piston of the small cylinder is always greater than the pressure upon the piston of the large cylinder. This difference of pressure in practice varies from 1½ to 3 pounds per square inch, according to the size of the opening in the valve relatively to the capacity of the small cylinder, to the length and tortuousness of the passages connecting the two cylinders, to the speed of the pistons, &c. Now, this difference of pressure, whatever it may be, and it is is always something of practical importance, is additional back pressure against the piston of the small cylinder, and must be added to the back pressure in the space, *CC*, to obtain the true back pressure against which that piston works. Thus, the piston of the small cylinder of the compound engine must always work practically though not theoretically against a greater back pressure than the surface of the ring works which remains on the piston of the large cylinder after subtraction of the piston of the small cylinder, by the difference between the pressure per square inch on the opposite sides of the movable partition separating the two cylinders. This additional back pressure is a loss of useful effect peculiar to the compound engine and has no analogue in the simple engine.

The foregoing principles governing the compound engine suffer modification by any variation of the relative position of the cylinders or addition of parts. The interposition of a receiver between the cylinders, whereby their pistons need not come simultaneously to the ends of their strokes, does not in the slightest degree affect the mode of action described ; neither does cutting off the steam in the small cylinder, whereby part of the expansion is caused to take place in that cylinder.

All the steam used in the large cylinder is always expanded steam; nor is the measure of expansion affected by placing a cut-off valve on that cylinder closing at any point of the stroke of its piston. The object of such a valve is to increase the pressure between the piston of the small cylinder and the movable partition separating the cylinders, that is to say, between that piston and the cylinder end towards which it is moving. Such an increase of pressure would be nearly useless, theoretically, in a tandem arrangement of cylinders for the compound engine, which arrangement supposes no space between the cylinders to be filled with steam in its transfer from the small to the large cylinder, except that in the connecting pipes; but just in proportion as space exists between the cylinders, as in the case of a receiver arrangement of them, is the necessity for a cut-off valve on the large cylinder. In some tandem arrangement of cylinders the steam from the small one is exhausted into the jacket of the large one, passing thence into the large cylinder, the jacket in which case forms a receiver; and a cut-off valve, therefore, becomes necessary on the large cylinder. Such a use of the jacket, however, is very injudicious and should never be resorted to. The large cylinder should receive its steam directly from the small one, and the jackets of both should be kept filled with steam of the boiler pressure. With a skilful tandem arrangement of cylinders, whereby the space between them is reduced to the minimum, but very little is to be gained by the application of a cut-off to the large cylinder; such a valve could not be closed judiciously until the stroke of the piston was at least two-thirds completed. In a theoretical tandem arrangement of the cylinders, that is, with no space between them, and without a cut-off valve on the large cylinder, the initial pressure in the large cylinder would be the same as the final pressure in the small cylinder, which is the effect sought to be produced by the application of a cut-off valve to the large cylinder when a receiver intervenes between it and the small cylinder, in which case the cut-off valve on the large cylinder must close earlier and earlier as the cut-off valve on the small cylinder closes later and later, The receiver arrangement of cylinders, therefore, compels, for maximum economic effect as regards pressure alone, the steam to be cut-off very early in the small cylinder, so that a large portion of its expansion may be done there, the remainder being done in the large cylinder whose cut-off valve should be so adjusted as to make the initial pressure in that cylinder the same as the final pressure in the small cylinder.

The object of the short cutting off in the small cylinder is to enable it to develop, under the preceding condition, a proper power, which it could not do with a late cut-off and the cut-off valve on the large cylinder closing at a point that would make equality of pressure at the end of the stroke of the piston of the small cylinder and at the beginning of the stroke of the piston of the large cylinder. Consequently, in receiver arrangements of cylinders—the steam being used with a given measure of expansion—the ratio of the volumes of the small and large cylinders is much less than *need be* in tandem arrangements. Of course, the steam can be cut-off properly as short in the small cylinder of the tandem arrangement as in the case of the receiver arrangement, but it need not be for maximum economic effect as regards pressure alone; in fact it can be worked without expansion in the small cylinder and the entire expansion done in the large one without sacrifice of economic effect due to pressure distribution, provided there be no space between the cylinders, in which case neither of them would require a cut-off valve, and the mechanism could be much simplified.

In the receiver arrangement of the two cylinders, however, a cut-off upon both is indispensable for maximum economic effect as regards pressure alone. Neither advantage nor necessity requires the receiver to be of greater capacity than the small cylinder and the pressure in the receiver must be kept the same as the final pressure in the small cylinder, which can only be done by the use of an adjustable cut-off valve on the large cylinder closing at the proper point to produce this effect. Further, this condition prevents the steam from being used without expansion in the small cylinder, as in that case the small cylinder could not develop any power. In order, therefore, that the small cylinder in the receiver arrangement should develop a proper power with the condition of equality between its final pressure and the pressure in the receiver, the steam must be cut-off in it considerably before the end of the stroke of its piston. Thus, with the receiver arrangement of the two cylinders, cut-off valves on both are indispensable for maximum economic effect as regards distribution of pressure, and the steam must be used with considerable expansion in the small cylinder to obtain the proper division of power between the cylinders. The manner in which those conditions affect the proportion of the two cylinders is very obvious. If the steam is to be used with a given measure of expansion, say six times, then in a tandem arrangement of the cylinders without cut-off valve on either, the volumes of the two cylinders would be as 1 and 6; but in the case of the receiver arrangement of the two cylinders, cutting of the steam in the small cylinder when one-third of the stroke of its piston was completed, the volumns of the cylinders would compare as 1 and 2, and if the large cylinder were divided into two so as to make a three-cylinder compound engine, all the cylinders could have the same dimensions, a very great mechanical convenience when the engine is a large one.



When the steam is worked expansively in the small cylinder of the compound engine, the application of a cut-off valve to the large cylinder is a source of much economy independently of the proper distribution of the pressure. In all cases of using saturated steam, considerable condensation is found in the cylinders, due to the alternate heating and cooling of the metal of which they are made, owing to the considerable difference of temperature to which the metal is exposed during a double stroke of the piston. This liquefaction of the steam is a minimum when the steam is worked without expansion, other things equal, and increases *pari passu* as it is worked more and more expansively. Now, whatever portion of the steam entering the small cylinder remains liquefied at the end of the steam stroke of its piston, is boiled off or revaporized during the return exhaust stroke under the lessened pressure of the exhaust by the contained heat in the water and in the metal of the cylinder, and this revaporized portion passes to the large cylinder and is used upon its piston without expansion is that cylinder have no cut-off valve; but if it have, then this revaporized portion is worked expansively, and is thus made to give a higher duty. Of course, the less the cylinder liquefaction of steam, the less will be the economic gain due to this cause, an *vice versa*.

The foregoing views of the true theory of the compound engine and of its mode of action, of the advantages of cut-off valves on both the small and the large cylinder, and of the arrangement in proper juxtaposition of the indicator diagrams taken from the two cylinders, are original with the writer and are believed to be novel. They are given with as much brevity as possible, the present purpose being to offer only so much explanation as will make clear the methods of calculation employed in this report but many additional issues of interest and advantage follow as obvious corollaries from the main propositions herein demonstrated.—*Isherwood.*

BOILERS OF COMPOUND ENGINES.

The compound engine may be considered as the general type of marine steam engine of the present day. In these engines the steam from the boilers is only admitted direct to a small cylinder, usually known as the high-pressure cylinder, and at the end of the stroke in that cylinder, instead of passing at once to the condenser, the steam enters one or more additional and larger cylinders, in which the expansion is completed; after which the steam passes to the condenser. The boilers are therefore only in direct communication with the high-pressure cylinders, and the condensers with the low-pressure cylinders.

The working steam pressure in the Royal Navy with this type of engine hitherto has been from 60 to 70 lbs. per square inch. The engines now under construction are designed to be worked with steam of 90 lbs. pressure. The principal object aimed at in increasing the pressure of steam has been to increase the economy of working, and the change from the ordinary surface-condensing engine, with 30 lbs. steam pressure, to the compound engine with 60 lbs. pressure, resulted in a reduction of the coal consumption per I. H. P., of between 30 and 40 per cent.

This step, however, has not been accompanied by a corresponding increase in piston speed, and decrease in dimensions and weight required per I. H. P. In fact, it must be admitted that, although the present type of compound engine is lighter than simple expansion engines worked at the same steam pressure, and with an equal amount of expansion would be, yet the machinery as a whole is generally heavier than that of the surface-condensing engines with flat-sided boilers, worked with steam of 30 lbs. pressure which immediately preceded them, and the piston speeds are certainly no higher.

The only advantage, therefore, in point of reduction of weight and space that has been gained as yet by the introduction of compound engines and high-pressure boilers has been the reduction of coal-bunker space required.

I will endeavor to point out the causes of this apparent check in the reduction of weight, &c., and to indicate what appears to be the most probable direction in which advance in the future is likely to take place.

The first point that strikes us is the increased weight of the boilers. For example, compare the boilers of the *Devastation* with those of the *Nelson*. The boilers of the *Devastation* are flat-sided, pressed to 30 lbs. per square inch, and, including water, weigh only 456 tons. The boilers of the *Nelson* are cylindrical, pressed to 60 lbs., and weigh 556 tons, including water. In other words, while the *Devastation's* boilers weigh 154 lbs. per I. H. P., the boilers of the *Nelson* weigh 200 lbs. per I. H. P., or 30 per cent. more. Again, compare the *Inflexible* with the *Hercules*, both of which ships have engines of about the same power. The boilers of the *Hercules* loaded to 30 lbs. pressure, weigh 547 tons, or 144 lbs. per I. H. P., while the cylindrical boilers of the *Inflexible* weigh 752 tons, or 198 lbs. per I. H. P., which is an increase of 37½ per cent.

This increase of weight may be to some extent attributed to the increased strength necessary to carry the higher steam pressure. This, however, is insufficient to account for all the increase, for, in consequence of the more economical working of the engines, less steam is required to be generated, so that the volumes of the boilers and the areas of heating and grate surface may be made less than in the low-pressure boilers.

The principal cause of the increased weight of the boilers appears to be due to the additional thickness of the plate allowed to provide against the effects of corrosion. Many of the earlier boilers, fed with water from surface condensers, were so rapidly weakened by corrosion that they had to be renewed after having been at work for one commission only. The expense of opening out the ship to do this was so great that it was considered desirable to increase the thickness of the shell plates, to enable the boilers to be kept in the ship, without the necessity of removal, for at least two commissions.

By the introduction of steel plates and more improved systems of management, it is hoped that this difficulty will be to a great extent removed. Steel plates are more uniform in structure and much stronger than iron, so that the scantlings may be reduced for a given strength; and now that the mystery that appeared for some time to enshroud the subject of the corrosion of marine boilers has been dispelled, and the true causes of the action ascertained, it appears probable that a reduction in the *factor of safety* usually employed may be safely made. The great importance of this would result from the increase in the maximum working pressure of steam that could then be carried with the present type of marine boiler.

To illustrate this point, let us consider the case of a cylindrical boiler 10 feet in diameter, the shell of which is made of steel plates ¾ of an inch thick. The tensile strength of these plates is usually specified to be not less than 26, nor more than 30 tons, per square inch. Many engineers are desirous of raising the lower limit of strength, and this may be possible before long; but for our present purpose we will take the lower limit of 26 tons, and estimate the difference in the pressures of steam that could be carried by allowing factors of safety of 8 and of 5 respectively. The strength of the joint has been taken as 0·75 of that of the solid plate.

If 8 be taken as the factor of safety, the maximum working stress allowed on the material would be one-eighth of the ultimate stress, or 7,280 lbs. per square inch. This would be produced by a working steam pressure of 68 lbs. per square inch. If, however, a factor of safety of 5 were considered to leave a sufficient margin of strength to provide for all contingencies, the maximum working stress on the material would be increased to 11,648 lbs. per square inch, which would permit a working steam-pressure of 109 lbs. per square inch to be carried. Further, if we suppose that after four or five years' work the plates were uniformly thinned by corrosion to the extent of ⅛ of an inch, the factor of safety in the second case, if the original working pressure were retained, would still be 4·167, which is by many engineers considered ample; but if it were deemed desirable to retain the original margin of safety, this could be done by reducing the working pressure of 91 lbs. per square inch.

In estimating the strength of a structure like that of the shell of a boiler there are few disturbing elements, and almost exact calculation can be applied. The strength of the material used may be considered uniform, and, with proper supervision during manufacture, inferior workmanship may be prevented. The most uncertain element, hitherto, has been the effect of corrosion and wear and tear, and this has caused a high factor of safety to be generally employed. Now, however, that most of the difficulties attending the boiler-corrosion question have been overcome and the methods of reducing or preventing this action have been satisfactorily ascertained, we may hope that marine boilers may retain their original strength for much longer periods than was formerly the case, and it would therefore appear that the factor of safety used for the shells of the boilers may be reduced with advantage.

The criterion of the relative strengths of the several parts is the strength they respectively possess when the boiler is worn out and unfit for further work. It is the usual practice in the Government Dockyards to burst by water pressure, for the sake of experiment, one boiler out of each set condemned, and a mass of very valuable information as to the ultimate condition of the boilers is thereby obtained. I have had, in the course of my duty, to conduct many of these bursting experiments, and, so far as my experience goes, the weakest part has, in every case, proved to be the furnace or combustion chamber, and I think it is quite safe to say that while the present form and dimensions of furnaces and combustion chambers are retained—and there appears to be no tendency to increase the thickness of the plates in these parts—there is no necessity to use a higher factor of safety for the shells than 5. Even with this factor I believe that, when the boiler comes to be worn out, the furnaces and combustion chambers will be found to be the weakest parts, notwithstanding the fact that they apparently had a much greater margin of strength than the shells, when new. It must not be forgotten, that in these parts the material is weakened to some *unknown* extent by the working and flanging at the fires during manufacture, and when the boilers are under steam, unequal and unknown strains are brought on the material by the expansion resulting from the heat of the furnaces. It is also probable that the material deteriorates from the alternate heating and cooling to which it is exposed; and corrosive action, if it occurred at all, would probably produce more effect on the heating surfaces than on the shells, which are kept at a much lower and more uniform temperature. The plates in these parts also are generally thinner than in the shells, so that the percentage of loss of strength for a given amount of corrosion would be the greater.

The present type of marine boiler is also a slow and wasteful generator of steam. Even when the draught is forced by means of the steam blast, not more than about 30 lbs. of coal can be burnt per square foot of fire-grate per hour; and only about one-half of this is utilized in evaporating the water. In many cases more than one-half of the heat that the coal is capable of evolving by complete combustion is wasted in various ways. Cylindrical boilers are even more slow and wasteful generators than the old flat-sided boilers.

In order to reduce the weight of the boiler, rapid combustion is necessary. The greater the quantity of coal that can be efficiently burned per square foot of fire-grate per hour, the smaller may the furnaces be made for a given power. In locomotive practice the rate of combustion of coal in ordinary work often reaches as high as from 80 to 100 lbs. per square foot of grate per hour, and in some cases it even exceeds this. This, combined with the smaller amount of water carried, has caused many marine engineers to look to this type as a means of reduction of weight. Mr. Thornycroft, in his fast torpedo-boats, was, I believe, the pioneer in this direction; and he forced the draught by closing the stoke-holds and putting them under air-pressure. The air was blown into the stoke-holds by means of a rotatory fan, and a pressure of air, equal to the weight of from 3 to 6 inches of water, is easily maintained. In some experiments, made at Portsmouth, to ascertain the performance of the boiler of a first-class torpedo boat, it was found that with an air pressure equal to three inches of water, 62 lbs. of coal could be burnt per square foot of grate per hour; and when the pressure was raised to 6 inches of water, the rate of combustion was increased to 96 lbs. per square foot of grate per hour.

The only ship of large size in which this plan has been adopted is the torpedo ram *Polyphemus*. The machinery of this ship has been constructed by Messrs. Humphreys and Tennant, and every effort has been made to secure lightness. The engines are driven at a high speed, both of piston and of revolution. They are expected when working at full power to make about 120 revolutions per minute and to have a piston speed of about 780 feet per minute. This will give about 38 I. H. P. per cubic foot of cylinder, and 12½ I. H. P. per ton of weight; which is a very great advance on anything yet attained with the ordinary marine engine; and the experiment is most interesting and instructive from both a scientific and practical point of view.

I do not, however, think the locomotive type of boiler will prove itself suitable for marine purposes generally; though it may be useful in some special cases. The water spaces are too confined for general work at sea, and it would, I think, be found impossible to keep the flat sides of the fire-boxes from bulging and becoming unsafe. The great difficulty that has hitherto been experienced with these boilers, even on the trial trips, which have yet been the only hard work to which they have been subjected in the Service, is the leakage of the tubes at the fire-box ends. The cause of this appears to be that the intense heat of the fire being so close to the tube-plate, causes it to expand and compress the ends of the tubes; so that when the fires are checked, the contraction of the tube-plate leaves the tubes slack in their holes. The leakage has shown itself in nearly every case, when the engines were leased after the full-power run, the forced draught being stopped, which reduced the temperature of the fire. The cold air, also, that enters the fire-door when it is opened, impinges directly on the hot tube-plate, without having to pass over such a length of fire as an ordinary marine boiler.

For the present working pressures of steam the ordinary type of marine boiler appears to be the most suitable; and probably little variation in its form need be made, so far as strength is concerned, for pressures up to about 150 lbs. per square inch. I doubt, however, if it would be wise to much exceed that pressure with the existing type of boiler. If pressures beyond this limit be arrived at, it will be, in my opinion, necessary to adopt some form of boiler built entirely of small tubes, to enable the steam to be generated with confidence and safety. I do not profess to indicate what type of *tubulous* boiler will prove most efficient. Those that have been tried hitherto have not given general satisfaction, but it is probable that the failures have been due more to defects in the details of construction or of management, than to causes inherent to, or inseparable from, the type of boiler. The Herreshoff coal-boiler has proved itself economical and efficient for small boats, and is the lightest type yet constructed for a given power. It is absolutely safe, but whether it is adaptable to larger powers has yet to be proved.

With the present type of marine boiler it is necessary that *artificial draught*, of some kind, should be employed for full-power working, in order to keep the dimensions within moderate limits. Until recently, the steam blast was the only means used for forcing the fires. This, however, is a very wasteful way of getting steam, especially with surface-condensing engines. Other methods of forcing the draught are—

1. Fitting an exhausting fan in the funnel.
2. Blowing air into closed ashpits.
3. Blowing jets of air into the base of the funnel.
4. Blowing air into closed stoke-holds.

The first plan is obviously unsuitable for ships, for the fan would require to be so large to allow all the products of combustion to pass through it, at a sufficiently high velocity, that the apparatus would be too cumbrous and unwieldy.

The blowing of air into closed ashpits is a very efficient plan, but has the objection that the pressure in the furnaces is greater than that in the stoke-holds, so that, unless care be taken when opening the fire doors, accidents are liable to occur. With artificial stoking this plan would probably be found to be both economical and efficient.

The blowing of jets of air into the base of the funnel has been tested by experiment in the French Service, and favorably reported on. It is also on trial in one or two ships belonging to the French Navy; but little is known, as yet, of its practical working and efficiency.

The fourth plan, viz., blowing air into closed stoke-holds, which has been adopted from the torpedo-boats, has found most favor in the Royal Navy. The stoke-holds of several of the more recent ships are being arranged and fitted, so that, when working at full-power, they may be closed in and kept under air pressure by means of fans.

The *Satellite*, now completing at Sheerness, is the first ship in which this system has been practically tested. This ship has two independent stoke-holds, in each of which there are two boilers. During a three hours' trial made on the 11th inst., with the forward stoke-hold closed, and kept under an air pressure equal to about one inch of water, the rate of combustion of coal per square foot of grate was raised to 39·4 lbs. per hour, and the I. H. P. developed from the two boilers was 865, or 15·7 I. H. P. per square foot of fire-grate. The average number of revolutions made by the engines per minute was 95·38. On a previous trial made on 3d April, 1882, without artificial draught, the coal burnt per square foot of grate was 18·6 lbs. per hour, and the average I. H. P. developed with four boilers, was 1,115. The effect of forcing the draught, in this case, enabled the power obtained from a given set of boilers to be increased from 558 to 865, or about 55 per cent.—*Richard Sennett, C. E. Royal Navy.*

◆

The Wood-worker, says: "It is remarkable, but nevertheless true, that statistics show that over one-fourth of the boiler explosions in this country occur in saw mills, planing mills and other wood-working industries. Does this large percentage arise from overwork of the boilers, or the incompetency of the men in charge of them?"

It doubtless arises from the fact, that boilers in such places are fired with shavings, or edgings and slabs, which produce a very intermittent fire, at one time exceedingly hot and at another much lower in temperature. Boilers so fired require careful watching.

◆

Says *The Railway Review:*

"English exchanges indicate a growing popularity of the compound locomotive. The engines of Mr. Webb make a saving of eight pounds of coal per mile, as compared with ordinary machines on the same class of trains. This item, though small, foots up to large figures when the mileage made by a single engine in a month or year is considered. A large number of new engines of this pattern are being constructed."

Admitting that eight pounds of coal per mile is something as compared with the ordinary engine, how much does it cost to build and maintain Webb's compound locomotive as compared with the ordinary engine? Does not first cost and maintenance very nearly eat up the eight pounds?

◆

By the shortcomings of engravers we are, in this issue, deprived of many illustrations that were intended for insertion, and we are also deranged in our "make up." Part of our paper goes to press before the other, and by counting upon deliveries that were promised, but not made, we have been put to great inconvenience.

◆

Comparing the numbers of torpedo boats in the various European navies, the English appear to have the greatest number of second-class boats, and the French the greatest number of first-class boats. They are hard pressed by the Italians, who will soon take the lead in first-class boats.

STEEL FOR SPECIAL TOOLS.

In discussing the ability of inspectors of crucible steel to determine approximately the content of carbon by the appearance of the fracture of an ingot, several gentlemen familiar with the properties of iron and steel considered it doubtful if more than one out of five manufacturers of crucible steel could furnish steel, simply ordered for a given purpose, within twenty pounds of a certain degree of carbon, decided upon to be the most suitable for the manufacture of any ordinary implement, of which a sufficiency is made to insure familiarity by steel makers with its requirements. Presuming such steel is usually determined as suitable by the fracture, rather than by analysis, the writer was delegated to determine how closely implements of a kind from different manufacturers corresponded to a chosen standard of carbon particularly fitting for the manufacture of such tools. As it may be of interest to some, I give the results of my inquiry in detail, as the average of the analyses conveys important information of the temper of steel best adapted for the manufacture of the several implements mentioned:

AUGER STEEL.

Carbon Previously Decided Upon, ·60.

	Carbon.	Manganese.	Phos. Avr'gd.	Silicon. Avr'gd.
English........	·65	·19	·058.	·196
German........	·48	·16		
American........	·67	·16		
English........	·57	·22		
American........	·64	·25		
Average........	·602	·196	·058	·196

. AX STEEL.

Carbon Previously Decided Upon, ·90.

	Carbon.	Manganese.	Phos. Avr'gd.	Silicon. Avr'gd.
American........	·88	·21	·032	.163.
English........	·96	·10		
English........	·93	·11		
German........	·93	·07		
English........	·93	·13		
English........	·97	·12		
American........	·96	·14		
Average........	·937	·125	·032.	·163

HOE STEEL.

Carbon Previously Determined Upon, ·63.

	Carbon.	Manganese.	Phos. Avr'gd.	Silicon. Avr'gd.
English........	·60	·14	·072	·216
English........	·68	·065		
American........	·62	·28		
American........	·85	·26		
Unknown........	·50	·31		
German........	·56	·15		
English........	·70	·21		
American........	·68	·24		
English........	·68	·13		
English........	·67	·10		
Average........	·65	·18	·072	·216

AGRICULTURAL FORK STEEL.

Carbon Previously Determined Upon, ·68.

	Carbon.	Manganese.	Phos. Avr'gd.	Silicon. Avr'gd.
American........	·86	·24	·067	·112.
American........	·83	·25		
English........	·96	·07		
American........	·86	·22		
English........	1·10	·10		
English........	1·05	·10		
American........	·65	·23		
Unkown........	·45	·18		
German........	·96	·03		
German........	·85	·00		
German........	·85	·03		
Average........	·85	·13	·067	·112

—Geo. H. Billings, *in American Manufacturer.*

◆

CAST IRON OF 47,500 POUNDS SQUARE INCH TENSILE STRENGTH.

The average tensile strength of cast iron being 25,000 pounds to the square inch, the extraordinary strength of the mixture below given, demands the widest circulation among engineers. If it can be made uniform it increases the usefulness of cast iron very greatly.

Edward Gridley, member of the Institute of mining engineers, says in *Van Nostrand's Magazine*, "A little more than a year ago, at the Wassaic Furnace, Dutchess County, N. Y., we made a few hundred tons of iron from a mixture of two-thirds raw carbonate and one-third Chateaugay ore, hoping that it would be suitable for steel purposes, but as the iron showed phosphorous 0.189 per cent., it was not offered. This iron looked well and seemed quite strong, and gave good results in malleable castings; but no special tests of strength were made.

"About February 1st, of this year, we began using two-thirds roasted carbonate and one-third Chateaugay, and noticing that the iron was stronger than usual, we had two samples tested, which showed tensile strength of 32,014 and 34,176 pounds per square inch. After our stock of Chateaugay ore was exhausted, we put on one-third raw carbonate with the two-thirds of roasted carbonate, and the first test made of the iron, showed 40,008 pounds per square inch.

"The three tests given above were made by Mr. A. J. Copp and Mr. E. B. Manning, of the Phœnix Furnace, Millerton, N. Y. Since these tests were made, they have broken samples made with all carbonate ore as follows: 39,669, 40,816, 41,882, 42,281, 39,902, and 40,130 pounds per square inch.

"A test taken from the same bed of iron as the last-mentioned (40,130), was broken, showing 40,151 pounds per square inch. A sample broken at Stevens Institute, under direction of Professor R. H. Thurston, showed 40,000 pounds per square inch. Another sample was broken by Professor Thurston on his torsion machine, and gave torsion 7° and tensile strength of 44,500 pounds. And still another sample, tensile strength 47,500 pounds per square inch. The average of the thirteen tests by Fairbanks, is 41,349 pounds.

"These tests were all made from iron cast in the pig-bed, direct from the furnace. Some were made from the full pig turned down, but most of them from samples obtained by making a hole in the sand at the end of the pig, from 10 to 20 inches long, and about 1¼ inches in diameter· No tests have yet been made from the re-melted iron."

◆

Says *The Trade Review:*—

A witty and well-posted correspondent, whose ink contains a trace of pepper-sauce, pays attention in this issue to some assertions of the editor of The Mechanical Engineer concerning the use of Petroleum as a fuel in manufacturing processes. We beg to assure our esteemed editorial confrere that nothing personal is intended and that we shall be pleased to publish his reply, should he see fit to pursue the discussion.

Bless your heart, we never reply to articles of that kind, most of it proceeds from a disordered liver. We would as soon undertake to reply to a hornet's nest as for "pursuing the discussion." We don't see anything to pursue. Miss Amanda will be wiser when she gets through with her experiments. Read what we say about criticism in another column.

◆

A New Electric Gun so called, has been produced in Europe, which fires a great many charges—104 in two minutes. Powder is used in it, and the only office electricity performs, is to fire it. *Cui bono!*

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
W. Barnet Le Van, 3607 Baring Street, Phila., Pa.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. John Beoker, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering. Send for catalogue before purchasing. F. Keppy, Publisher, Bridgeport, Conn.

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THE MECHANICAL ENGINEER.

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Enlarged 1883.

New York, October 27, 1883.

Single Copies 8 Cents.
$2.00 per Annum.

COMPOUND ENGINES OF THE STEAMER "RURIK."

DESIGNED BY A. H. LINDFORS.

Through the courtesy of the designer we are enabled to lay before our readers engravings of the new engines of the steamer "Rurik," now running on the river Wolchoff in Russia. These engines replaced others, of a kind not specified, which were inefficient; the vessel, therefore, is not a new one, and some peculiarities in the engines were necessitated by the conditions existing.

The designer says:

"They could not keep steam or make the time with the old engines, and I had to use the old boiler and make as few alterations generally, as possible. The engine room is very small, and many of the arrangements embodied are due to this cause. The engines are, as may be seen, compound non-condensing, and the dimensions of the vessel are as follows:

"Length, 100′; extreme beam, 14′; draft of water aft, 5′ 10″. The dimensions of the boiler are:—heating surface, 705 square feet; grate area, 24 square feet. The engines are two in number; the small cylinder being 15″, the large 20″ by 12″ stroke. Number of revolutions 210 per minute. Diameter of wheel, 4′ 9″; pitch, 8′ 3″ at extremities of blades, slightly less at roots. The boiler pressure is 100 pounds, and diameter of blast pipes 3¼″.

"With these engines this vessel has made for 3 continuous hours 17¼ miles, or 14·96 knots. The total indicated horse power is 322, and the consumption of coal, per hour, 870 pounds; per square foot of grate surface 36 pounds, and per indicated horse power 2·7."

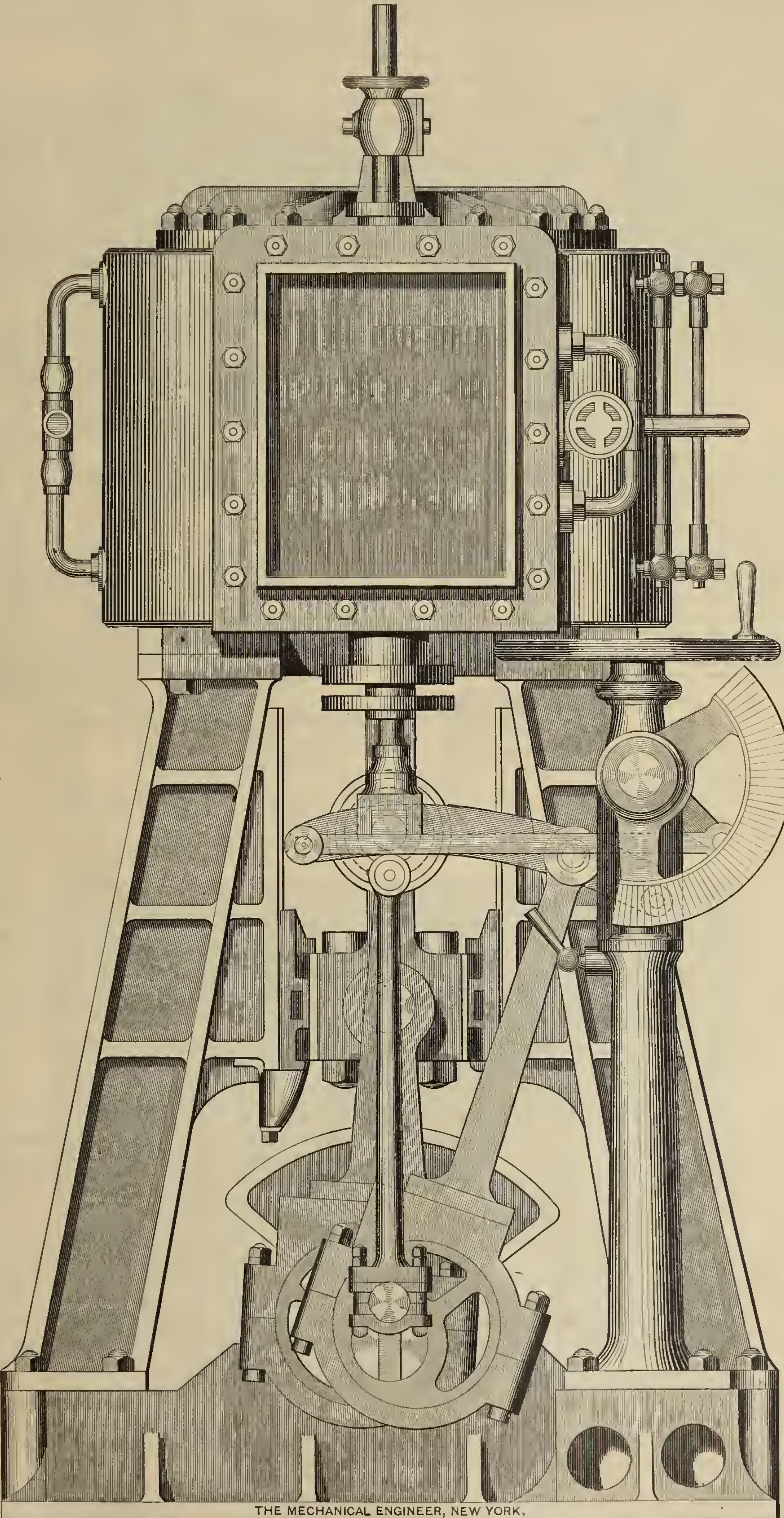
At full speed the engines worked finely, having no vibrations to speak of. This is also true of the hull, although it might have been expected, as the vessel is very lightly built.

The cards herewith show both small and large cylinders put together, and the work is very evenly divided. Owing to the proportions observed in the cylinders and the point of cut-off adopted, the loss by expansion between the high and low pressure is very small.

The cards show slight leaks, which might be expected in new machines, but the average results are very good indeed.

The speed of the vessel is especially good, we might say remarkably high for its dimensions, and the designer is to be congratulated upon his achievement. There are not many vessels afloat of 100′ in length—outside of torpedo boats and pleasure yachts—that can make 17 miles an hour, and maintain it for three hours.

The engines are not remarkable for lightness in construction, and the boiler is doubtless of the ordinary type. These are disadvantages which handicapped the designer, but, as the results show, proved no serious detriment.



COMPOUND ENGINES OF THE STEAMER "RURIK."

WE REGRET that there is a little uncertainty as regards the valve-motion in our engraving, but as the original was a blue print, somewhat blurred at this particular spot, we were unable to fix the exact connection of the parts.

APROPOS OF MACHINE DESIGN, a contributor says:

> "I notice a series of articles on this subject in a technical paper, and the writer has a firm grip on Reuleaux's coat tails already. If he hangs on he will get lost in abstract reasoning, and if he lets go he has got to be a genius not to be caught tripping by specialists on every separate machine he ventures to discuss. Anyway he will have to stand a volley all along the line."

These are fearful alternatives.

A CONTEMPORARY unnamed, because we do not wish to hold it up to scorn, says:

> "A statue to the inventor of the manufacture of soda is about to be erected at Issoudun, his native place."

The exigencies of the make-up sometimes demands two-line items of scintillating brilliancy, but in the example above our friends are unfortunate. No one cares anything about the inventor of soda, or statues to him, and it is immaterial that "Issoudun" is his native place. Our friends are only encouraging the Associated Press, and the Cable companies, which constantly disseminate similar intelligence.

THE *Mechanical World*, England, notes in a few lines, as follows:

> "The Mogul engines recently turned out by the Pittsburgh Locomotive Works, are made to draw 1,900 tons."

Please remark in the next issue, that we say that the Consolidated engines turned out by the Baldwin Locomotive Works will draw 2,760 gross tons on a level, without winking.

THE *Austral* was an English steamer 456 feet long, 48¼ feet wide, and 34 feet deep, with a gross tonnage of 5,588. She sank alongside of the dock in Sidney Harbor. Notwithstanding her large dimensions this ship was so crank that 160 tons of coal put in on one side would list her to an angle of 15 degrees. With her spars in, and ballast tanks empty, she would not stand on an even keel.

THE EXPLOSION OF THE BOILER ON THE PROPELLER COLORADO.

The above-named vessel exploded the starboard boiler quite recently, and, so far as can be ascertained from the *Buffalo Express*, the cause of it was closing a stop-valve, thus shutting the boiler off from the safety-valve. If this is correct the safety-valve must have been on the cross pipe, and common to both boilers, instead of each boiler having one of its own.

The usual be-muddled newspaper report is annexed:

> "It is the custom to clean out one boiler on every trip to Buffalo, and on the present trip the starboard boiler had been cleaned. To do this it would be necessary to shut her steam valve, so as to cut off connection with the other boiler. After the boiler is cleaned out it is again filled with water and fired up. An examination of this steam valve since the explosion finds it still closed. This explains the cause of the accident. All the steam made by this boiler must escape by the safety-valve above or remain in the boiler. The moment Engineer Lovett went to tampering with the safety-valve he shut all the steam in, and the explosion followed as a matter of course. It has been stated that he had noticed that this boiler was blowing off, and yet the vessel was not making as much headway as she should."

It is not necessary that the stop-valve should be closed in order to clean the boiler. If there was steam on one boiler and the stop-valve leaked on the one that was being cleaned, it is possible that the men closed it and forgot to open it; such things have been known before.

We have, by private advices, some damaging reports as to the action of one of the engineers on the boat, but in the absence of exact knowledge we prefer not to make comments which may injure an innocent man.

The Sun says:

> "Boilers continue to explode and kill people as regularly since the disclosures recently made in the Riverdale investigation as before. The latest explosion occurred at Albany yesterday morning, the boiler of a tugboat bursting with a shock that some persons mistook for an earthquake. It is lucky that only two victims were near enough to the boiler to be killed. A very surprising statement comes from Washington concerning this Albany explosion, the Supervising Inspector-General there saying that as the certificate of the boat expired on the 21st inst., he supposed her boiler had just been inspected. Well, there must certainly be some way of stopping this sort of thing."

Yes, there is a way, but those interested—the public generally—do not seem to care much about the matter, so the same state of things may be looked for for sometime to come.

◆

AMERICAN IRON SHIPS.

It is a fact that, in spite of the disadvantages American ship-owners are under in running their ships, especially steamships, in competition with those of other countries whose taxation laws are liberal, the building of American iron ships is going on annually. The current year will show a very great increase. On the Delaware river 51 iron and 5 steel vessels, with a tonnage of 55,079 tons, were built during the first six months.

There are now six iron ship-yards on the Delaware, against but three a few years ago. And they are all enlarging their business. One feature of this year's trade is the building of several ships intended for the foreign trade. Several of the ships built this year have been over 2,000 tons each.

Plucky builders have demonstrated the possibility of American iron and steam ship-building. But they cannot change the laws of taxation. Now it is high time for Congress to take the matter up, abolish all but federal tax, and make about the same as England levies—one per cent. on net income—and then will be demonstrated the possibility of a new American carrying trade. —*American Manufacturer.*

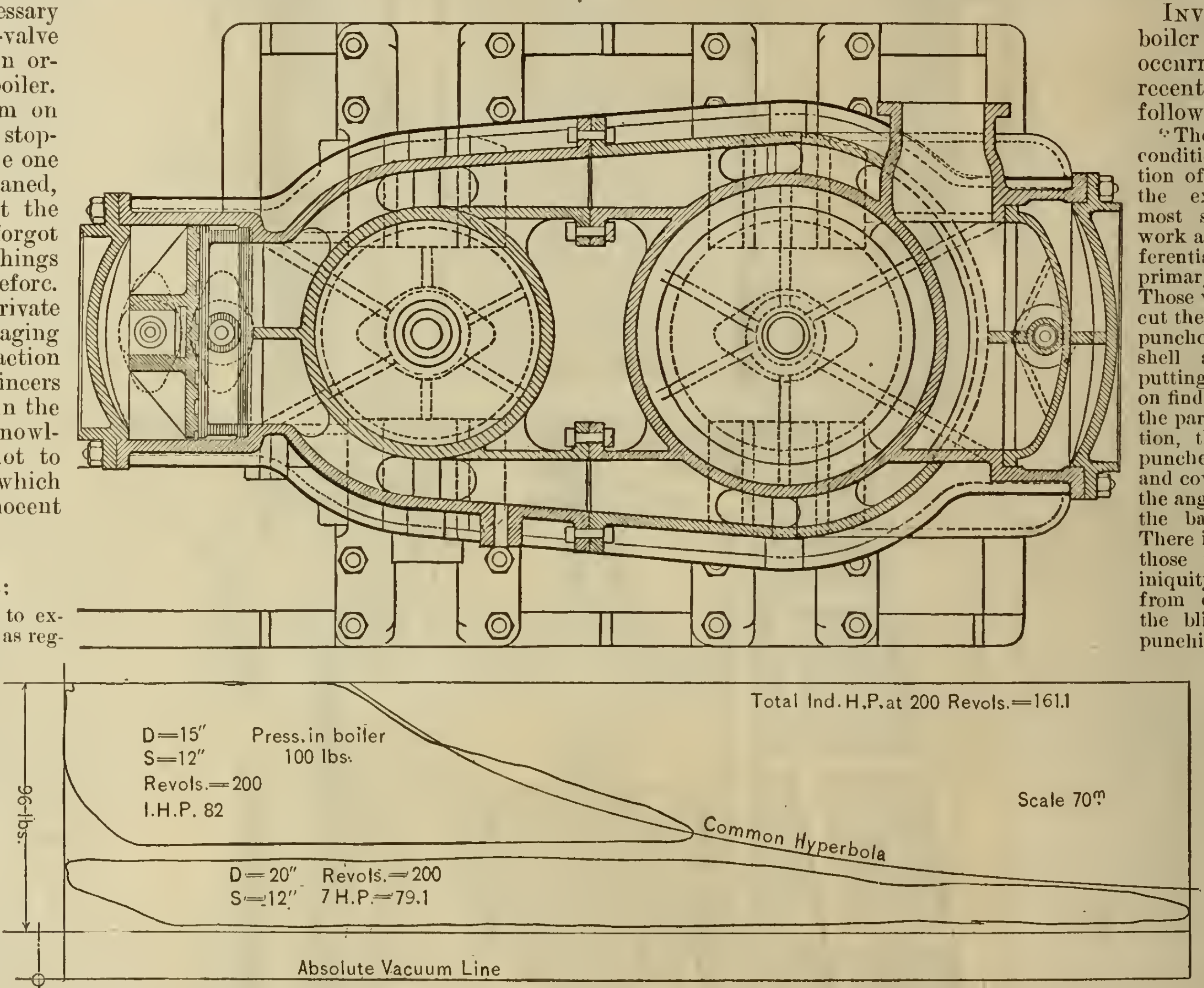
◆

A professor in a large university, in a personal letter to the editor of The Mechanical Engineer, says:

> "Writers of elementary mechanics have, in most instances, but used the titles as a peg on which to hang a string of mathematical problems, very puzzling (and very useless) to those who wish to confine themselves to, and to understand the common things about us."

To which just observation we say, Amen, loudly. It is a fit corollary to what we have said in another column on "*A defect in technical books.*"

◆



SECTION THROUGH CYLINDER, AND INDICATOR CARDS FROM S. S. "RURIK." (SEE FIRST PAGE.)

BOOKS FOR MECHANICS.

The long winter evenings are approaching, and those who desire to rise higher will seek to improve their spare time by study. Our readers will notice in this issue many announcements in the advertising columns of new and of standard works, embracing all lines of trade and technical information.

Besides those announced, the publishers issue many others which can be found in their catalogues, and we advise all to send for them and make selections. Money spent for useful books is the very best possible investment any one can make.

◆

Our readers will observe some "slight" allusions in this issue to our own affairs. The object of them is to increase our business. At all other times of the year we hold our peace on this topic, but just now all publishers are "in arms and eager for the fray," and we are no exception. All who are well disposed towards us can do us signal service by circulating a knowledge of our offer to clubs, and otherwise.

◆

Prompt remittance secures all the Indicator articles.

A contemporary says:

> "The accompanying engravings gives a perspective view of a very ingeniously contrived and skillfully arranged machine for doing work that has been hitherto considered too complicated for anything beyond hand operating."

and the illustration shows a contrivance which has set-screws, springs, weights, tappets, connecting rods, toggle-joints, guides, slides, crossheads, cams, levers, pulleys, mysterious wires, quadrants, thumbscrews, *files*, cranks, and a few other objects unknown to us, all in a small compass. "Hitherto considered too complicated" is facetious, in the face of the facts.

◆

The *Manufacturers Gazette* says: "There was considerable interest manifested to see the new two-cent stamp, and many purchased out of pure curiosity. There being a quantity of the old pattern of two-cent stamps on hand, the curious ones received the same old red stamp which they have used so long. The peculiar expression of countenance which came over purchasers was decidedly ludicrous."

◆

Investigation of a boiler explosion, which occurred in England recently, revealed the following facts:

> "The plates were in fair condition, but an examination of the fragments after the explosion revealed a most scandalous piece of work at the bottom circumferential seam where the primary fracture occurred. Those who made the boiler, cut the furnace mouth and punched all the holes in the shell and firebox, before putting them together, and on finding them blind when the parts were put in position, they marked off and punched the second set, and covered the defects [illegible] the angle iron [illegible] the base [illegible]. There is evidence [illegible] those who committed this iniquity tried to hide it from others, for I found the blind holes filled with punchings evidently from the same plate. The average width of the metal left between the double set of rivet holes was less than ¼ in., and it was moreover injured by the double punching. When the explosion occurred the shell ripped through this seam for about half its circumference, and then tore from top to bottom in four places, the uptake tube being also torn through at the root of the bottom flange. The pressure just prior to the explosion is stated to have been 60 lb., and to have been then increasing."

This is very tough practice.

◆

Most water colors are merely solutions of gum with the pigment which gives the tint. Those sold under the name of moist colors, and for which very high prices are asked—40 cents for a little cake of carmine $\frac{3}{4}'' \times \frac{1}{2}'' \times \frac{1}{4}$—have glycerine mixed with them, which being non-evaporative, dissolves more readily.

◆

A curious epidemic of whistling seems to have suddenly broken out among all classes, high and low, rich and poor, young and old. The idiotic "tootle too" echoes and re-echoes along all public streets, stairways and halls. People who have so much wind on the stomach should seek medical advice.

◆

Mr. Benjamin F. Kelley, of 91 Liberty street, is the agent for the Berryman Feed Water and Purifier, and has some interesting information on that subject which can be had by addressing him.

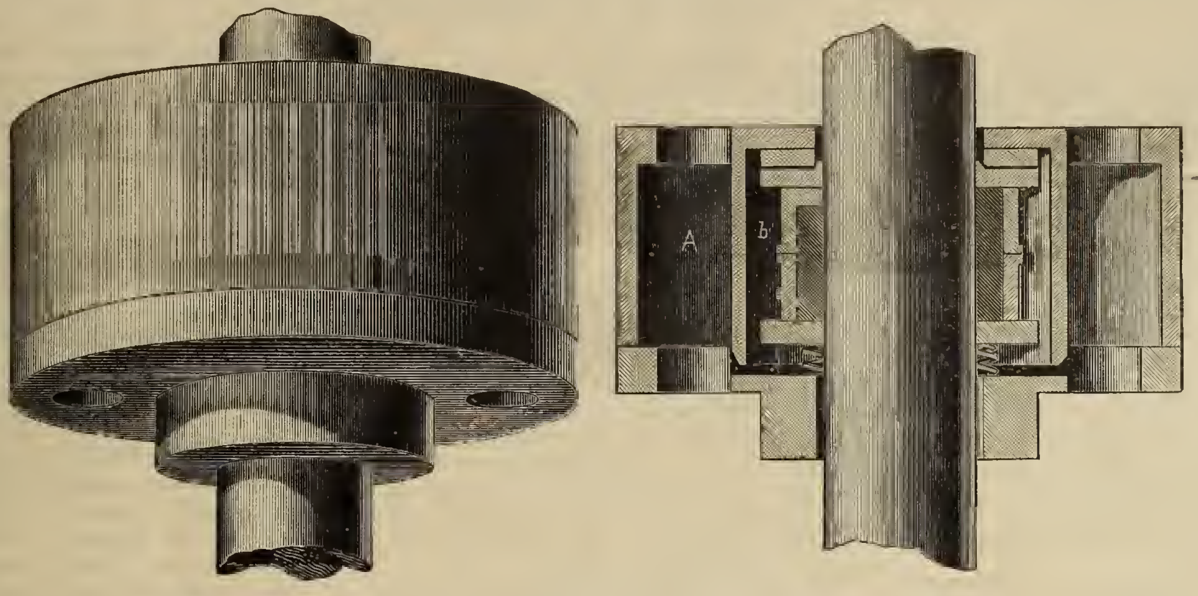
TRIPP'S METALLIC PACKING.

Our engravings represent a metallic packing which has now been in use for some years in the Eastern States, but has not been widely introduced until very recently, as the Company have desired to assure themselves that their guarantees of perfection are attained. To this end it has been put on many engines and left wholly in charge of disinterested engineers, who were instructed to approve or condemn it upon its merits. We are assured that in no single instance has the packing been removed for failure to perform what is claimed of it.

In construction it is wholly of metal. The gland or case, *A*, being secured by stud-bolts to the cylinder head as usual, and the steam-tight joint being obtained by the details within. These are very simple, consisting merely of brass shells lined with a special soft metal, and parting each side of the rod. These chocks, as they may be termed, encircle the rod on both sides, and rest upon several small spiral springs, the office of them being merely to sustain the weight of the chocks and keep them up against the face joint outside, when steam is first let into the cylinder. On the outside of these chocks are two springs, *b*, which also serve to keep the chocks up to their work until the engine is running. The action is as follows: When steam is let into the cylinder it fills the case, *A*, and forces the chocks closely against the rod; it also keeps them up against the face joint, so that in effect the rod is self-packed by the steam pressure in the cylinder.

On casual examination it might seem that when the pressure was removed the packing would leak air, if on a low pressure engine, but this is not the case, for the springs shown come into action and effectually preserve the vacuum.

This packing has been used on large steamers and in countless stationary engines in this city and the Eastern States, and is meeting with rapid sale wherever introduced. From a thorough examination of its merits, we believe the claims made for it are warranted. Address for terms Tripp's Metallic Packing Company, Boston, Mass.



TRIPP'S METALLIC PACKING.

COUPLINGS between two engines are not the safest things in the world. It depends somewhat upon how the couplings are made. In the case of a pair of large automatic engines just put up, the wedge-action of the coupling forced the shaft of one outboard a quarter of an inch, stripping all the eccentrics, wheels, and collars from their seats. There is a constant side-thrust, where the old-fashioned quartered clutch is used, which should be provided for.

A CONTEMPORARY has been investigating the condition of trade, and the outlook generally, in the West. The result is this: Those who have lots of orders on hand think it is going to be good, while those who have none think it is going to be very dull! "'Twas ever thus!" The way to make trade good is to go for it, red-hot, now, and all the time. Not much comes in the door that is not brought in.

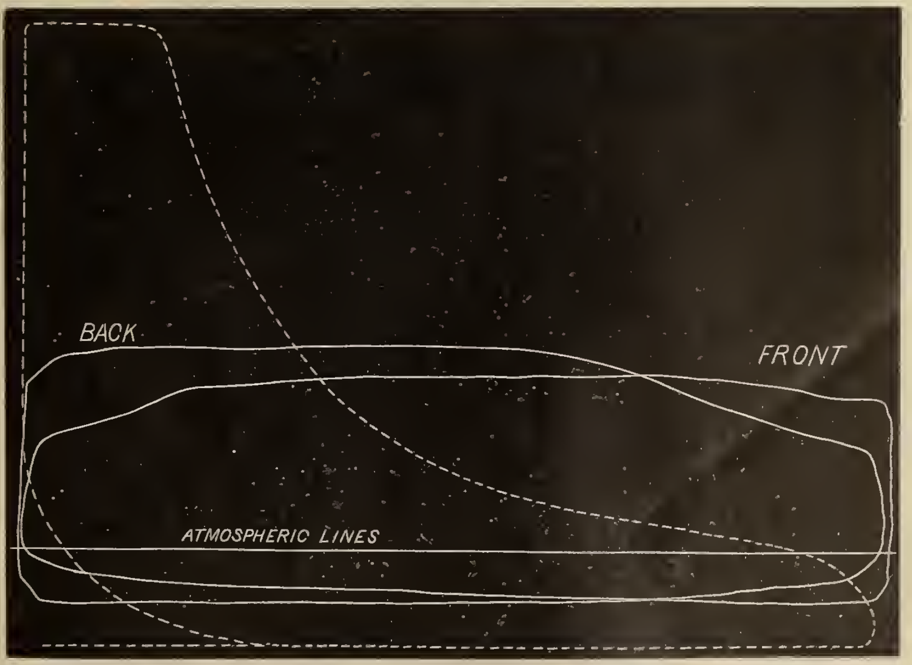
THE *United States Miller* is kind enough to ascribe some very fine sentiments upon the tariff question to THE MECHANICAL ENGINEER. Common honesty obliges us to deny the paternity. We would have said what our friends say we did, if we had thought of it.

THE DISTANCE FROM Sandy Hook, N. Y., to Queenstown, Ireland, is 2,783 miles, but the route traveled by steamers is about 160 miles longer. The shortest time ever made was by the Alaska, in 6 days, 18 hours and 37 minutes.

EXAMPLES FROM AN ENGLISH STATIONARY ENGINE.

In presenting the accompanying diagrams, I do so not so much for the purpose of teaching what should be done, as for pointing out what should be avoided.

They are taken from an engine situated at a great distance from the boilers, in the first place, and, in the second, the throttle-valve was out of order, so that, although there was a pressure in the boiler at the time of indicating, of 85½ lbs. per square inch, and a separate expansion-valve was fitted, the initial pressure only attained a maximum of 33 lbs. at the back and 29 lbs. at the front end of the cylinders. Further, the maximum pressure did not occur at the commencement of the stroke. The vacuum, also, is very poor, not exceeding 8 lbs. at the most, though the barometer at the time stood fairly high.



It appears marvellous that such diagrams could be allowed at the Works at which this engine was, the pecuniary condition of the company being most excellent.

The cure evidently is, after finding whether or not the needful repairs to the throttle-valve will do any good, to increase the diameter of the steam-pipe. The cylinder of this engine had a diameter of 17¼ inches, the length of the stroke being 30 inches and the speed 60 revolutions per minute. The scale is $\frac{1}{30}$th.

It is not difficult to see that, under ordinary conditions, this engine should produce a fairly good diagram; but it had one fault, in that the steam passages from the valve to the cylinder were very long, and much steam was thus wasted, as the cushioning on the return strokes was practically non-existent.

The draughtsman who designed this engine was a German, with the usual high theoretical notions possessed by that people. I believe he had had a thorough technical school education, also. The whole arrangement of engine and steam-pipes had been in his hands. These diagrams prove that an engineer is not manufactured — he grows. Had they been a very little worse than what they are, it would have been difficult to have told which was the steam and which the exhaust end of the figures, and it is evident, from the increase of pressure which occurs as the piston travels from the point of rest, that the steam opening must be cramped; and the slow fall of the exhaust indicates the same fault.

The poverty of the vacuum may be due to faulty valves, but is also probably enhanced by pipes of too small capacity, as the condensing water is of ample quantity, cool, and requiring no lifting.

The enormous wastefulness is evident at a glance, but no data could be obtained in regard to this, as the engine was one of several taking steam from boilers which also supplied steam for boiling and other purposes. The dotted line approximately indicates a figure which might have been obtained; securing a greater power if the vacuum also was improved, as shown by dotted line.

The lateness of the exhaust opening is a fault some designers are addicted to; they fancy they can take the last ounce of work out of the steam by holding it to the end of the stroke. This is especially noticeable in these figures. A greater mistake cannot be made. Always exhaust freely; far more is lost by lateness in the full amount of the vacuum than is gained by taking the last little bit of work out of the steam.

AN ENGLISH ENGINEER.
LONDON, ENGLAND.

[The above article comes to us from an English constructing engineer, who desires to give our readers, from time to time, examples of English practice in various lines, such as machine-tools, boilers, gearing, locomotives, gas-engines, etc., etc. We shall be glad to hear from him, but as all our arrangements are not perfected, we cannot announce positively an engagement.

We may say, in passing, that we do not agree with all the conclusions expressed as to the diagram above. —EDS.]

ACCORDING TO THE STANDARD of the British Admiralty the knot is the length of one minute of longitude at the equator, or 6,086 feet 1·1527 statute inches, or 1,855 metres. The mean length of latitude, sometimes reckoned as a knot, is 6,076 feet 1·151 statute miles, or 1,852 metres. A marine league is three of these sea miles.

Prompt remittance secures all the Indicator series.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

OF GENERAL INTEREST.

Editors MECHANICAL ENGINEER:

I am more familiar with a coal-shovel than with figures, and wish you would give me your opinion as to whether the engine mentioned is economical and about what horse power it is.

Cylinder 8×12; runs at 130 revolutions; average steam pressure, 65 lbs. Steam is cut off at ½ stroke by means of a cut-off sliding on back of main valve; a Water's governor is used to regulate speed and steam. The fuel used for 10 hours is 8 bushels of screenings (say 640 lbs.) which yields a large quantity of ashes. Feed water supplied by an injector, delivered to boiler at about 160 deg.; temperature varies with pressure. I have no way of measuring the amount of water used.

The boiler is a horizontal tubular, 12 ft. long, 3 ft. diam., twenty-eight 3-inch tubes, grate surface, 12 sq. ft.; boiler is set in brick, and an artificial draught used (air forced by blower into ashpit.)

Catch me firing for the engineer that "*Reverse Lever*" writes about in last issue. I never attempted to run a boiler by "*instinct.*" I like to err on the safe side, and use the gauge-cock pretty freely; haven't much faith in the glass. I was once taught a lifelong lesson in London, England, by a treacherous glass water-gauge.

I do not accept as truth what Mr. John Cullum says, viz.: "An experienced man could tell the condition of the bottom of a boiler by throwing the light of a lamp upon it." He can't do it, for the boiler may be just like the Pharisee spoken of in Scripture, "beautiful outward, but within full of dead men's bones and of all *uncleanness.*"

Excuse these remarks, but you invite criticism, so no apology is needed. Now that the long evenings are coming on, engineers should purchase a slate and an arithmetic, as your humble servant has done. I feel that a thorough knowledge of figures is of great value to men who have control of the coal-pile, and that a lack of it—knowledge—keeps many from getting on.

MASS. H. B.

[The simple rule in everyday use shows this engine to be doing very well indeed. The boiler pressure is 65 pounds. Supposing that pressure to be in the steam chest, the mean effective, cutting-off at half stroke, is 40·5 pounds. This gives the following results: Area of piston, 50·25 inches; multiplied by the pressure on it, (40·5), we have 2035+total effect. This, multiplied by the speed of the piston in feet per minute, 260, gives 525,900 foot-pounds. A horse-power is 33,000 foot-pounds, which, divided into the foot-pounds made by the engine, gives 15+horse power for the engine. The coal used is 640 lbs. in 10 hours; that is 64 lbs. per hour. The horse-power being 15, the amount of coal used is about 4⅓ lbs. per hour, which is a very good showing for so small an engine at point of cut-off. We have been thus minute in this matter for the purpose of illustrating the rule in general use, and think it may be of service to others.

Our correspondent evidently thinks Mr. Cullum's statement as to throwing a light on the bottom of the boiler, refers to the exterior. Mr. Cullum means, of course, that, if the boiler is clean, reflected light inside will discover corrosion and weak places. In this he is partly right and partly wrong, for shadows would intervene and baffle him. The hammer is the best test, and never deceives.—EDS.]

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MR. DANSE'S REPLY TO "REVERSE LEVER."

Editors MECHANICAL ENGINEER:

In your issue of October 13th, "Reverse Lever" makes some kindly criticisms on my article No. 10, quoting particularly the lines "the steam issuing from the pet cocks, etc." The word "steam" as printed was an error, either in the printing or in the copy; perhaps in both. It should have been "stream."

L. O. DANSE.

PITTSBURGH, October 2d, 1883.

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THE CONVENTION OF STATIONARY ENGINEERS AT CHICAGO.

Agreeably to announcement, the delegates for the several associations of Stationary Engineers met on Tuesday, the 2d October, with President Cozens in the chair; V. P. George M. Barker; Secretary, A. M. Davy; Treas., Jas. G. Beckerleg; and Doorkeeper N. W. Williames at their several posts; also Bros. Cullinan, Grover, and Baker were present.

Bro. J. F. A. Cullinan, Rochester, N. Y., was appointed Conductor, *Pro. Tem.* A Committee on Credentials, consisting of Bros. Baker, Cullinan and Beckerleg was then appointed, and reported the following delegates entitled to seats: A. J. Brush for Detroit, Geo. M. Barker, for Grand Lodge of Massachusetts, Lynn, No. 2, and Hamden, No. 3, of Massachusetts; H. D. Cozens, del., for Providence R. I., New Haven and Meriden, Conn., and Brooklyn, N. Y.; Geo. A. Grover for Worcester, Mass.; J. J. Wightwrick, of New York; R. H. Shultz, of Baltimore, Md.; A. M. Davy, del., for San Francisco, Cal., and Leadville, Col.; Jas. Ostrander, Urbana, Ill.; Jas. G. Beckerleg, del., for Rome, N. Y., and Toledo, Ohio; C. R. Elliott, of Denver, Col.; G. G. Minor, Cincinnati, Ohio; W. A. Hammitt, No. 1, of Mass.; C. E. Byerly, of Owosso, Mich.; R. J. Kilpatrick, of South St. Louis; E. T. Ivester, of St. Louis, Mo.; I. A. Baker, of Wilmington, Del.; Wm. Ponsonby, Chicago, No. 1; C. L. Dicey, of Chicago, No. 2; J. J. Wightwrick, for Jersey City, N. J.; J. F. A. Cullinan, Rochester, N. Y.; N. W. Williames, Phila., Pa.; R. H. Depew, St. Paul, Min.; C. S. Curry, Louisville, Ky.

The delegates represented members of the different associations, to the number of: Brooklyn, 80; New York, 72; Chicago, No. 1, 259; Detroit, 30; Keystone Council, Phila., 111; Providence, 75; Wilmington, Del., 31; Mass. Lodges, 145; St. Paul, 16; Canton, Ohio, 11; Rochester, N. Y., 30; Carthage, Mo., 13; St. Louis, 57; San Francisco, 30; Denver, 16; Chester, Pa., 20; Baltimore, 59; Chicago, No. 2, 28; Meriden, Conn., 15; Cincinnati, 22; Louisville, Ky., 27; Owosso, Mich., 16; New Haven, Conn., 56; Rome, N. Y., 12; South St. Louis, 15; Kansas City, 25; Urbana, 11; Jersey City, 18; Toledo, 14; Leadville, 32. Total, 1,349.

The Secretary reported 1,349 members, and the Treasurer $215, balance on hand.

The Convention then went into the transaction of general business. A constitution governing the body and subordinate institutions was adopted, but is too long to publish at this time. It will appear in a later number of this paper. The Mutual Aid branch was also provided for in this respect.

Regarding the association at Fall River, Mass., concerning the status of which there has been some dispute, (also the *Flour City Association*, of Rochester, New York, and the "*Missouri Locals.*" of St. Louis, Mo.,) the Convention decided that the National Association had no right to issue a charter to the first-named, but the members must apply to their State Association for recognition. The *Flour City Association* was annulled, and a new charter issued, bringing it into the association under the title of *Rochester Association*, Number 3, of New York. The *Missouri Locals* had already surrendered their charter, and therefore their petition was not entertained, the National Association recognizing the legality of the charter issued to the *St. Louis Association*, Number 2, of Missouri.

A form of visiting, clearance and membership card was adopted, and uniform style for all lodges was decided upon. Hereafter all engineers under the jurisdiction of THE NATIONAL ASSOCIATION OF THE STATIONARY ENGINEERS OF THE UNITED STATES will have one title; for example, "*The Association of Stationary Engineers of New York, No.* 1.

The following officers of THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS were chosen for the ensuing year:

JAMES G. BECKERLEG, Chicago, Ill., *President.*
R. J. KILPATRICK, St. Louis, Mo., *Vice-President.*
A. M. DAVY, Detroit, Mich., *Secretary.*
GEO. M. BARKER, Boston, *Treasurer.*
JOHN F. A. CULLINAN, Rochester, N. Y., *Conductor.*
N. W. WILLIAMES, Philadelphia, *Doorkeeper.*

The unwritten work was entirely changed. Brother Williames presented the Association with an elegant seal of his design, representing an indicator card, full stroke on one end, and working expansively on the other end, with the work of both cards summarized on each. The words "National Association of Stationary Engineers" are over the top, and the words, "Organized 1882," at the bottom.

President Beckerleg presented a copy of Roberts' Manual, which has been adopted as the authority of the Association.

The regular business of the Convention was suspended for the moment, while Brother Cullinan presented the following resolution:

"*Whereas*, our respected and beloved Brother Williames has been recently deprived of his loved companion by death: Therefore, be it

"*Resolved*, that we tender to Brother Williames our deep and sincere sympathy for his great loss."

This mark of esteem was responded to by Brother Williames in appropriate terms.

The business of the Convention was then resumed, the question of the remuneration to be awarded to the Secretary, for his services, was considered. It was resolved that he should receive eight per cent. of all moneys turned in.

On miscellaneous business, papers, relating to scientific discoveries in the line of the profession, during the past year, were presented. Many of these were discussed at length, and held over till the next meeting.

A vote of thanks was extended to the Chicago Associations for the courteous and liberal manner in which they had entertained the delegates, as also, to the Press of Chicago, for their unbiased reports of the proceedings. The Convention recognized, fully, the services of all technical papers which had espoused their cause during the past year, and unanimously decided not to select any as a special organ.

NOTES.

Our report of the proceedings comes to hand at the latest possible moment, and we regret that, from this cause, we are compelled to condense to the above summary of what transpired. The feeling and harmony pervading the assemblage, were especially noticeable. Every delegate seemed to be fully aware of the situation, and the importance of carefully considering each question. The results show that their deliberations were wise; the officers elected are all conservative men, with but one object in view, and that one, the advancement of the best interests of Stationary Engineers everywhere. No personalties were indulged in, and all passed off harmoniously. The Convention was not disgraced by any scramble for office, or grab for personal distinction, and the meeting of 1883, at Chicago, will long be remembered by all who were a part of it.

ENTERTAINMENT OF VISITING BROTHERS.

The Chicago Associations, Numbers I. and II., gave the delegates a sample of Western hospitality. They received the delegates at their rooms on Tuesday, and made them formally welcome; on which occasion Bros. Minor, Barker, Williames, Cozens, and Elliott, of the delegates, made appropriate responses. On Wednesday the delegates visited the Exposition in a body, and on Thursday they blossomed out into a grand ball given in their honor by the Chicago Associations I. and II. The reporter acknowledges himself unable to describe, fittingly, the occasion. He has, even at this time and the distance at which he writes up his notes, only an abiding recollection of an assem[illegible] women and brave men, striving in all wa[illegible] delegates enjoy themselves, as they certai[illegible] utmost.

On Friday carriages were placed at the disposal of the delegates, and they visited many places of note. Among others Bemis & Company's brewery, the engine and boiler room of which was universally acknowledged to be the finest ever seen by the delegates.

Subsequently, Mrs. James G. Beckerleg, wife of the President-elect, entertained the Brothers, assisted therein by Mrs. Walbridge and the Misses Brown, Palmer, etc., etc. After this, many of the delegates left for their homes, carrying with them most agreeable recollections.

All of the principals concerned in the Convention were renewed in their faith as to the need and occasion for the Association, and strengthened in their intentions to prosecute its interests to the utmost.

The next meeting will be held in Baltimore, Md., on the first Tuesday in September, 1884, when a largely-increased membership is expected.

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NOTICE TO STATIONARY ENGINEERS' ASSOCIATIONS.

As soon as possible the Constitutions will be printed. The different associations who are now called by various names, will please inform me if they wish them changed, as I shall issue Charters to them soon. Let me suggest that in all cases the associations be called by the name of the city in which they are located. I shall have the necessary books ready by January 1st. All wishing them, and seals, will please inform me of the fact. As the year is to begin on July 1st, 1884, let me ask, as a favor, that the present officers hold over until June next.

Now let every Association put its shoulder to the wheel and *work!* Let us have at least 3,000 engineers represented at our next meeting.

The Constitutions will be ready by November 1st, and the Minutes by November 15th.

For myself, let me say I shall do my level best to attend to all correspondence, and should it grow to such proportions that I cannot, I shall call upon parties who have promised to assist me.

Until further notice, make all P. O. orders payable to Geo. M. Barker, of Boston, Mass., but send them to me first so I can credit the Association sending on the books. I will then forward them to the Treasurer for collection; by so doing much expense will be saved.

Associations needing Rituals will send to me for them. The cost is $1.00 per set of four.

A. M DAVY,
Sec. N. A. S. E., of U. S. A.
179 ELMWOOD AVE., DETROIT, MICH.

SETTING A SLIDE VALVE.

Simple as this matter is there are many to whom it is difficult, and for the benefit of such persons we have made a diagram that shows the relation of the crank and eccentric very plainly. To the experienced engineer setting a valve is a matter of a few minutes, if the draughtsman has done his part properly, and the engine is made from regular drawings. If, however, the lengths of the eccentric rod, and throw of the wheel itself are matters of guess work, to be adjusted after all the parts come together for the first time, then it is necessary to use judgment. Sometimes, in engines made by the rule of thumb, the throw of the eccentric is too great, and the valve strikes both ends of the steam-chest. In this case, if the rocker-arm is long enough, the pin in it must be lowered. If it cannot be lowered, a new and longer arm must be made. If there is no rocker-arm and the eccentric is connected directly to the valve-stem there is no remedy a new eccentric must be made with less throw. It is not very likely that the inexperienced man will meet with such cases, and we will confine ourselves to valves which have been set, but have slipped out of place.

When the crank is on the center the relative positions of crank and eccentric are as shown in the diagram. The wheel, *A*, shows an eccentric attached to a valve, which has neither lap nor lead. The valve merely covers the ports and, therefore, the widest part of it stands at right angles with the crank. Wheel, *B*, shows the position of the eccentric, with reference to the crank, when the shaft turns in the direction of the upper arrow; wheel, *C*, shows the position when the shaft revolves in the direction of the lower arrow. These wheels, *B* and *C*, the beginner will observe, are not at right angles with the crank, but a little in advance of a right angle. This is to allow for the lap of the valve, if any, and the lead—if anybody wants it.

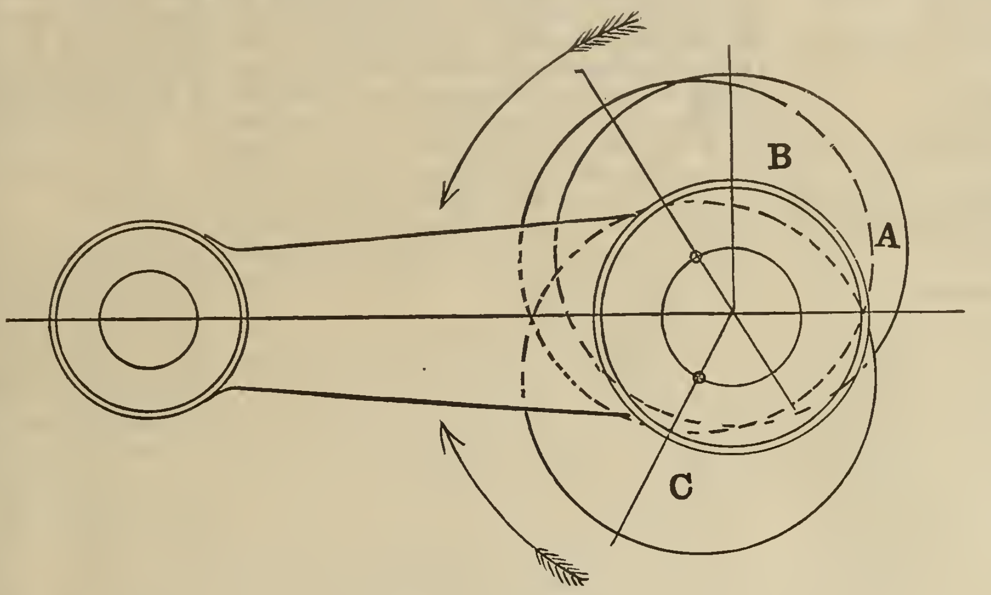
Before placing the wheel in any position, the beginner should connect the eccentric to the valve-stem, or rocker-arm, and see if the valve opens alike on each end. If it does not, either the valve-stem or eccentric-rod must be shortened or lengthened half of the difference. If one port is opened half an inch, and the other only one-fourth of an inch, the valve-stem must be corrected one-eighth of an inch. When the valve runs square, as it is termed, then the eccentric may be set as shown.

In setting valves with link-motions, the process is identically the same, but care must be taken to get both eccentric-rods of the proper length before anything is done toward fixing either eccentric fast on the shaft. If one valve is set first, say on the go-ahead side, and the backing eccentric left to be set and adjusted for length afterward, there will be trouble, for the wrong side will throw the right side out again. Or, if this is a little obscure, one wheel may be set right, but if the other one is wrong it will affect the wheel which is set properly.

Just this one thing has puzzled some engineers more than any other. They get one wheel right for going ahead, neglecting the backing wheel, then they set the backing wheel and the go-ahead side is wrong. They try to remedy this by altering the lengths of the valve-stem, or eccentric-rod, and then the backing wheel is out again, and so it goes on until they give the job up as mysterious and unlike any other.

There are endless rules and diagrams extant for setting valves with trams, and squares, and circles marked on the shaft, etc., etc., but these are all needless and unnecessary. All one requires is to be sure and get the crank on the absolute dead center before fastening the wheel. Any man with gumption enough to set a valve at all, knows how to do that without instruction.

IT IS NOT unusual to find articles in workshops which have been spoiled in the process of manufacture, and have been laid on one side until they may chance to come in for some other purpose. We think we are right in saying that there is often more time and money wasted in trying to make some such article "come in" than would have sufficed to have made complete the required object.—*Mechanical World.*

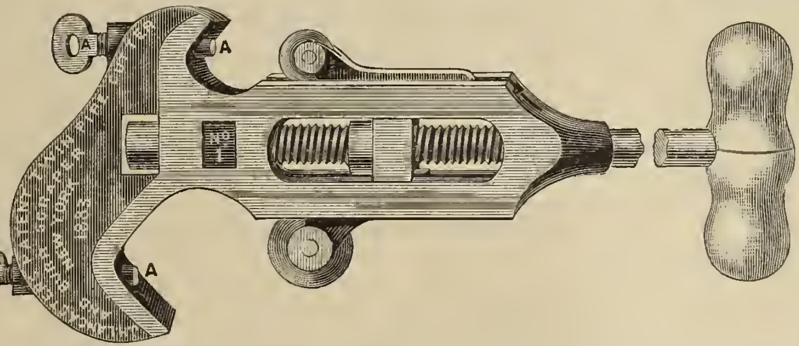


SETTING A SLIDE VALVE.

THE LANCASTER PATENT "TWIN" PIPE CUTTER.

The illustration herewith shows a tool in very general use which contains some features unusual to them. It is called "twin," for the reason that there are two sides, or sizes, to it, which allow a wider range of capacity in one tool; doing the work which generally requires two separate sizes in other pipe-cutters.

This tool is light, handy, and made entirely of steel. The set screw of burr scrapers, marked *A* in cut, can be adjusted so that none or any desired depth of burr can be removed, and the end of pipe slightly tapered and pipe cut off ready for threading at one operation.



The increased range of pipe taken by each size makes the twin cutters cheaper and more convenient for general use than others. They are made both with and without the burr scrapers shown at *A*.

This tool is the invention of Mr. James H. Lancaster, and price lists can be had by addressing The Lancaster Manufacturing Company, 36 Dey street, New York.

SURFACE INDICATIONS.

When prospectors for gold see promises in plain sight on top, they call them surface indications, and are encouraged to develop them to the fullest extent. The publisher of a journal is a prospector for gold, and sometimes he sees surface indications which lead him to believe that he is following the right vein.

A friend in the West (and there are a good many there of THE MECHANICAL ENGINEER) says, of his club of eighteen, sent to us last January:

> "All say they would not be without it for twice the price, as it is *the* paper for practical engineers and mechanics."

Another friend, who sent a club of thirty-five, says the same, only more so, and adds:

> "I have received only the most favorable reports from my club, as to THE MECHANICAL ENGINEER"

Another, instrumental in getting up a club of forty, says:

> "If you do as well in the future as you have this year, you will certainly have the support of all reliable engineers everywhere."

And another:

> "I am glad we have one engineers' paper in this country worthy of the name. You publish a paper for engineers, not like the *American Moulder*, which is full of boys' trash and poppycock about things the editor never saw or heard of," etc., etc.

We might multiply these communications many times, but we have some consideration for the feelings of our friends, and do not wish them to think that we are going to fill our paper with personal compliments. "Good wine needs no bush," says the proverb, and we mean to make THE MECHANICAL ENGINEER so useful that it will carry its certificate on its face. Sometimes everything is slack, and not much that is new presents itself worthy of discussion, but we think that he must be a very learned man who cannot, in the course of a year, get the worth of his money from the paper.

The coming year—1884—will mark a very great advance in THE MECHANICAL ENGINEER. As our facilities improve, the paper will show it, and if our friends wish to see *the* engineer's paper in all respects, engravings, execution, and general appearance, let them say a good word for us when they can, and it will be a great service.

During 1884, we shall have new contributors in all lines, and we shall—let the future speak for itself.

THE HORSE POWER OF A TEN-INCH GUN.

Expressed in foot-pounds, the energy of a ten-inch shot is something tremendous. The explosive force of gunpowder is, in round numbers, 25,000 lbs. per square inch, and the velocity of the shot as it leaves the muzzle is 1,500 feet per second. Therefore we have: Area of the ten-inch shot, 78·54; omit the decimal and we have 78, multiplied by the pressure on it (25,000 lbs.)=1,950,000 lbs., which, again multiplied by the velocity (90,000 feet per minute) gives us 175,500,000,000 foot-pounds of work stored up in the shot of a ten-inch gun as it leaves the muzzle.

By the articles of war, it is death to stop a cannon-ball, and small wonder.

THE NUMEROUS FRIENDS of Mr. Jesse H. Lord, well known as an able writer on technical subjects, will be pleased to know that he is now attached to the *Scientific American.*

AN INDIANA MILLING FIRM, in renewing their subscription to the *American Miller*, say: "It was carelessness on our part that we let our subscription expire; but your paper is the only one that stops when the subscription is up. The balance of the papers aim to force a circulation, and we don't like it."

Friend! just cast an eye in this direction, and observe our business column. We nailed up this flag when the ship was launched, and it has been flying ever since. It is adhered to most religiously—no money, no papers. We have always admired the simplicity with which some publishers open accounts all over the United States for two or three dollars. In one paper of this class, which boasts 10,000 circulation, we saw sometime since: $6,000 wanted! Any publisher can get a circulation of that character. We don't blame a man for not paying for a paper that is given to him. Why should he? Why not sell a man a barrel of flour, or a pair of boots, and give him more when they are gone?

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

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Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, when possible.

INDUCEMENTS TO CLUBS.

Last year we offered, as an inducement to new subscribers, to send the last four issues of the year gratuitously to all who sent in their names for the coming year before a given time. This plan worked so well that we renew our offer, to all not now on our books, for lists of not less than five names at one time.

Persons who may have read the paper casually, and formed an intention to subscribe with the coming year, can now unite with others and obtain fourteen months for one year's subscription. The rates will be found in our business column on this page.

As to the class of matter to be published in the next volume, we cannot specifically announce the titles of all serials. Those already published by us have been favorably received by our readers. In no one instance has either the character—that is, the serial form—or the value of the matter been questioned. It is, as we have said, too early for us to announce the whole list, but if our readers will take our word for it, we can assure them that the articles will be instructive, and add to their stock of general information in other trades with which they are not directly connected.

To take advantage of this proposal—the four last issues gratuitously—all club subscriptions must be sent before the 15th of November. New single subscribers will also be received at regular rates, $2. This offer is valid only from this time to the date in question, and persons accepting it are particularly requested to note the conditions.

One reason for this offer is that on the last of the current year and during the first of the next, we are crowded with business. Old subscriptions are renewed, and new ones are received; if we can anticipate a little and form new lists in advance of the busy season, we are relieved of a great pressure.

We have therefore opened our subscription books for 1884, at this time, and shall be pleased to inscribe 10,000 new names in it.

Persons who have written us that newsdealers do not keep The Mechanical Engineer can have every copy sent promptly on time, and obtain the last four issues of this year gratuitously by subscibing now.

COMPOUND LOCOMOTIVES.

The success of compound engines, afloat and ashore, (in stationary engines) has naturally directed attention to one other branch of engineering as yet unworked to any extent, and the experiments in the direction named, now going forward, will be watched with interest by all engineers.

Compound locomotives are now being built in this country and Europe. In England Webbs and Mallet's "systems," so called, have been employed, though why they are so designated it is difficult to see. All the system there is about these compound engines is that practiced in every other, the only difference being in the mechanical arrangement. But the value of the principle, as applied to locomotives, may be open to question.

There is certainly some as regards passenger engines. Compounding an engine is only available, or economical, when the exhaust leaves the high pressure, or first cylinder, in a condition for further work. At high speeds, with the ordinary locomotive, there is very little value in the terminal pressure, for the practice is to cut off so short that, as cards show, it is very little above the atmosphere. At 100 lbs. actual pressure in the steam chest, cutting off at 1-5th, the average point at high speeds with passenger locomotives, the terminal is about 24 lbs. absolute, or only 9 lbs. available pressure for the second, or so called low pressure cylinder; even this would be still further reduced between the small and large cylinder, so by the time it reached the last cylinder the value derived from the exhaust would be comparatively small.

This argument is fully borne out by the published performance of one passenger locomotive (Webb's) on the compound principle, where all the saving that can be figured by the designer is 8 lbs. of coal per mile over an ordinary locomotive. This, it is easy to see, may become somewhat less in the hands of disinterested observers and ordinary management.

With much higher than the usual pressures carried in locomotive boilers—say 175 lbs.—the value of the exhaust, from ordinary engines, would be greater at the same point of cut-off, but this value would be reduced or it could be rendered available by larger cylinders and higher expansion, so that the terminal could have any grade desired.

For other than passenger engines, the compound principle may have less objection urged against it. On coal-hauling engines and freight service, the waste of steam is great, chiefly from the low grades of expansion, and here compounding may come in advantageously, but the benefits to be realized, on any mechanical arrangement adopted, depend so greatly upon the handling of the engine by the runner, that it is easy to see the designer's intentions may be wholly neutralized. Pressures and points of cut-off have to do with the economy of the system.

Locomotive service is wholly unlike either marine or stationary work. In both of these latter there is a fixed duty to be done, and the load never varies, to speak of, incidentally it may. Aboard ship the engines may race; or shoal water may necessitate shutting down for a short time. In these cases the compound engine is no better than any other, but the time occupied, or the occasions for the action noted, are so seldom that they may be called incidental. Not so with the locomotive. Nothing moved by steam has so variable a load. Curves, grades, cars hauled, atmospheric resistance, etc., etc., enter into the account, and are against the value of the compound principle, for there would be periods when the second cylinder would not only do no work, but would be an additional load. Add to this the expense of maintenance and first cost, and it is open to question whether the compound principle can be made available in locomotives. [illegible] of this same line of argument has [illegible] by a foreign contemporary, and with the [illegible] conclusions. This article was projected and written, in great part, before it appeared.

THE INDICATOR SERIES.

Our readers will observe that in this issue we commence the series on the indicator, announced and commented on in our last impression. We have taken the earliest opportunity to produce them. It is proverbial that the best laid schemes will go astray sometimes, and we acknowledge to being a little late with the articles in question. We do not think, however, that our readers have lost anything by the delay. The author—Mr. W. Barnet Le Van—is well known all over the country as a professional and practical mechanical engineer, thoroughly versed in his business, and, withal, a capable writer. He has no hobbies to expound, no dogmas to uphold, and he does not believe that he is the inventor and originator of the indicator. The articles in question are purposely elementary in character, and are addressed to those who have had no practical experience with the instrument, but would like to have some. Mr. Le Van will assume that his readers know nothing beyond the sometimes vague, and sometimes incorrect instructions of text-books, and will write with this impression before him.

Coming in connection with our offer to clubs, this series is most opportune, as it enables those who subscribe at once to secure the articles entire.

STUFF AND NONSENSE.

In a trade-organ, published in this city, we find the following:

> "Why should Labor fill the world with plenty, and live in want and abject misery? There is something wrong when those who do the most get the least."

If labor lives in abject want and misery in this country it is its own fault. God gave to every man two hands, and brains to direct them. With proper use of these no man in this country need live in want or misery.

And again:

> "We are slaves without the advantage of slavery."

This is sickening. The idea of an American workingman calling himself a slave! If there ever was a country on the face of the globe where a man had a clear field and no favor, it is this one. A man here is what he makes himself, and if he does not get his share of the blessings and pleasures of life, no one but himself is to blame for it; certainly not his calling or his occupation. There are not wanting in all trades certain persons who think that their lack of success is owing to the business itself. The calling does not make the man, the man makes the calling, and according as he is worthy, upright, honest and intelligent, he elevates it. The reverse of these qualities degrades it. A workingman is no slave to his calling in this country; he may be to some habit.

Such utterances as we have quoted make a true American workingman ashamed.

NO REMEDY AT PRESENT.

The *Iron Age* says, in relation to the inspection laws:

> "If the Government could insure safety, its present system would be well enough, but it cannot, and no further complication of the law would secure this result. It would be much better and simpler to abolish the whole business, and substitute a code of laws defining the measure of responsibility assumed by owners of boats licensed to carry passengers, and then leave them free to adopt such measures of safety as they saw fit. Under such circumstances, there could be no dodging behind inspection certificates when boats burn or boilers explode. The owners of a boat would not run the risks they now assume with impunity if the consequences to themselves, in the event of fatal accident, were the confiscation of their property and imprisonment for terms of years proportioned to the gravity of their offence."

We don't think much of our contemporary's remedy for the present useless system. Allowing owners to adopt such measures of safety as they see fit is just the trouble now, and to give them a license to do so would be legalizing recklessness. A great trouble which exists, is that owners of steamboats—mere moneyed men, take it upon themselves to say what repairs are needed. They know well enough that the boilers, or machinery need some, but they will not make these because they cost money.

As regards pains and penalties for breaking the law, steamboat owners laugh at them, knowing full well that the same would never be enforced. Suppose such a law as our contemporary wishes carried with it a penalty of $5,000 fine, and one year's imprisonment; and suppose further that one of the Iron Steamboat Company's boats burst its boiler; does our contemporary feel that directors would be imprisoned, either singly or collectively? Who are the owners, and how are they to be reached? If the case were one of some poor Irishman, owning a little tug, trying to make a living, it is just possible that, in the event of his boat blowing up its boiler, prompt action would be taken, but the wealthy and influential would escape through countless loopholes.

There is no remedy at present for these accidents on sea. On land there is. A company makes it a business to insure against such disasters, and all boilers covered by them are practically safe. They can tell what inspection discovers, and how loath owners are to make the most trivial repairs.

Until engineers are held harmless for reporting defects in steam apparatus, and the repairs they find needed are promptly made, there will always be danger.

A DEFECT IN TECHNICAL BOOKS.

We long for the day when compilers of technical books, discarding higher mathematics will put the results of their reading and study into simple calculations, so that those who need the information can buy it. As it now is, all advanced investigations are wrapped in densest gloom to the very class who thirst for the information, and have the money to pay for it.

Mathematicians are few; persons of liberal education in any mechanical pursuit are fewer, and the great need is for technical books adapted to the wants of workers in all lines. Simple in style, direct and correct in conclusions, few in words, but positive in results: these are the cardinal points of a technical work, and when writers fully understand this the sale of them will increase most rapidly. The men who do not understand higher mathematics are those who need instruction, while those who do understand them do not need technical books, as a class. For example: a foreman of a shop wishes to make a pair of cone-pulleys, and buys a work which purports to tell him how to do so. Turning to the page devoted to it, he is handed this:

> "If, therefore v is the velocity of the first pair of pulleys, a and b, the velocity ratio of the rest must be:
>
> $$ve \quad ve^2 \quad ve^3 \quad . \quad . \quad . \quad ve^{n}-1,$$

When he sees this he naturally stands appalled, and feels a little indignant withal. It tantalizes him to think that the knowledge he seeks lies before him written in an unknown tongue, and he wonders why his wants are ignored, and mechanical or technical works are written for professors instead of machinists. We join in the plaint. The voice of the foreman is our voice. Technical books, in a majority of cases, are far away from the comprehension of working mechanics, and the sooner a change is made in the methods of treatment of the calculations, the greater will be the demand for them.

A CURIOUS PLACE FOR MICA.

In cleaning out the back connection of the steamer *Guyandotte's* boiler, a sheet of mica, described to us as about 2 feet one way by 3 feet the other, was discovered lying up against the side, or end. The coal passer who was engaged in the duty, not thinking mica in a back connection was anything unusual, merely broke it up with his scaling hammer and threw the fragments in the fire-room, where they were seen by the engineer, Mr. J. B. Sundell. This gentleman's attention was attracted and his curiosity aroused; his inquiries resulted as previously stated. Not unnaturally he wishes to know how the mica got into the back connection. We are not able to give him any information on this point. Mica is a mineral formation, occurring only in the oldest geological strata; it is found in comparatively small pieces, say 8 × 10 inches. A sheet of mica such as that described above, two feet by three feet, is, we believe, quite unknown to the trade which handles it. How the mica got into the back connection, and why it was so abnormally large, are questions Mr. Sundell would like very much to have answered; and so would we.

FAST PASSENGER-ENGINES.

The dimensions and weights of fast passenger engines in this country, as built by the Pennsylvania Railroad Company and the Baldwin Locomotive Works, Philadelphia, are as follows:

Engine.	P. R. R. No. 10.	B. L. W. No. 162.
Total weight	92,000	85,000
Weight on drivers	65,300	57,000
Total wheel base	19' 5"	21' 8"
Cylinders	18"×24"	18"×24"
Drivers, diameter	78"	68"
" journal	8"×10½"	7½"×8½"
" spread	7' 9"	7' 6"
Truck wheel diameter	33"	32"
" " spread	6' 6"	5' 8"
Boiler diameter	50"	52"
" center above rail	89¼"	82½"
Tubes, number	201	200
" diameter	1⅞"	2"
" length	10' 11⅜"	11' 5⅞"
" heating surface	1080'	1195'
Furnace, length	120"	126⅞"
" width	41¾"	43¾"
" heating surface	125'	140'
Steam port	16¾"×1½"	16"×1⅝"
Exhaust port	16¾"×3¼"	16"×3"
Valve travel	5½"	5½"
Main wrist-pin	4⅝"×4"	5"×4½"
Side, rod wrist-pin	3¼"×3¼"	4"×3½"
Total heating surface	1205'	1335'

In some points, there is a marked difference in the details of these engines—in the drivers, the wheel-base, height above rails, and total heating surface. Those who feel certain that large drivers insure high speed—all other things being equal—may be interested in learning that the Baldwin Locomotive Works engine, with 68" drivers, has made better records over the same road, with the same trains, than the Pennsylvania Railroad engine. A 68" wheel starts away with a train more readily than a 78" wheel, and as there is more heating surface in the boilers by 130 square feet, the cylinders can be supplied fast enough to give the additional revolutions required to make the same time in a given distance. There are many points of comparison in the above details, which are of interest, that for want of time to study carefully we cannot make—the adhesion or weight on drivers for one thing—and we must content ourselves with this brief allusion.

BOOK NOTICES.

DIXON'S MACHINISTS AND ENGINEERS' CALCULATOR.—The Machinists and Engineers' Practical Calculator; a compilation of useful rules and problems arithmetically solved, together with general information applicable to shop-tools, mill gearing, pulleys and shafts, steam boilers and engines; embracing valuable tables and instruction in screw cutting, valve and link-motion, etc., etc., by D. B. DIXON, New York: D. VAN NOSTRAND, Publisher, 27 Warren Street.

Of books for machinists and engineers there are no end, most of them professing to afford information upon points not generally known, and to give simple rules for arriving at the proportions of machinery and steam apparatus in general. Unfortunately, the compilers of these works address a comparatively small class in the community of workers, for they have, for the most part, locked up the knowledge they possess in algebraic formulæ, and advanced arithmetical problems, with the result of disappointing the very persons who most need the information. The mathematicians in any community, are a small proportion of the whole, and among working men, in particular, there are very few who have any more than rudimentary knowledge of the first four rules of arithmetic. If they could make these available, and solve some rules by their aid, they would be encouraged to seek further, and in due time become expert with figures.

It is just in this respect that the average pocket-book for engineers and machinists disappoints the class who have a special need of it.

We are glad to find, in the work under notice, that the author is fully aware of the defects in pocket-books generally, for the use of those who have had limited educations, and he has so simplified standard rules that any young man, who can multiply and subtract, can avail himself of a great deal in mechanical engineering, which he has hitherto been debarred from. Moreover, the author instructs in mathematics; avoiding the jargon of schools, and the trade terms of text-book makers; he leads the willing pupil into a thorough knowledge of square and cube root, involution, evolution, and mensuration. Before he is aware that he is learning something the mysteries vanish, and the student finds that, by the aid of a competent teacher, who knows his needs, mathematics, so far as we have noted, is quite within his capacity. Many men have fancied that they were in some way mentally deficient, as regards the solution of problems, and have wondered why matters, which are simple to others, seemed so difficult to them. The trouble lies, in a majority of cases, with the methods by which they have attempted to learn, and not with their mental constitutions.

For example, in one book for engineers and machinists, we find the following rule for the size of a shaft to resist torsion, or twisting strain:

> "The diameter of a cast iron shaft to transmit a certain horse-power, H, is to be multiplied by 400 and divided by the number of revolutions per minute, n, then extract the third root of the quotient; this gives the diameter in inches." The formula is
>
> $$\frac{\sqrt[3]{400 \times H}}{n.}$$

This is simple enough to those who know all about it; but to the man who is building a water-wheel, and has not had the pleasure of the acquaintance of that mysterious zig-zag in front, the knowledge he seeks is as far off as ever. If he had Dixon's Pocket-Book, he would turn to it and find, under the head of torsion, this rule, p. 166:

> "*To determine the diameter required for a given torsional stress.*
>
> *Rule.* Multiply the twisting force in pounds by the length of the crank in feet, divide by 120, and the cube root of the product will be the diameter in inches."

When the millwright or working engineer sees this, he says: "Here is that terrible cube root again," but, as he has previously read the contents of the work mentioned, he finds that cube root and how to extract it is all laid down plain before him.

This wonderful process, he sees, is nothing but the first four rules of arithmetic after all, used in a certain sequence; and before he is aware of it he has learned it. We use this term—"before he is aware of it"—advisedly, because Mr. Dixon's methods of induction (leading up to a subject) are so clear that any one can understand and practice them.

We have been thus diffuse in our notice of Dixon's Pocket-Book for the reason that it opens a new field to the working mechanic and engineer. It is not only couched in simple arithmetical practice, as to its explanations, but it also instructs in the higher mathematical branches. In a sense, it might be called a mechanics' arithmetic, for, in combination with the various tables and rules for proportions of steam-boilers and engines, gears, screw-cutting, etc., etc., it is an arithmetic. For the class to whom it is chiefly addressed, it is a most valuable work and the most complete of its kind. When a mechanic has mastered it, he will find it a key to many other more advanced works and will derive many times its cost in knowledge he would otherwise acquire either very slowly or not at all. The price is $2 00, and we think all who aspire to be more than mere hewers of wood and drawers of water will send for a copy at once.

WORKSHOP RECEIPTS FOR MANUFACTURERS AND SCIENTIFIC AMATEURS.—Second Series, 485 pages, by ROBERT HALDANE. New York: E. & F. N. SPON, 35 Murray Street.

This work is much more satisfactory in character and treatment than the majority of such books. Some, treating of technical processes, and giving receipts for special purposes, deal in generalities and cover too much ground. We find in this one, however, that the author has endeavored to be exact and thorough. In many cases a great deal of space is given to the subject; as, for instance, in the chapters devoted to corrosion of steam boilers. Here many authorities are cited and the causes, in some instances, fixed and remedies suggested.

In other chapters acidimetry, baking powders, bitters, bleaching, cements and lutes, dyeing, staining and coloring, glues and cements, matches, etc., etc., are fully explained as to the best modes of manufacture. Dyeing and staining alone has 60 pages devoted to it, containing innumerable receipts for every imaginable shade and process.

For the class to whom it is addressed, the book is an extremely useful one, and should be in every mechanic's library.

MECHANICS OF ENGINEERING AND OF MACHINERY.—By Dr. JULIUS WEISBACH: vol. 3, part 1. Sec. 1. The Mechanics of the Machinery of Transmission. Second edition, greatly enlarged and revised by GUSTAV HERMANN, Professor at Royal Polytechnic School, Aachen, Germany. Designed as a text-book for schools and colleges, and for the use of engineers and draughtsmen, by J. F. KLEIN, D. E., Professor Mechanical Engineering, Lehigh University, Bethlehem, Pa. New York: JOHN WILEY & SONS, 15 Astor Place.

The work, of which the above is the title-page, is of great value to the profession, and is intended for advanced readers, who have a knowledge of higher mathematics. Weisbach is a standard in all matters of engineering and mechanics, and his teachings are accepted as correct. There is scarcely a modification of a mechanical motion, or a combination in ordinary use in the shop, that is not explained in detail, and has rules—formulas—given for its successful adaptation under varying circumstances. Journals, shafts, couplings and bearings, gearing in all its various forms, belts and their curious action, etc., etc., have great space devoted to them. As before stated, however, most of the propositions are couched in expressions which render them unavailable to any but expert mathematicians. To such the work is indispensable.

PERFECTLY DRY COKE, it has been found by actual experiment, absorbs 75 per cent. of its own weight of water.

What an inducement to buy dry and sell wet!

IN THE ROUND HOUSE.—No. XII.

BY L. O. DANSE.

RUNNING.

When a runner changes from one road to another, he is not given charge of a locomotive immediately, but is obliged to "learn the road." To do this, he rides on the engine with another experienced runner, who "coaches" him regarding the grades, switches, passing and meeting points, whistling-points, water-tanks and coaling-shutes, the parts of the road where the best and the slowest time must be made, and a thousand little points which must be known in order to "handle a run."

Learning the road usually occupies two weeks. While learning, the new man spends his spare time in familiarizing himself with the schedule and rules of the road. He is required to report for duty, just as the regular engineer who is to teach him the road does. On the road he sits with the fireman, and notes exactly how the engine is managed. The most important point to be learned is the location of the "shutting-off" points and "pulling-out" points.

There are many people who think that all that is required to get a train over the road is simply to open the throttle at the starting point and close it at the stopping point, forgetting that a railroad is not straight, level, and in equally good condition all over.

A certain amount of time is allowed a train to go from one point to another, and the train must use that time—no more and no less. Now, between the starting point and the stopping point, there is some good track and some bad. The speed must be reduced on the bad track and increased on the good stretches, so as to balance to the average schedule speed for the entire distance. There is a limit to the speed to be used in making up time, beside that due to the capacity of the engine and the weight of the train, for the rules of the road usually specify a maximum speed, which must under no circumstances be exceeded.

It will readily be understood that the nature of the train makes a great difference in the handling of the engine, as a heavy train requires much more power to draw it than a light one. To obtain more power, we must use less expansion, as expansion, though enabling us to get more power from what steam we use, reduces the total power of a given sized cylinder. As we expand less, we use more steam, and get more power, but the amount of steam used, and hence of water and coal consumed, increases much more rapidly than the power. From this, it is evident that when we use a locomotive at its maximum capacity, we cause a much greater consumption of fuel and water, in proportion to the work done, than when it is used at lighter work.

The great problem in railway economy is: "What is the greatest number of cars we can haul advantageously with one locomotive over the worst portion of our division?"

There are many sides to this question, but there is one that is seldom given the attention it deserves, and that I have just alluded to—the difference in effect of a given quantity of coal used under different working conditions.

To return to our subject, grades have an effect on the action of the engine similar to that of an increase in the size of the train, and must be met by an increased consumption of coal and water. On a grade which rises one foot in a hundred (or 52·8 feet per mile) a locomotive will draw only 24 per cent. of the load she moves easily on a level. On a grade of two feet in a hundred (105·6 per mile), the hauling capacity is only 11½ per cent. On a 3 per cent. grade (158·4 per mile), the hauling capacity is reduced to 7¼ per cent. Even very light grades affect the locomotive very perceptibly, a grade of only 1 foot per mile reducing the hauling power 6 per cent. A rise of 10 feet per mile reduces the ability to haul by 36 per cent.

Enginemen generally make a "run" for the grade at their maximum speed, just as a boy runs for a start when he wants to go up a steep plank; depending on the momentum acquired to help carry them up. When approaching a heavy grade, the runner brings up the water in his boiler as high as he can safely carry it, and the fireman makes up a heavy fire. A large quantity of hot water in the boiler, when the grade is reached, is a great advantage, as the amount of water consumed is very great, and the cold water fed by a pump to replace it has a constant cooling tendency, both on the water and the steam in the boiler. It is evident that a gallon of cold water will have less cooling effect on three gallons of hot water than on two gallons at the same temperature.

As the engine labors up the incline, her speed gradually decreases; and sometimes she is in great danger of stalling before she reaches the top. In this case, the runner sometimes shuts off his pump to obviate the cooling of his boiler. This, although quite effective, is very dangerous, and much to be condemned. Suppose the water were to be worked down until the crown sheet was uncovered. Where would that boiler and man be when the pump was put on again?

When a heavy train has to be started on a heavy grade, from a state of rest, the wheels are pretty sure to slip so soon as the throttle is opened. In this case, the engineman instantly shuts off the steam, opens the sand-box, and lets the steam on again. Slipping wheels wear their tires and the rails very rapidly, and the enormous speed at which the working parts move when the drivers slip, is very detrimental to the machinery; so that an expert engineman does not lose a second in closing the throttle, when the tumultuous "chewowowoo" of the exhaust gives warning that the wheels are "spinning" around. The inordinate rapidity with which the machinery moves when the drivers fail to grip the rail produces a tremor which shakes the whole locomotive. Shutting off, giving sand, and "letting her out" again, are so quickly accomplished by the experienced runner that the novice does not have time to see what has been done.

When the train to be started is extremely heavy, and the rail is slippery, it is sometimes impossible to start until the fireman has worked the sand against the drivers with a spade. A few fragments of stone, from the ballast, are quickly pulverized by the drivers, and help increase the adhesion when the engine starts backward, as, in running backward, the sand-boxes are useless, except when specially arranged.

BURNING SCREENINGS.

Some interesting tests have recently been made in burning screenings under a boiler, with and without the Jarvis Furnace. The first tests were made June 13th and 14th, one with natural draft, and the second with a fan blower, the boiler being thoroughly cleaned inside and out before tests were made. The boiler was then reset with the Jarvis Patent Furnace, and the tests of July 19th and 20th were made. Everything was as near comparative as possible.

The tests were made at the laboratory of T. A. Edison, Menlo Park, N. J., on a Babcock & Wilcox sectional boiler, rated at 75 H. P.

On June 13th and 14th, the tests were with the ordinary boiler setting, the first test being with natural draft, and the fuel five parts anthracite slack to one part Cumberland slack. The second test was with forced draft and reduced grate surface and the same fuel.

Tests were made July 19th and 20th with the Jarvis Furnace setting and with natural draft. The fuel used July 19th contained five parts anthracite slack and one part Cumberland slack. On July 20th, three parts anthracite and one part Cumberland. Anthracite slack, per ton, $2.50; Cumberland, per ton, $6.50.

The results were that without the Jarvis Furnace the evaporation per pound of coal from 212 degrees was 7·48 pounds of water, while with the Jarvis Furnace the evaporation was 8·85 under the same conditions as in previous test.

JAMES PRENTISS & SON, 176 Broadway, New York, have issued a beautifully-illustrated pamphlet—magazine, we might say—of every sort of optical, mathematical and engineering instruments known to the trade. It is of great service to all using such goods, and will be sent to any address.

THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER 1.

By William Barnet Le Van.

The indicator is an instrument for showing the pressure of steam in the cylinder at all points of the stroke, and registering the varying pressures, as the piston moves to and fro, on a piece of paper secured to a revolving drum, by a pencil attached to the indicator piston.

The indicator was invented and first used by James Watt. For some time it was kept by him a secret, but became known before his death, and to its use, now quite general, we are more indebted than to anything else for the degree of excellence which the steam-engine has attained.

The improved form of instrument, known as "The Thompson Indicator," is now largely employed. It consists of a small cylinder accurately bored out and fitted with a piston capable of working in the cylinder with little or no friction, and yet practically steam-tight. The piston-rod is connected to a pair of light levers, so linked together that a pencil carried at the end of one of the levers moves in nearly a straight line vertically. A spiral spring placed in the cylinder above the piston, and of a strength proportioned to the steam-pressure, resists the motion of the piston; and the elasticity of this spring is such that each pound pressure on the piston causes the pencil to move a certain fractional part of an inch.

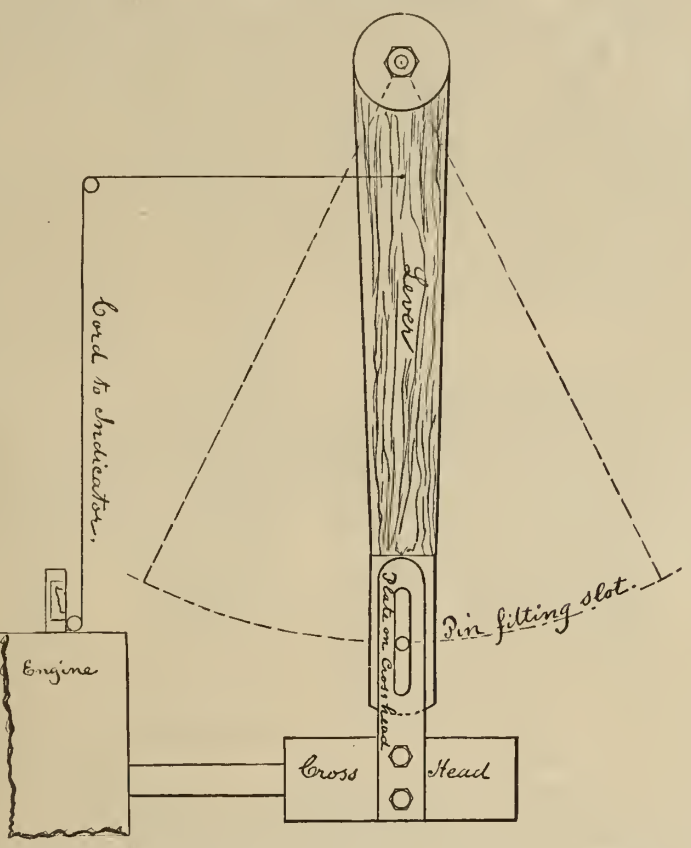
The paper is wound round the drum of the instrument, which has a diameter of two inches, and is capable of a semi-rotatory motion upon its axis of such an extent that the extreme length of diagram may be five inches. Motion is given to the drum in one direction by means of a cord connected to a suitable part of the engine, moving the same way with that of the piston, and the drum makes its return movement by the action of a coiled spring at the base of the drum.

The indicator may be fixed in any desired position, and the guide-pulleys attached to the instrument, under the paper-drum, may also be placed so as to bring the cord upon the drum-pulley from any convenient direction. The upper side of the piston is open to the atmosphere, the lower side may, by means of the cock on it, be put into communication either with the atmosphere or the cylinder of the engine. When the key of the cock is so turned that both sides of the indicator piston are acted on by the atmosphere, the pencil, on being brought into contact with the moving paper, will rule a straight line; this is called the atmospheric line.

It is now a common practice to connect, by means of pipes, both ends of the steam-engine cylinder (fitted with a two-way cock,) so that by one movement of the lever of the latter, the indicator can be put in communication with either end of the cylinder at pleasure, or it may be shut off from both to produce the atmospheric line as above described.

In order to produce a diagram, showing the action of the steam in the engine cylinder, if the indicator is put in connection with one end of the engine cylinder, the spring will be compressed by the steam-pressure under it, and the amount to which the indicator piston rises is a measure of the steam pressure. For example: suppose that the spring compresses one-sixteenth of an inch for every pound on it; then, if the steam pressure is forty pounds, the piston will rise two and one-half inches. As the piston of the engine travels forward on its stroke the steam pressure begins to diminish, and becomes less and less able to compress the indicator spring, and consequently the indicator piston continually falls. In order to register these continually varying pressures, the pencil is kept in contact with the paper on the drum of the indicator, and as the engine piston moves backwards and forwards the drum of the indicator partially rotates also, backwards and forwards, coincident with that of the engine piston, and the curved line thus traced by the pencil moving vertically up and down on the paper (itself moving at right angles to the up and down movement of the pencil) is called an indicator card or diagram. It is nothing more than a register of the varying pressures in the cylinder as the piston moves to and fro.

In order, also, that the diagram shall be correct, it is essential, first, that the motion of the drum and paper shall coincide exactly with that of the engine-piston; second, that the position of the pencil shall precisely indicate the pressure of steam in the cylinder.



The first condition is frequently somewhat difficult to bring about, because it is not only necessary that the beginning and end of the motions shall be coincident, but that these and all intermediate points shall be so. Owing to the irregular motion of the engine-piston, consequent upon the varying angularity of the connecting-rod, it is, therefore, generally advisable to connect the cord in some way to the piston-crosshead. If any other point be chosen, it must be carefully seen that the motion given does not vitiate the diagram.

As the motion of the parts mentioned exceeds in length the motion of the indicator, it must be reduced in length by levers of such proportions as may be required for that purpose. For example: if the stroke of the engine is thirty-six inches, and the length of the diagram is to be four inches, then the lengths of levers are as *one* is to *nine*, or if only one lever is used, then the indicator motion must be taken from a point on the lever sufficiently far from its fixed end to obtain the reduced travel required.

One of the simplest ways of reducing the motion, is by a swinging lever with a pin working in a slot of an arm secured to the crosshead of the engine, and transmitting the motion by a cord to the indicator as shown herewith.

]TO BE CONTINUED.]

THE CAUSE OF ONE BOILER EXPLOSION ASCERTAINED.

Supervising Inspector Starbuck, of New York, who is investigating the explosion on the tug Robinson, at Albany, reports to the Supervising Inspector General of Steam Vessels, that the investigation is proceeding, and that he has taken the testimony of Frederick L. Tinslar, the engineer of the tug, who was scalded, and is now lying at his home in West Troy. Mr. Tinslar, he said, admits that he screwed down the "pop" valve of the Robinson's boiler because it was out of order and blew too easily.

It is thought that this admission leaves Tinslar liable under two sections of the steamboat laws, one of which makes the obstruction of the safety valve of a boiler or the hindering of the operation of any machinery or device employed to denote the state of water or steam in a boiler a misdemeanor, punishable by a fine of $200 and by imprisonment not to exceed five years, and the other of which makes the engineer or other officer of any vessel, by whose misconduct the life of any person is destroyed, subject to imprisonment for not more than ten years.

General Dumont said, to-day, that he could not recall any case wherein a conviction had been had under either of the sections referred to, although persons had been prosecuted under them.—*Press Despatch.*

THE TUG BABCOCK.

The tug *D. L. Babcock,* condemned in hull and boiler a year ago by the local inspectors in Chicago, but taken to Milwaukee and there given a certificate by Supervising Inspector Cook, has just been inspected again by the local inspectors here and again condemned. Supervising Inspector Cook was present at this last inspection. When the inside of the hull was exposed, Mr. Cook said: "I have seen enough." When the boiler was touched with the hammer on the belly and along the rivet seams, Mr. Cook said: "Well, I never! Can such things be? Enough! Enough! Too much!"

The local inspectors again condemned hull and boiler. The owner of the boat appealed to Supervising Inspector Cook, and he referred him back to the local inspectors, confirming their condemnation.

But the great Supervising Inspector of steamboats of this district stands in a most unenviable position. He acknowledges that in overriding the local inspectors a year ago he did wrong, and let a boat continue running which was unsafe in both hull and boiler.—*Inter Ocean.*

The *Trade Review,* in commenting upon the superiority of American engravings of machinery over foreign, says, that they look dull and heavy, etc., etc. They do, and it is not alone in the execution of them that they are poor, but in the printing. Foreign pressmen do not apparently, understand how to bring up engravings, but print them flat from the block; "overlays" and "underlays" seem to be too much for them. Shadows are dull and solid in their hands, ending in abrupt puddles of ink. We have frequently republished foreign engravings in The Mechanical Engineer, and under skilful treatment they look far better than the originals. Also, we have seen fine American cuts printed in foreign papers, and they were simply spoiled.

It requires many hours to prepare a block for the press. An unskilful pressman can spoil the finest engraving by bad printing.

A terrible accident occurred during the recent visit of members of the English Iron and Steel Institute at the Northeastern Steel Works. A blow was completed in a 10-ton converter, and the metal poured into a ladle and lifted on to a bogie drawn by a small engine. In some way not explained, the ladle was overset, and 10 tons of molten steel was poured out on the floor below, almost among the visitors and workmen. Mr. Green ran along the platform as fast as he could, shouting to Mr. Davison to follow. He did not do so, but made a spring at a lift which was at hand, and instantly involved himself in a bath of molten metal. The lift was lowered as speedily as possible, when it was found that the unfortunate gentleman's clothes had been burned from his body. His face was charred. His hair and whiskers had disappeared, and his whole body bore marks of fearful injury, from which there was no hope of his recovery. Among others who received injuries were M. Simon, inventor of the Simon-Carvés coking process.

Any person knowing that dies are used for flanging boiler plates anywhere in this country, will confer a favor by writing us to that effect.

SMOKE PREVENTION.

It is well known to most engineers that the more perfect combustion is in the furnace, the less is the volume of smoke emitted from the smoke-pipe. Possibly the type of boiler used has much to do with smoke prevention. The ordinary portable, or locomotive boiler, which consumes fuel rapidly, by using a sharp blast, drags the unconsumed gases rapidly through the tubes before combustion can take place, and is, doubtless, the most wasteful type used. Engineers and others have attempted to introduce features to prevent smoke and enhance the economy of these types of boilers, by attaching various contrivances, but those who have advocated radical changes from the original designs and dimensions of the boiler itself are few. Some of these attachments have fulfilled the expectations of their inventors and been crowned with success. The fire-brick arch is the simplest and as successful as any. The object of the brick arch is to concentrate the unconsumed gases on the highly-heated masonry, so that they may ignite and consume. This will occur to some extent, depending upon the volume and velocity of the gases impinging on the masonry, which in turn is governed by the impetus and volume of the air passed through the fire.

The steam-blast is an ancient English invention, first used on one of Stephenson's locomotives, and it answers the purpose for which it was designed, but it is a wasteful adjunct. It not only wastes the gases, but is frequently so intense that it lifts a portion of the coal from the fire-box and ejects it through the smoke-stack in the form of cinders or coke.

The water-bridge, it is stated, has not met with the success contemplated, nor proved effectual as heating surface. Possibly, a hanging water-back deflector, designed so as to precipitate the gases from the fire-box into a chamber lined with fire-brick, thence upward through the tubes, would be an improvement more effectual than the ordinary brick arch.

Our "Gothic" locomotive boilers of to-day differ little from types designed thirty years ago, and while the dimensions have increased from year to year, the cubical displacement of the piston has increased in a greater ratio, so that the boilers are no larger in comparison to the work done.

In accordance with the growth in population and prosperity of the nation, more rapid transit becomes necessary, and the people are subjected to great inconvenience for lack of it. They gladly welcome any project tending to advance safety and speed on railroads. If the modern locomotive has reached its approximate limits as to speed, a necessity exists for modification in the design of it. This will present many difficulties to engineers. So long as bituminous coal is used on locomotives, the smoke nuisance will not be entirely abated; for, with the limited heating and grate surfaces in the present type, combustion is too rapid to properly consume the gases. Moreover, all the gases constituting smoke are not combustible. About the densest smoke that I ever saw emitted from a chimney was where a patent smoke-consuming device was connected with the furnace; and here a hint to the aspiring fireman is not amiss. Although the conditions are such that we cannot always prevent smoke, yet we can exercise care in managing the fire; putting the required amount of fuel on the fire at the proper time, where it belongs, which will do much to abate the nuisance.

An ordinary individual has much to learn regarding smoke consumption, and if he accepts as true all that he may read, he will find many contradictory statements. One person tells us that the idea that smoke cannot be burned is a fallacy. Others will assert that smoke is incombustible, yet if we inject smoke through a tube so that it will impinge directly on a gas-jet, most of the smoke (or what we term smoke) will apparently be consumed. This seems to demonstrate that flame is necessary to consume smoke, for if we pass smoke through a red-hot pipe, the smoke will not be consumed, which apparently indicates that, if "smoke" is combustible, it would not be consumed by impinging on highly-heated masonry, but these hasty and imperfect experiments demonstrate nothing. Hydrogen will not burn of itself; an equivalent of oxygen is necessary. If this is supplied in just the volume needed, the results would be entirely different. Also, by the admixture of oxygen in just the right proportion, the gases will ignite at a lower temperature than when too much oxygen is admitted, but an excess of air, above or through the fire, can only result in loss by lowering the temperature in the furnace. If we can heat the air supplied to the furnace, by that which would be otherwise lost, we can count on so much heat saved and a corresponding gain in economy and furnace efficiency.

BEVERLY, MASS. SMOKE ARCH.

THE VARIOUS METHODS OF TESTING LUBRICANTS.

Several years ago the writer took up the study of lubricants, and during that period has given the subject a great amount of thought. My examination of the various methods of testing their value very soon convinced me that chemical analysis indicated nothing, except as to the purity of the material, and that concerning the question of the benefit or injury of an adulteration, it could give no satisfactory answer. I turned my attention to mechanical tests, with the firm conviction that an apparatus could be devised which would give the desired information.

The first machine which came under my observation was an old-style machine, simply an axle running in bearings with an upper and lower brass. The pressure upon these brasses was obtained by two levers with iron weights suspended from them after the style of a safety valve lever. The pressure upon the journal was light, and, since the fulcrums were fixed, the relative friction could not be obtained. I constructed a small machine after this pattern, and its records are amusing in the light of what I now know. For example, using ten drops of oil with a pressure of 20 lbs. per inch: Lard oil ran 1st, 6 min. 45 sec.; ran 2d, 9 min. 10 sec.; ran 3d, 6 min. 50 sec.; reduced petroleum, 9 min. 20 sec.; a mixed oil 1st, 7 min. 20 sec.; 2d, 7 min. 45 sec.; 3d, 8 min. 30 sec.

The variations of lard oil alone, in three tests, was 2 minutes, 25 seconds, while the total difference between the highest and lowest test for three oils, was only 2 minutes, 35 seconds.

My first attempt not proving very satisfactory, I concluded to try again; thinking a larger journal would give more satisfactory results. I constructed a machine with a journal bearing 4½ inches by 2½ inches. The pressure upon the brasses was so arranged as to leave them free to turn. An apparatus attached to these brasses indicated the friction in pounds per square inch. The limit of pressure upon this machine was 100 pounds per inch.

I subjoin a few of its tests taken from a large number. All of the tests were made at 100 pounds per inch pressure. The extreme range of the tests was five minutes for the shortest, and 14 minutes for the longest, and, what is peculiar, both were different tests of the same oil: Coach oil 1st test, 8 min.; 2d test, 14 min.; 3d test, 5 min.; pure lard oil, 8 min.; reduced petroleum 1st, 8 min.; 2d, 10 min.; 29° natural petroleum, 10½ min.; 25° paraffin, 10 min.

After thoroughly testing the machine and getting no results better than the above, I concluded that one of two things was true; either there was no essential difference in the lubricants, or the ordinary oil-testing machine failed to indicate that difference. Such machines could give the friction of the various lubricants, but beyond that they could not go.

I know of a prominent railway which has one of the latest improved oil-testing machines, but finding it unreliable as a test for durability, the officers use it only to rid themselves of persistent salesmen. Their oils, etc., are submitted to a test upon this machine, and the uniform report is that their goods possess no merit beyond that of the oils which the company already have in use.

A description of the action of one machine is a description of them all. Finding no relief from outside testing machines, and with the firm conviction that there were great differences in lubricants, which would be shown if some plan could only be devised for determining them, I continued my experiments, making alterations and additions as fast as each succeeding one proved inefficient, until at length light dawned upon the subject, and I began to feel that I had accomplished what I had been looking after so long.

The tests are made in the following manner: Six grains of the lubricant are used in all of the following tests. Enough of this and no more is used (in starting the machine) to thoroughly lubricate the bearings. Of oil, three or four drops are sufficient. When the friction shows this to be worn out and the bearings in danger, enough more is added to reduce the friction to its normal condition, and when this last feed is worn out an additional quantity is added, etc., until the whole quantity is used up and worn out. The number of revolutions made by the journal in wearing out this amount (six grains) constitutes its record, or the record may be indicated by the time. A pressure of 300 pounds per square inch is used and a speed of 400 revolutions per minute; equivalent to about 25 miles per hour of an ordinary car.

The action of this machine is remarkable. From the first its conduct seemed to indicate that it knew what it was about. In the department of pure unmixed oils it immediately enthroned pure lard oil as king, and sent the mineral oils to the rear and persistently kept them there, although every opportunity was given them to redeem their character.

At the head of the mineral oils stood natural West Virginia 28 degrees; then came 29 degrees, mixed up with some of the best reduced oils from good stock; then 30 degrees natural with a slightly inferior grade of reduced oils; then other grades of reduced oils, and last of all common lubricating oil.—*Railway Age.*

JOINTS FOR HIGH PRESSURE STEAM.

According to *The Mechanical World* there is difficulty in making steam joints tight under high pressures in England. It says:

> "The value of high steam pressure is a [illegible] which very different opinions have been h[illegible] at through the medium of a good indicato[illegible] from an engine with a quick cut-off motion, it appears as though there should be no question as to its superiority; but there is also a practical way of looking at the question which is too often avoided, and this has reference to the capacity of our engine builders to supply steam-tight working surfaces.
>
> "Any one who has taken down valve-chest covers, and pulled out the valve, will have noticed that frequently certain portions of the working faces are black and dull, the remaining parts being bright. This means that steam has been passing through at the blackened and rough places. Pistons are also found faulty in a similar manner. This point has therefore a deal to do with the question of economy in using high pressure steam. We have still to face difficulties, and our steam surfaces are not perfect; hence the large variety of pistons which are being offered to the public. The same remarks apply equally to valves and steam packings."

No trouble is experienced in this country, either with joints, packings or pistons, under any pressure. For the highest all face joints are scraped—iron and iron.

* * *

SAYS A CONTEMPORARY:

> "Even wooden plugs have been driven into holes in steamers' boilers when steam was up. What other result is to be expected (that is, explosion), even though we admit that these are isolated and exaggerated cases?"

Certainly, wooden plugs are driven into boilers when steam is up, but they are not the cause of explosions. If a rivet blows out, we drive in a pine plug at once, until we can get a chance to put in a rivet. The pine plug is harmless enough!

* * *

MR. ORLANDO WETMORE has patented a device for increasing the traction power of locomotives by adding the weight of the forward end of the tender to the rear driving wheels.—*Railway Age.*

He has eh! Well, M. Forney wishes to see him.

* * *

IT IS LEFT to the Chinese to utilize old wire rope; a large quantity is exported to China, for the manufacture of the nails which fasten up their tea chests.

* * *

Prompt remittances will secure all the Indicator series.

MACHINE TOOLS.

By J. Richards.

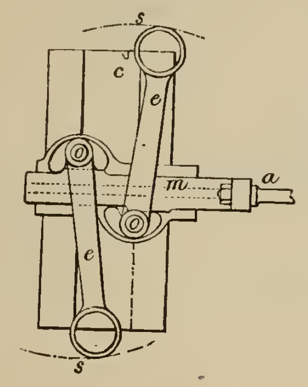
The precision of stroke, that enables a planer to stop continually at one point, is a result of double belts, high speed, and differential shifting. When all these are carefully applied, a machine can be made to stop and reverse with precision enough, so that keyways can be planed into a "single hole," the diameter of which equals the width of the key. This assertion is made after many experiments with the shifting gearing shown in Fig. 1, the tappet rod, *a*, being moved or struck at the same speed as the tool movement.

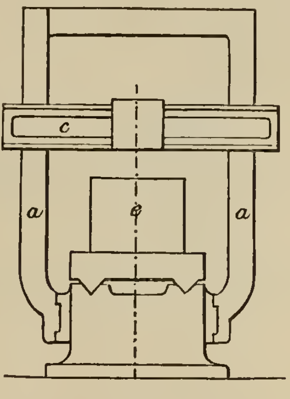
This arrangement of such gearing has only recently come into use and deserves careful attention. It is in most respects better than any that has preceded. The cost of construction is trifling compared to some other modifications, while the functions filled are complete. The bands are shifted one at a time, one before the other, alternately, to the pulley *c*, which is the driver. When shifted either way the forks, *e*, are firmly locked in position and cannot be moved except by the slide-bar, *m*. This slide-bar, after shifting the forks, *e*, is free to move on, and can be drawn away from between the shifting forks, a matter of considerable importance, because if the tappets over-run no harm is done, and in case of bands slipping they are allowed ample time to reverse the machine. By placing the pivots, *o o*, on the opposite side of the bar, *m*, the arms, *e*, are lengthened and the curve at *s*, is less sharp. These and other details of metal-planing machines have never met with the careful consideration bestowed on many, or even most, kinds of machinery. They seem to have been more the result of accident than design, until the experiments and improvements made by Messrs. William Sellers and Co., of Philadelphia, twenty years ago, and since then. We do not know that this firm have ever made claim to the invention of double bands, high speed of first movers, and differential shifting gearing. The matter is stated here solely from personal observation of American tool practice.

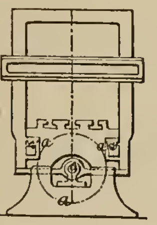
Another improvement of considerable value, before mentioned, is the method of operating the tool feed separate from the band shifting appliances. The advantages of this consist in relieving the tappet on the platen from the heavy duty of operating the feed, permitting the belt shifting gearing to be operated by hand, and allowing the feed motion to yield in case of accidental obstruction. The difficulty of preventing tappets from slipping is well known, and the advantage of being able to stop and start a machine independent of the overhead gearing is sufficiently obvious, especially in the case of large heavy machines. These several features taken separately may not much affect the working of a machine, but collectively, they do; adding to the accuracy of action and the rate of performance.

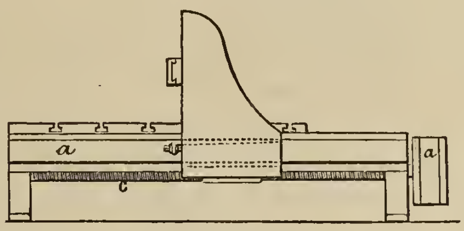
The development of a machine seems to be separated into two stages or divisions, the inception of a designer, or, as we may say, the invention of a principle, or mode of operating, and the improvement of details. This is true of nearly all distinct machines which have passed into that stage called "standard,"

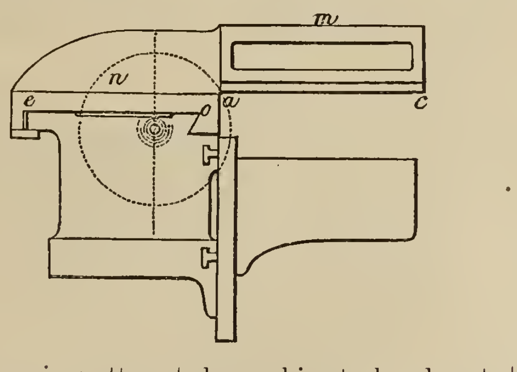
The reversing gearing of planing machines, for example, involving the speed and time of movement of platens, belts, and rotary parts, the momentum and inertia of the platen and its load, on the forward and back stroke, the relation of movement between the platen and shifting forks, forms a problem that may be compared to link motion for valves. One has become a scientific problem, the other has remained mainly a matter of experimental expedients; the difference is owing, no doubt, to the relative importance of the two things. The running platen carrying the work under fixed tools has so long remained a principle of planing machine practice that we may safely infer there are some strong reasons in favor of this method. With a carriage machine the stroke or space required for movement is double the length of the work. A machine to plane 20 feet long, requires more than 40 feet in length of floor space. The weight of the work together with massive platens has to be moved backward and forward for the tool action, which seems in comparison an insignificant matter. The cutting speed has to be diminished as the weight of the work and platen increases, until the only means of performing a reasonable amount of work is by rapid feed and enormous strain upon the tools; the larger and heavier the work, the weaker tool supports become. What there is in the carriage method to compensate these several objections it is not easy to discover, yet there are reasons beyond doubt why this method has been so uniform, and, as we may say, universally followed. Principal among these reasons is, no doubt, the possible operation of tools in three planes or on three sides of a piece, as indicated in Fig. 2. By mounting tools on the standards, *a*, and on the crossbeam, *c*, a piece, *e*, can be planed on three sides without being loosened or moved. This consideration may be safely set down as the principal one at the present time in favor of running platens or carriages. It has also led to the various attempts by machine tool makers to construct machines with a fixed bed, the upright standards and crosshead having a traversing motion.











Why this last named modification has not attained more success it is also hard to explain; it is certainly that arrangement of a machine which the conditions of use suggest. The mechanical difficulties to be overcome are many and great, so also is the economical one of first cost. With moving standards the driving power, it has been thought, must be applied at each side of a machine, and at points far enough apart to receive the work between, at least this has been the method of construction in such machines as have been made and designed, among which may be named those of Messrs. William Sellers & Co., of Philadelphia, Penn., and Mr. Hulse, of Manchester. One of the first-named machines was exhibited at Paris in 1867. The housing, so to call it, of such a machine, moving on gibbed ways at each side of the work, and rigidly connected at the top, cannot well be carried by two screws or two racks, one at each side, because the slightest wear of either would throw all the stress on one side, produce a torsional strain, and soon spoil all.

Another reason why carriage planing machines have best succeeded is that tool, slides or sliding mechanism to carry tools, could not be made perfect enough to produce true work. The planing machine had to generate itself, so to speak. The accurate fitting introduced by Sir Joseph Whitworth enabled him to produce the first successful machine for planing with moving tools, namely, the shaping machine. Imperfect surfaces also compelled the employment of what may be called gravity bearings, wherein a constant force acting in one direction, as in the case of a common planing carriage, produces tolerably true movement, in a degree, irrespective of the truth of the ways.

This matter has been previously alluded to in connection with sliding ways, and is no doubt among the causes that have given us the common type of planing machine.

Now, when slides of almost any length can be prepared true enough to carry tools at any distance from the ways that convenience may demand, we see an increasing tendency towards tool movement. Massive planing machines, with platens weighing from 20 to 50 tons, are seldom made, and, when made, are among the first to become idle in engineering works.

In England the "moving tool system" has made more progress than in America. Machines of the kind are becoming common under various modifications, and there are indications that in a not distant future the enormous platen machines will not only be no longer made, but will be forced out of use by reason of their slow performance. Large pieces are usually soft, and the parts requiring planing are not so large, so that a tool movement 15 feet to 20 feet a minute, taking light cuts, will perform more than heavy cutting at a rate of 6 feet to 12 feet a minute. The strain upon tools is generally as their speed, that is, the amount of feed and the depth of the cut is in proportion to the movement. As the strain increases the work becomes more imperfect, and must be gone over oftener than when light cutting is done at a higher rate of speed. These conditions favor tool movement. Figs. 3 and 4 contain a suggestion respecting planing machines which has grown out of the several propositions that have preceded. The flat bearings at *a a*, their faces normal to the line of principal strain, would certainly be better than angular ways, such as now employed in the Hulse machines. A single driving screw, *c*, in the center, would avoid a twisting strain upon the carriage already alluded to, and the cost of construction would be but little, if any, more than for a carriage machine. The weight would be less.

In experiments already made the success with moving tools has been more than was expected. Machines to plane 20 feet long and 4 feet wide have been made on the plan shown in Fig. 5. The overhang, from *a* to *c*, is made one-third more than the distance from *e* to *o*, and with this proportion there is no difficulty in doing work at the outer extreme of the tool traverse. The length of the carriage is one-fourth more than the overhang. The first conclusion respecting a machine thus arranged is that the projecting arm or bracket, *m*, would not have the required rigidity, but if the "compensation" is taken into account, and comparison made with a common shaping machine, it will be seen this objection is more fanciful than real. The stroke from end to end is made under uniform conditions, while with a shaping machine, where the overhang is much the same, the conditions as to rigidity alter throughout the stroke, being less rigid as the distance from the sliding ways increases. This tends to produce uneven or imperfect work, and always does so when a shaping machine is worked at a full stroke. This is not, however, the principal difference in the two methods, which, for distinction may be called "cross stroke," and "parallel stroke."

The saddle or carriage, *n*, is employed for cross stroke machines the same as in Fig. 5, but not with such substantial gibbing and bearings as are shown. In addition to this there are the cutter bar slides on top. Instead of one set of sliding ways there are two, so that on the whole the chances of rigidity are in favor or parallel motion as in Fig. 5. This has been fully borne out by experiment, as before mentioned, with machines of various sizes, the result always being a matter of surprise.—*Engineering.*

THE AMERICAN IN EUROPE.

Judging from *Vanity Fair*, an English paper, Brother Jonathan is sometimes a thorn in the side of Europeans. It says:

"These companies of Americans go over by contract because it is one or two hundred dollars cheaper than if they should go leisurely and comfortably, and as they are rushed through Europe they are in an unending fret until they get safely beyond the sight of foreign soil on the homeward trip. They give a good shaking up to the steady-paced, placid folk of the other side by their energy and speed. There is a determined air to get all there is to be had of Europe for the money expended, and an insatiable hunger for the next sight. The sensation of seeing the sights along the beaten path of travel does not meet the average American's expectation. He finds a castle used as a barracks with only one or two old rooms of historic interest open, and it takes a livelier imagination than goes with tired limbs and weary brain to get much satisfaction out of a little bedroom of some queen where some king was born, especially when one hundred other tired, restless Americans press in to hear the talk of the guide and grow nervous and fretful when they find him relating ancient history. Americans make harder work of European sight seeing than they ever do of anything else. They are constantly expecting to experience some new physical or mental sensation, and they are constantly disappointed. Then they get an idea they are not getting their money's worth and they besiege people with questions. The English are not a ready race. The ordinary guard of the railroad train, head waiter of the hotel, or custodian of the museum, not to speak of the police, more stupid here than elsewhere, impresses the nimble brained American as being about the most stupid persons he ever met. It takes fully five minutes for a Yankee question to percolate into an average Englishman's brain, and five minutes more for him to frame an answer. In the mean time the American is fretting at the loss of time. The custom of tipping every one who does a slight service is a most annoying one to Americans, who never know just exactly what to give and are disposed to first inform themselves as to what is expected of them in this respect. It is indeed remarkable how little the mass of Americans know about Europe. A Congressman this summer on being shown Westminister Abbey from one of the windows of the House of Parliament asked if the Queen lived there. The questions put about the English form of government are enough to set an Englishman wild, and when he gets his anger at fever heat, he wants to know why the Americans don't hang O'Donovan Rossa for his dynamitish plots against her Majesty's Government. This proposition was gravely advanced in my presence by the Chief of Police of one of the largest cities of Great Britain. This same individual frankly disclosed his impression that money could do anything in America—change the judge's mind, stay the hangman's hand, make justice blind and deaf, and truth idiotic."

Vanity Fair is not far out of the way.

GLASS AND PAPER GAS-PIPES.

At a glass house at Rive-de-Gier, France, water and gas-pipes are constructed of glass-tubes covered with asphalt. For conveying gas in localities liable to disturbance of the soil the hemp-paper and asphalt pipes are recommended. These are made by passing an endless strip of hemp-paper, the width of which equals the length of the tube, through a bath of melted asphalt, and then rolling it tightly and smoothly on a core, to give the required diameter. When the number of layers thus rolled is sufficient to afford the desired thickness, the tube is strongly compressed, the outside sprinkled with fine sand, and the whole cooled in water. When cold the core is drawn out, and the inside served with waterproofing composition.

In addition to being absolutely tight and smooth, and much cheaper than iron, these pipes have great strength; for when the sides are scarcely more than three-fifths of an inch thick they will withstand a pressure of more than 15 atmospheres. If buried under ground they will not be broken by settlement, nor when violently shaken or jarred. The material being a bad conductor of heat, the pipes do not readily freeze.

As an example of one of the many uses to which asphalt may be applied, it is recorded that a French engineer, M. Malo, in 1862, made a large block of it mixed with broken stone, for the foundation of a horizontal steam-engine of 50-horse power, in a place where the temperature varied between 30 deg. and 40 deg. C. During all this time the block has not shown any change of shape. The material, on the other hand, possesses a permanent elasticity, which renders it very suitable for sustaining machinery running at great velocities.

A PRACTICAL SMOKE PREVENTER.

Much has been written on this subject, and scientific men have shown the exact quantity of oxygen, etc., necessary to effect perfect combustion; but still the practical realization of the problem appears to be no nearer solved than it was twenty-five years ago. Everything depends on the fireman's attention to the smoke-stack and fire-door. Other little details go far to assist, such as wet coal, and opening the blower and fire-door when the engine is running into a station. But the most effective remedy is the fire-door, which must be kept on the jar so long as black smoke is seen at the stack. On this point, the kind of fire-door has much to do. If the door has no damper in it, the air enters unequally and to one side, thus being only partially distributed, while a damper in the door allows of a more equal distribution of the air. This will be noticed by any one, for if the door has no damper and it is left partially open, it will be seen that the gases on the hinge side of the door are blacker than on the latch side, while, with the damper arrangement, the fire-box has a more equally colored flame or body of gases, because the air is more equally distributed and not allowed to flow into one side of the box only.

The want of sufficient time for the mingling of the air with the gases is the main stumbling-block in the way of smoke consuming or smoke preventing in the locomotive. Many attempts to overcome this have been made by providing combustion chambers, by extending the fire box into the shell of the boiler, with drop legs or hanging legs, etc., to retard or obstruct the straight shoot of the gases. We remember an engine of this kind, in which the flues were shortened to about six feet, the fire-box extending into the boiler shell the rest of the distance. One or two hanging legs and several baffle-plates were provided, and (on examination of the drawings, the black gases in the fire-box, shown by a plentiful use of India ink, rapidly changed by vermilion and orange into a solid body of flame into the combustion chamber), the success of this device seemed assured, and the more so when we heard the inventor talk. Several of them were built, and poorer steamers or blacker smokers never worried a fireman. We have seen many other devices and arrangements for the same purpose since them, all like the former, making good showings so long as the inventor was on hand with a picked fireman, and coal, and train, and side-tracks, and an accommodating train dispatcher. But in every-day service they were a failure; and, to sum up, the best smoke preventers we know of are a good fireman and a brick arch.—*National Car Builder.*

THE STEAMER *Wilbur A. Heiser* is a stern wheeler plying between this city and New Jersey villages along the coast. She has two horizontal engines with cam-motion, 18″ diameter by 7′ stroke, making 19 revolutions per minute. She carries 200 lbs of steam.

THE BROTHERHOOD OF LOCOMTIVE FIREMEN held its tenth annual convention in Denver, Colorado, beginning September 18. The organiziation is one of the largest if not the largest association of the kind in the world, numbering about 8,000 members. The number of delegates in attendance was about 200. The Brotherhood voted $14,000 for the aid of disabled members, and appointed a committee to select a site and report the cost of a home for members who have become old and infirm. The organization is in a flourishing condition, and much enthusiasm was manifested during the sessions of the convention. It has kept within the limits which are appropriate to such societies, and has been rewarded by great success. F. W. Arnold was re-elected grand master; Vice grand master, F. P. Sargent, Tucson, A. T.; executive committee, W. E. Bivens, Chicago; A. H. Tucker, Mason City, Iowa; J. J. Hannahan, Chicago; C. J. McGee, Illinois, and A. J. Regan, Portland, Me. The next annual convention will be held in Toronto, Can., September 13, 1884.—*Railway Age.*

THE ELECTRIC ORGANS of the torpedo or "Shock-fish" may be compared, to some extent, to the voltaic pile, and consist of two series of layers of hexagonal cells, the intervening spaces between the plates being filled with a trembling jelly-like substance, so that each cell can be compared to a Leyden jar. Each torpedo carries about 480 of these batteries, the whole being equal in power to about fifteen Leyden jars, making 3,500 square inches charged to the highest degree. The upper side of the fish is positive and the lower negative, the shocks seemingly being entirely at the will of the strange electrician.

WE HAVE from the Crosby Steam-Gauge and Valve Company, Boston, Mass., their latest catalogue, a handsome publication containing a great deal of useful information, in addition to the goods manufactured by tl [illegible] In connection with the Indicator series [illegible] in THE MECHANICAL ENGI [illegible] useful. Sent to any address.

JAMES MAHONY & SON, 73 Astor House, N. Y., also favor us with their new catalogue, illustrated, of their Universal Patent Furnace, recently published in this paper. Messrs. Mahony have compiled some not universally known facts of practical value to engineers and steam users in this pamphlet, and wish to present it to all who take interest in such things. It can be had upon application as above.

IN 1866 THE best railroad time between New York and New Orleans was five days, and a passenger had to make nine changes, many of them long rides from depot to depot. In 1869 the time was reduced to four days; in 1873 to three and a half days, and in 1878 to three days and only one change. Now the time has been reduced to fifty-eight hours.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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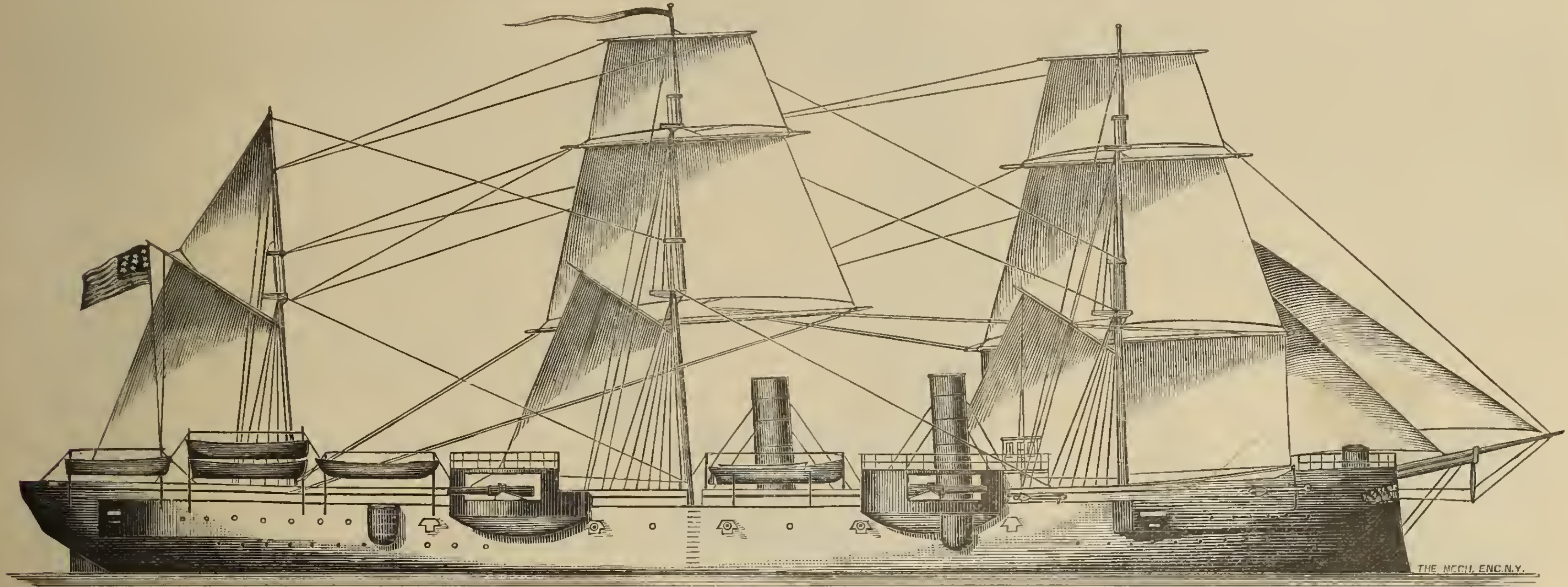
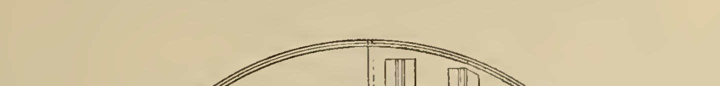
THE NEW CRUISER "CHICAGO."

The new cruiser "Chicago," now building for the Government, is to have twin screws and an indicated H. P. of 5,000. She is 325 feet long at water line, extreme width, 48′ 2½″, and mean draft at load line of 19′; her displacement is 4,500 tons, and she carries a plain sail area of 14,880 square feet. Her crew will consist of 300 men, and her armament will be four 8″, long breech-loaders in half turrets, and eight 6″ and two 5″ on gun deck. Her speed at sea is to be 14 knots. The vessel has no armor, but is protected by her coal, this will be 9 feet thick from the water line to 8 feet above it, and 5 feet thick from the water line to 14 feet below it. The ship is to be built of mild steel throughout, and is to have the latest improvements in all lines.


THE MECH. ENG. N.Y.

THE NEW CRUISER CHICAGO, WITH FRONT ELEVATION OF HER BOILERS AND FIRE-BRICK FURNACES.—FROM GOVERNMENT DRAWINGS.



The engines are compound, of the overhead beam variety. The cylinders are 45 and 78 inches, by 52 inches stroke. The high and low pressure cylinders are side by side with their axes vertical; and each engine, with all its machinery, will be enclosed in a water-tight compartment 22 feet long. The cylinders will be jacketed and the valves of the poppet variety. The engines will be capable of working high pressure if accident to one cylinder demands it, and the low pressure cylinder can also take steam direct from the boiler, and may be worked high pressure. The crank shafts will be built up of steel forgings in two separate interchangeable sections, and secured by couplings forged on the shafts. The propellers are of steel with four adjustable blades, diameters 15′ 6″, and mean pitch 22′ 6″.

The working beams for the engines are made of two steel plates, 1½″ thick, parabolic in form; they are 11′ long and 4′ wide; on the edges they are 3″ wide and 2″ thick. The center-bosses are 20″ diameter. These beams are to be of rolled steel. The beam pillow-blocks and the frames are also steel, 16″ wide and 1½″ thick. Beam engines have been used a long time on river boats, where their performance is well known, but for sea service there is but one steamship in the merchant service which has them. This is the *Louisiana*, of the Cromwell line. The adoption of this type is, therefore, not an experiment, but an innovation, in naval practice. It was necessitated by the conditions, for it was impossible to get a vertical inverted cylinder engine below the water line.

The boilers, as will be seen, have fire brick furnaces, and are arranged as shown in the engraving. In but one other steamer, in this country is this furnace in use, that is the SS. *Louisiana* of the Cromwell line, where it was introduced some years ago by Miers Coryell, Esq., the resident engineer of the company. Mr. Coryell is also a member of the Naval Advisory Board, and it is doubtless owing to his experience that the government have adopted it in the *Chicago*. It will be seen that the first cost of the boiler is much reduced by this form of furnace, as also its durability. The boiler is much easier cleaned, and the strains incidental to expansion and contraction when under pressure are reduced. The boiler is not intensely heated in the furnace, as is the case with the usual form; but is subjected to uniform temperature all along the bottom and in the tubes.

This improves the circulation materially, for with the brick furnace there is no colder stratum of water lying at the bottom. It is also more economical in fuel; in other words, the combustion is better, for the bricks become highly heated in a short time and act as regenerators, consuming gases which would otherwise escape unignited. No trouble is found with the bricks themselves. They are subjected to the usual wear and tear of ordinary firemen, and the cost of repair and loss of efficiency is next to nothing. If we did not misunderstand Mr. Coryell, the same furnaces have been in the *Louisiana* for two years.

Aside from these advantages, there is the very important one, to an engineer, of removing one great source of anxiety—the furnaces. There are no crowns to come down, no corrosion, blistering, or burning of plates, to be guarded against, and no inaccessible corners or pockets to collect scale and dirt. The boiler is converted into an ordinary tubular one, and when we have said this we have said all that is necessary. Fire-brick furnaces will be one feature of the best form of marine boilers in future.

A CORRESPONDENT of the *Scientific American* asks its advice, as follows:

> "What sized engine would be required to run a boat 15 feet long and 4 feet wide, and how many miles per hour would it run? Answer — For a propeller yacht, engine 3 inches cylinder by 3½ inches or 4 inches stroke. Boiler with about 40 feet fire surface. Propeller about 18 inches diameter; probably get a speed of about 6 miles per hour."

This is not correct. A boat of the dimensions stated would not carry such an engine and boiler, made for service. The engine is too large for the boat, and the boiler is much too small for the engine. A boat of the dimensions named above does not need more than a 2¼″ cylinder by 4″ stroke. "Propeller about 18 inches" diameter is meaningless, for the pitch is not given. The propeller for such a boat as above mentioned should be 16″ diameter by 18″ pitch; this, at 300 revolutions per minute, would give a speed of 5¼ miles per hour less the slip. Thirty-five feet heating surface in the boiler is ample.

ALL STEAM ENGINES of any size should be provided with some means of moving them by hand. In the case of a pair of large automatic engines near by, they cannot be turned over except by a pinch-bar, for the valve motion is through gearing, and is so fixed that it cannot be disconnected.

* * *

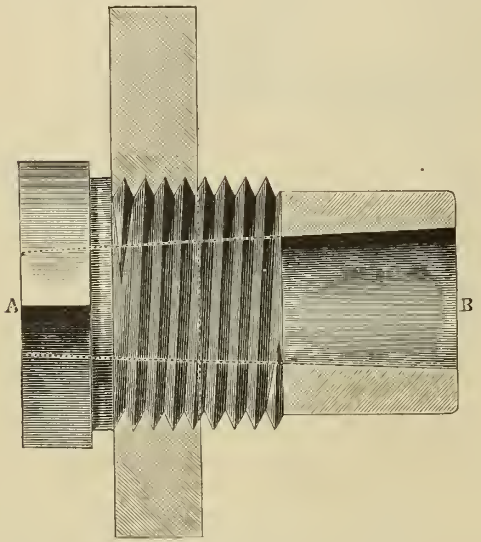
THE BEST INDIA INK has a rather brownish tint, is very hard and heavy in the stick, and has a metallic ring when struck. If it sounds dull it is not uniform.

FUSIBLE PLUGS.

A fusible plug is a composition shell filled with banca tin, lead, or some suitable alloy, intended to be used as a safeguard against a class of disasters caused by low water. Fusible plugs are variously placed according to the type of boiler in which they are used; the idea being to place them upon the highest point of the fire line. Their operation is as follows: So long as water of ordinary temperature is in contact with the plug it remains intact, but if uncovered by a deficiency of water the filling melts before the boiler can be dangerously overheated while the discharge of steam through the aperture of the plug gives a warning of impending danger, and slightly reduces the pressure within the boiler.

The shell for fusible plugs should be made of hard brass that will insure durability and admit of a proper finish with a clean cut thread; and substantial hexagonal head, made stout and strong, to withstand frequent removal and replacing for examination; and refilling when necessary. The cored holes for the fusible filling are variously made by different manufacturers, some being straight, others straight with a conical head, while others again are bell-mouthed.

The straight ones, we think, are insecure, with a constant liability to fuse in and out of season. Those with straight bore and conical head are better, if the countersunk part forming the conical head is properly done, while the bell-mouthed ones present a weak section about the head, so that if the plug is set fast in the boiler-head, as it is apt to be after one or two years' use, it will be almost impossible to get it out without such distortion as will prevent its further use. Therefore, while we would recommend every one who uses fusible plugs to have one or more extra ones on hand so there may be no delay in replacing a melted one, we would only advocate the use of such a plug as would withstand several refillings. This, we think, may be accomplished if the cored hole for the fusible filling should be made about half an inch in diameter at the head end, *A*, tapering to say three-quarter inch at the opposite end, or point of the plug, *B*, as shown, in which *A*, *B*, is the conical shaped filling, and *C*, a cross section of a portion of the boiler-head with the plug in position.



The experience of the Hartford Steam Boiler Insurance Company causes it to favor a longer plug than is ordinarily used, one about two inches long exclusive of the head of the plug, with a projection not exceeding one and one-half inches, nor less than one inch into the interior of the boiler beyond the boiler-head. The external diameter of this plug should be about $1\frac{5}{16}$ inch, which corresponds to the size of an inch pipe-tap. The thread need only be cut upon half the length of the plug; the other half may be turned down to about $1\frac{3}{16}$ inch diameter and not threaded, as shown in figure. This pattern we have found more desirable than the short ones commonly provided; evidently because while surrounded by water it cannot be treated to a temperature sufficiently high to melt it.

Occasionally we find the filling of short fusible plugs badly honey-combed on the fire side for a distance nearly through the head of the boiler, the fusible part having apparently melted in the ordinary use of the boiler, there being no other indications of overheating apparent, leaving but the dross and a light film of good material next to the water side. In some externally fired boilers, where the fusible plug is tapped into the back head of the boiler, they last for years without giving trouble. In internally fired boilers they are not generally so durable.

The National Boiler Insurance Company of England do not consider a plug reliable for a period exceeding two years without refilling. It is generally believed by engineers that after a year's service the ordinary fusible plug cannot be depended upon to fuse at a low temperature, owing possibly to changes which occur in the character of the alloy.

Banca tin is the filling recommended by the United States Engineers, and we believe it to be as reliable as most of the alloys. Of course the purity of the article determines its usefulness for this purpose. We have a plug that melted inside of two weeks after being put in service, as also did several others of the same manufacture, under like circumstances previously, there being an ample quantity of water in every case, and no unusual disturbance noticed within the boiler. The melting was attributed to some peculiarity in the composition of the alloy.

The law of Massachusetts requires a fusible plug upon all boilers, as also does the municipal law of several cities. The rules of the United States Steamboat Inspection service provides as follows:

"Rule 31. All steamers shall have inserted in their boilers plugs of Banca tin at least one-half inch in diameter at the smallest end of the internal opening, in the following manner, to wit: Cylinder boilers with flues shall have one plug inserted in one flue of each boiler, and also one plug inserted in the flue of each boiler from the inside, immediately before the fire line, and not less than four feet from the forward end of the boilers. All fire-box boilers shall have one plug inserted in the corner of the back connections, or in the highest fire service of the boiler. These plugs, in external diameter, must correspond in size to a one-inch gas or steam-pipe screw tap."—*The Locomotive.*

◆

THE FAULTS of the Brooklyn Bridge system of transportation are many, and its virtues few. The managers seem to think that if they can only haul a car across the bridge, and get the grip to hold on, all goes well, but they wholly omit to observe the cost of doing the work. This is enormous, as engineers can see from an incident which occurred recently. Standing by one of the engines—28″ × 4′—when it was started with 75 pounds of steam, and with a full turn of the throttle, it was hard to move the cable. This is not wonderful, when its length, weight and "up hill and down dale" method of tension are considered. A friction diagram would reveal a fearful state of things. The cable is constantly being run off the pulleys by the men who have to lift it in place on the car for each trip, and a worse abortion than the whole contrivance would be hard to find.

◆

OF COURSE the inevitable blunder crops up just where we tried hard to have everything exact. This is in our article in last issue—"*Inducements to Clubs.*" In it we say all subscriptions must be sent in before the *fifteenth* of November, whereas, in our special offer in business column, we limit the time to the twenty-fifth of November. This latter is the correct date.

◆

CONTEMPORARIES CONTINUE TO COMMENT favorably on the convenience of a clamp recently illustrated in a foreign paper; said clamp being intended to bind a broken shaft so that the ship could steam slowly into port. The contemporaries aforesaid were conveniently blind to its merits when we suggested and illustrated it in THE MECHANICAL ENGINEER some years before it appeared abroad.

◆

WE ACKNOWLEDGE the receipt of the report of the Department of Public Works, Chicago, from D. C. Cregier, Esq., Commissioner.

A GENERAL CHANGE throughout the country is being made in railway time. The new plan has been termed the "hour" system. It provides for standards differing from each other by exactly an hour. Leaving out the eastern and western extremes of the continent, there are "eastern," "central" and "mountain" times. The first will be employed from New Brunswick to the meridian of Detroit, the second as far west as the boundary between Kansas and Colorado and the third to the line between Utah and Nevada. It is proposed that all the roads now using Boston, New York, Philadelphia, Baltimore, Toronto, Hamilton or Washington time as a standard, shall be governed by "eastern" or seventy-fifth meridian time, four minutes slower than New York. This includes the roads run by Portland, Providence, New London, Montreal, Albany, Richmond and Charleston time, in addition to those specified. Roads now using Columbus, Savannah, Atalanta, Cincinnati, Louisville, Indianapolis, Chicago, Jefferson City, St. Paul or Kansas City will be run by "central" or ninetieth meridian time, nine minutes slower than Chicago time. This includes the roads run by Macon, Rome, Nashville, Selma, Mobile, St. Louis, Vicksburg, Dubuque, Minneapolis, St. Joseph, Galveston, Houston and Omaha time. West of this, roads are to be run by "mountain" time or exactly that of Denver. It is stated that the eastern district standard time has been used by all the roads between Boston and Montreal since last Sunday, with a possible view to first testing the plan.

We don't understand this clearly, but may be there are others who will.

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A CURIOUS FEATURE OF TRADE is the importation of eggs from Germany, Denmark, Belgium and Italy to this city. The eggs cost about 7 or 8c. per dozen on the other side, and about 50c. per barrel for freight to New York (with 70 dozen eggs in a barrel), which permits a fair profit after arrival. This trade is practicable only in the winter. Arrivals are placed in cold storage, and as the eggs will stand two months of cold weather without serious deterioration, the project is said to work well. The loss from breakage is said to average less than on consignments from Chicago.

The question is what constitutes serious deterioration in an egg!

◆

TRADE CATALOGUES.

That well-known house, the Pond Machine Tool Company, of Worcester, Mass., favors us with their latest catalogue of tools of their manufacture. These are specially in the line of railroad work, and master mechanics and others will find it useful for reference.

E. W. Bliss, Brooklyn, N. Y., manufacturer of presses and dies and special machinery, sends us a beautifully-illustrated list of their goods, which shows their peculiar points most clearly. They are chiefly in the line of tin and sheet-iron working, and one is astonished to see the number of ingenious machines employed in that trade.

◆

IF WE WERE prone to despondent feelings we would quite break down at the way in which English contemporaries treat us. The *London Engineer* copies our remarks on Webb's Compound Locomotive, and gives them to the *American Engineer;* another, the *Engineering Review*, steals outright an article on Tool Posts, and all and sundry, when they find anything worthy of notice in our paper, coolly attribute it to "an exchange," or "a foreign contemporary." Considering the course of THE MECHANICAL ENGINEER in always giving credit to sources of information, British fair play does not seem to glitter, as it were—always excepting our contemporary "*Engineering.*"

◆

WHEN WE GO INTO AN ENGINE-ROOM where the engine is manifestly badly out of order, it is well to suspend judgment until we know whether it is the fault of the employer or of the man in charge. Most engineers are keenly sensitive to criticism, and know when repairs are needed well enough, but their demands are often disregarded. It is not always the engineer's fault when an engine works badly.

QUANTITY OF CARBON IN SMOKE.

Delezenne estimated in 1855 that the proportion of carbon that escaped combustion in this form might be taken at 5 per cent. of the total weight of fuel burned in the grate. Burnat pointed out in a valuable paper on the combustion of smoke in boiler furnaces, the amount of finely divided carbon produced in a certain lampblack factory is only 3 per cent. of the coal burned, and therefore the amount of carbon in ordinary smoke must be much lower. In 1858 Graham estimated that very black smoke does not contain more than $\frac{1}{10}$ per cent. of the carbon of the coal burned, and the accurate experiments of Schewrer-Kestner showed that in boiler furnaces the loss of carbon in the form of soot never exceeds 1 per cent. of the fuel burned, while the mean loss is probably between $\frac{1}{2}$ and $\frac{3}{4}$ per cent. A case, however, is recorded in which a coal containing 69 per cent. of carbon (burned with an inadequate supply of air) lost an amount of carbon as soot equal to 2·03 per cent. of the fuel burned. As might be anticipated, the amount of soot is greater in the case of an open fireplace than in a boiler furnace.

In an extreme case, in an open fireplace, no less than $2\frac{1}{4}$ per cent. of soot, compared with the fuel burned, was found in the flue at the end of the trial. In the case of three close stoves of careful construction, rather less than $\frac{1}{2}$ per cent. was found, while in some cases it fell to $\frac{1}{4}$ per cent., and in one case to $\frac{1}{20}$ per cent. Of course, these numbers do not include the amount escaping into the air. In a preliminary experiment, made with an ordinary open fireplace, connected with a chimney by means of a sheet iron pipe 6 feet long and 9 inches diameter, 17 pounds of bituminous coal were burned in three hours, and no less than ·61 per cent. of the fuel burned was collected in the pipe in the form of soot, while the soot that passed into the chimney was not collected. This ·61 per cent. of soot, after drying at 100° C., yielded, on distillation at 300° C., 12 per cent. of an oily, strong-smelling mixture of hydrocarbons.

◆

A FINE LUSTRELESS surface on tempered steel can be procured by either of the following operations: After the steel article has been tempered it should be rubbed on a smooth iron surface with some pulverized oil-stone until it is perfectly smooth and even, then laid upon a sheet of white paper and rubbed back and forth until it acquires a fine dead finish. Any screw holes or depressions in the steel must be cleaned beforehand with a piece of wood and oil-stone. This delicate lustreless surface is quite sensitive, and should be rinsed with pure soft water only. A more durable finish is obtained by first smoothing the steel surface with an iron polisher and some powdered oil-stone, carefully washing and rinsing. Then mix, in a small vessel, some fresh oil and powdered oil-stone, dip into this mixture the end of a piece of elder-pith and finish the steel surface with a gentle pressure, cutting off the end of the pith as it commences to become soiled. In conclusion, it should be thoroughly cleaned in soft water, when the article will be found to have a fine white lustreless finish.—*The Amateur Mechanic.*

◆

THE REPORT BY the London and Glasgow Engineering and Iron Shipbuilding Company (Limited) for the past year states, that, notwithstanding the work during the year has been larger than ever before, the profit resulting therefrom has been unsatisfactory. Owing to the excessive demands of the workmen for increased remuneration, and the irregularity of their attendance during the working hours, the completion of the work has been seriously retarded, and the cost of its production thereby greatly increased.

◆

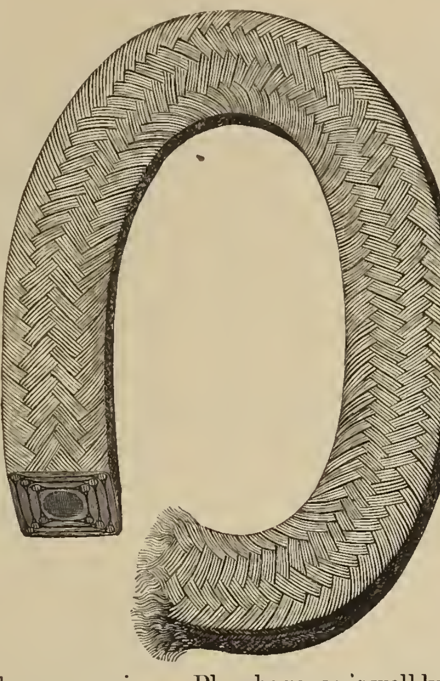
A CONTEMPORARY SAYS:

> "We will not knowingly send the paper to any one who does not wish it, but if it is continued through the failure of the subscriber to notify us to discontinue it, we shall positively demand payment for the time it is sent."

And won't you have a good time getting the money? Best thing to do is to sell so much paper for so much money, and get the money first. Then no one can find any fault.

WINANS' FIBROUS PACKING.

Our engraving represents a new packing for steam engines and all stuffing boxes under pressure. It is a woven or braided fabric, composed of hemp and other materials, thoroughly incorporated with plumbago of the best quality, carefully prepared for its work. The packing is machine-made, and can be laid up to any tension required, either hard or soft, as may suit the purpose it is intended for. It is made in all sizes, from $\frac{3}{8}$ of an inch upward, and being square in form, lies close to the rod with very little compression. Plumbago, as is well known, acts as a lubricant by filling up all scratches or imperfections, and, being of a "slippery" nature, it decreases friction in a marked degree.



This packing is without any hard or soft spots in it, and all the woody portions, or "slivers," likely to scratch rods, are removed. It is widely adopted in all parts of the country, and its use is extending as fast as it becomes known. Address the Winans Packing Company, 408 Bleecker street, New York.

◆

A NEW ENGLISH BALEING PRESS is thus described in the *Engineer*:

The total height to the top of crosshead is a little over 75 feet, and in weight the machine exceeds 130 tons. The press is constructed on the compound steam and hydraulic principle, with 48 inch steam and 16-inch hydraulic cylinders, the primary object of this system being, by the combination of steam and hydraulic power, to press the cotton rapidly. The first 10 feet of compression is given quickly by steam power only; the second, or finishing down stroke of the steam piston, brings into action the hydraulic ram pumping power, and the whole operation of pressing the bale is completed in one up-and-down stroke of the piston. The pressure is given in an upward direction, the cotton presses being filled in from the top of the press; and in order that the filling in of the boxes may keep time with the quick action of the machine, the presses are arranged with three boxes revolving round a central column, two of the boxes being filled by separate sets of men, whilst the third is under the press. By this arrangement an average of one bale of five hundred weight can be packed and baled per minute, and during a special trial of one of these machines as many as seventy-five Egyptian bales have been made up within the hour.

◆

THE DIMENSIONS OF THE LOCOMOTIVE 611, on the New York Central and Hudson River Railroad, which made the extraordinary run mentioned in another part of this issue, are as follows: Cylinder, 17″ × 24″; drivers (four) 5′ 10″ diameter; tubes, 2″, 194 in number; firebox, 6′ long by 6′ feet high, 36″ at bottom, 45″ at top; fuel, bituminous coal; pressure, 135 lbs., and weight, 38 tons; on drivers 24 tons, on truck 14 tons. Built at Schenectady Locomotive Works.

◆

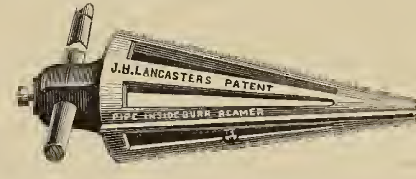
THE PER CENTAGE of coke produced from a ton of coal in this country is about 80.

WHEN VISION IS NOT AIDED by any magnifying process, there is a point of minuteness when an object cannot be seen by the unaided eye. But when the object is viewed by means of a microscope, it becomes visible. There is a question, whether any object may become so attenuated that it cannot be made visible by any means? Not many years ago there were lines that could not be resolved by any lenses then in existence, which can be exhibited now without difficulty; but, at that time, makers had not the skill of making them with large angles of aperture, but now they are made with the highest angle possible, and consequently the capacity of such objectives can only be increased by greater skill in their manufacture. But the limit of angle of aperture having been reached, is it not reasonable to suppose that, with present appliances, no greater skill in manufacture can be expected? Sir Royston Pigott, recently, at a meeting of the Royal Meteorological Society, stated that he had seen globules of mercury, made by smashing a minute particle of mercury with a watch spring, less than $\frac{1}{100}$ of $\frac{1}{10000}$ of an inch, or less than the millionth of an inch. Another member replied that he was not aware that there is any limit of visibility in the microscope other than that imposed by the sensibility of the observer's retina, the correction of the objective, and the illumination.—*The Microscope.*

◆

IMPROVED RIMMER FOR METAL WORK.

The rimmer illustrated herewith is intended for boiler shops more particularly, and is for taking off burrs from flue-sheets, inner ends of tubes, countersinking, slightly, holes of a size within its capacity, and for general utility. It is made of the best tool steel, and has adjustable blades, or cutters, which can be readily sharpened or replaced when impaired. It will be found very serviceable. It is the invention of Jas. H. Lancaster, and is made by the Lancaster Manufacturing Co., of 36 Dey Street, N. Y.



◆

A CURIOUS NEW CARBON, which is described as flexible, has been invented by the eminent electrician, Varley. He uses fine filaments in a rope-like bundle as the poles of the arc. It is said that the space between the two points is so heavily charged with incandescent carbonaceous matter that the resistance is considerably reduced, and the "light" is of much greater area, for the luminosity comes from the arc itself and not so much from the carbons, which no longer present the cup and cone formation.

One advantage is that the carbons are flexible, can be wound on a reel, and be payed out by means of clockwork. The carbons are made of pieces of rope soaked in parafin or ozokerit, and carbonized in a crucible kept constantly filled with a hydrocarbon atmosphere.

◆

IT IS NOT GENERALLY KNOWN that domestic sugar is produced in New Jersey from sorghum. It was thought for a long time that sorghum syrup could not be crystallized, but the company at Rio Grande, N. J., have succeeded in making a very excellent quality of white sugar, entirely free from any disagreeable flavor. The possibilities of this scheme are very great, and the results, to the people at large, of importance.

◆

STEEL RAILS are now quoted at Pennsylvania mills as low as $37 per ton. In February, 1880, they were sold at $80. Allowing an average of 90 tons to the mile, the reduction here indicated shows a saving in the cost of railway construction of $3,870 per mile for rails alone.

◆

RAILWAYS spend a great deal of money in renewing and keeping up their lines. Estimates on various English roads vary from $600,000 to $1,000,000 annually for each road.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

REPAIRS TO A SMALL ENGINE.

Editors MECHANICAL ENGINEER:

A correspondent in one of your late issues says he wants to hear from engineers who have made repairs to engines, as he thinks it may be of use to the trade. I take this view myself, and have, therefore, jotted down (more with the view of getting others to write than from anything new in my plan) how I repaired a small engine in a printing-office some time since. It was a horizontal engine, 6″×12″, with steam-chest on the side, and was run by the pressman, no regular engineer being employed. It had got so badly out of order that steam could not be kept up, and, as I was visiting the place, they asked me to look at it. On opening the steam-chest, I found that by allowing water to remain in the chest, the ports had all run together, so to speak. That is, the lower edges of the ports were rusted out, so that the steam-ports ran into the exhaust-port. The valve, also, had a curious kind of "paving-stone" face on it. The cylinder and piston were in keeping with the rest, the first having a channel formed on the bottom, by rust, and the rings touching nowhere to speak of.

I could not take the engine out of use a day, and therefore did this: I took the valve out and chipped and filed a true face on it, then I got a lot of type-metal and filled all the holes in the valve-seat and dovetailed it in; I hammered it in as hard as I could. I threw away the rings and made a hemp gasket, and drove that in, and when that engine started up it was just as good as new. This was over two years ago, and the proprietor informed me he has had no trouble with it since.

NEW YORK. STARTING BAR.

◆

THE NEW HAVEN ASSOCIATION OF STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER:

I wish to say a few words about our Association here. We are doing splendidly, having now over sixty-five members, starting with twenty-eight. We have for several weeks past taken in from two to five members each meeting, and have just moved into a nice new hall, fitted up at a cost of $500, all of which was raised by subscription, the manufacturers taking an interest in us and subscribing liberally. We intend to dedicate our hall the first week in November, and expect several good speakers. We shall invite the manufacturers and engineers who are not yet members, and expect to have a hundred or more members by the first of January, 1884. An Association is what has long been needed among engineers, and all who join are deeply interested in it. When we get our hall completely furnished we shall go for a library, that being, I think, an important adjunct.

THE MECHANICAL ENGINEER is much liked here, and I wish it came every week. I am sorry "The Professor in the Machine Shop" could not continue his articles, as they were very interesting. Business here is very good, all of our members having employment. Wishing you success, I am yours,

NEW HAVEN, CONN. UNO WHOO.

[The New Haven Association has our hearty congratulations upon their prosperity; assuredly it is deserved. We hope the library will be stocked with standard works suitable for engineers seeking advancement.—EDS.]

◆

TWO THOUSAND DOLLARS A YEAR FOR WHISTLING!

Editors MECHANICAL ENGINEER:

You are rough on the whistlers! There is a young lady in Boston who made over $2,000 last year whistling in concerts. The best orchestras have accompanied her whistling solos. Her name is Ella Chamberlain, and next time she whistles in New York, you had better take it in.

BOSTON. W. L. C.

[Well, there might be something in a $2,000 whistle, but the discordant mouthings that bespeak the vacant mind, the shrill pipings of callow youth that salute the ear on every side, are simply a vexation of spirit.—EDS.]

◆

READ "THE MECHANICAL ENGINEER."

Editors MECHANICAL ENGINEER:

Would you be kind enough to tell a subscriber where to get a good work on the indicator which will explain how to use it, and how to work the cards up, for work done and condition of the engine.

2646 North Front St., PHILADELPHIA, PA. E. S.

◆

DIES FOR FLANGING BOILER-PLATES.

Editors MECHANICAL ENGINEER:

In THE MECHANICAL ENGINEER, No. 9, I saw an item requesting any person knowing that dies are used for flanging boiler-plates to let you know. I can say that the Dickson Manufacturing Company of this city, use dies and a hydraulic press for flanging boiler-plates.

WALTER DAWSON, M. M., D., L. & W. R. R.
SCRANTON, PA.

VOTE OF THANKS.

The Detroit Association Stationary Engineers, No. 1, wish to express their thanks through the columns of THE MECHANICAL ENGINEER to Wm. A. Harris; Knowles Steam Pump Co., Exeter Machine Co., Blake Steam Pump Co., Providence Steam Engine Co., Deane Pump Co., Buckeye Engine Co., Edward P. Allis & Co., Fitchburg Engine Co., Westinghouse Engine Co., Hartford Engineering Co., and the Babcock and Wilcox Boiler Company, for photographs of their machinery lately received.

A. M. DAVY,
Sec. D. A. of S. E.

◆

NOTES ON PUMPS, HEATERS AND INJECTORS.

The single acting plunger-pump is the oldest device for boiler feeding. It has admirably performed its duty when other methods have failed. Of late years it has been considerably improved, and is still used in many establishments, where it is preferred to other devices for boiler feeding. As to economy, the pump will compare favorably with other devices if a good heater is used in conjunction with it, enabling us to utilize the exhaust steam or other waste heat for heating the feed.

The old-time pump was usually a rickety, noisy affair, and generally without an air-chamber. If it performed its duty that was thought to be all that was necessary. A pump is a necessity, but an injector is a valuable adjunct, and one should be held in reserve for contingencies when the engine is not in motion. I believe a pump, proportioned for its work, will discount an injector in economy, if (as before stated) a good heater is used. Opinions of engineers conflict on this point, and it would be an obvious waste of time to argue it. A heater properly constructed—that is, without cramped passages for feed-water or exhaust steam—should diminish the back pressure on the piston by the cooling effects of the feed-water condensing a portion of the exhaust. There are details to be considered regarding the capacity of a pump, the type of engine and boiler, the probable amount of steam used for other purposes, and other things will influence the selection of the pump. It is well to select a pump larger than necessary, with an arrangement to vary the stroke at will.

The cheapest way to put water into a steam-boiler is to run it in direct from a street main, through a heater, graduating the supply so that the water will flow into the boiler in volume just sufficient to maintain a uniform level. Of course this can only be done where the pressure on the street main considerably exceeds the average boiler pressure; also, extra precautions would be necessary to prevent fluctuation in the boiler pressure.

Injectors have, to a great extent, supplanted the pump on locomotives, and for several reasons: They are simple in action, occupy but little space, can be worked at any time while steam is on, and the boiler is not subjected to the deteriorating influence of cold water. The injector also renders the ordinary heater-pipes unnecessary in cold weather, as it (the injector) can be used to keep the pipes from freezing; it is also claimed that the injector assists circulation in the boiler. On the other hand, there are sometimes serious losses between the pump and boiler, caused by numerous bends in the feed-pipes, cramped water-passages or pipes partly choked by a deposit of lime, mud, etc., from the feed-water. These put an extra load on the pump, causing loss of efficiency.

Regarding heaters, we find in use many that are worthless for the purpose intended. In a day's travel among manufacturing establishments, we can hardly find two heaters of a kind. Many contrivances, however, for heating the feed are particularly worthy of comment, and we should not undervalue their general utility. Again, there are some so designed that the feed absorbs but little heat from the exhaust steam, and in case repairs are needed they will cost more than a new heater properly designed and set would. A good heater is an indispensable adjunct when a pump is used for boiler feeding, and it should be of ample capacity to heat the feed within a few degrees of the temperature of the water in the boiler; it should be so designed and connected that it can be repaired or cleaned with dispatch and offer the least resistance possible to the current of feed-water.

SMOKE ARCH.

◆

A WRITER IN BRADSTREETS says: "The completion within the last five years of such monster merchantmen as the *Gallia*, the *Arizona*, the *Orient*, the *Servia*, the *Alaska*, the *Austral*, the *City of Rome* and the *Aurania* constitute an epoch in the history of ship-building and marine engineering, and bid fair to lead to a period when, according to a well-known Clyde ship-builder, 'we shall see steamers of 800 feet long, the ferryboats of two oceans, with America for their central station, and Europe and Asia for their working termini.' Thirteen years ago vessels exceeding 400 feet in length were not afloat, with one very notable exception; now there is scarcely a merchant fleet which does not include one or two vessels over 400 feet long, and at the rate at which the length of vessels is increasing, it will soon be no boast that ships of 600 feet are in active service."

To which we add that vessels of this class may become a necessity, but they will be widely different from one of that size built some years ago—the *Great Eastern* to wit.

◆

GREAT ATTENTION IS GIVEN to the English railway stations. At Shrewsbury, for example, a city of half the size of Hartford, Conn., or say 25,000 inhabitants, the station cost $500,000. Along the route a grade crossing is hardly ever seen; when it is the gate is kept shut, except when some one wants to cross the track. Its normal condition is to be closed. Tunnels and bridges are frequent. Over these in many places ivies are grown and other climbing vines; and at many places the cultivation of flowers, stimulated by prizes offered by the companies, has been carried to an art. Crossing the tracks at stations is not feasible, and walking on the tracks through the country is forbidden. Look from the car window half a day and you see no one on the track except an occasional railroad employé. The whistle scarcely ever blows except at stations. The guard notifies the engineer that all is ready by blowing a shrill little whistle which he carries in his pocket. The engineer pipes a shrill answer from the locomotive whistle, and off you go, quietly and without the infernal bell ringing and leaping on the last car that we are used to.—*National Car Builder.*

◆

THE ARGUMENT contained in this paragraph, cut from the *Engineering Review*, is that machines will ultimately wear out, therefore it is just as well to build them originally in the condition they reach after years of wear. To wit:

> "The fits on this machine were as loose as proper running would permit, and they could not be reasonably expected to get any looser. The shafts in this machine were one thirty-second inch loose in their gear-end boxes. The question arises whether there is any difference between old, worn-out surfaces which have ground away till they are one thirty-second of an inch loose. In this particular machine there are probably not less than a dozen pairs of clutch-gears, which are, of course, loose on their shafts, and there are any number of shaft boxes. Time will show, after this machine gets running, if there is any noticeable badness chargeable to this system of extraordinary loose fits."

What is a loose "fit?" It must be akin to a tight slackness.

◆

SULPHURIC ACID, it is claimed by some person unknown to us, is a simple but certain test for adulterated butter. Fresh, pure yellow butter, by the slightest contact with sulphuric acid, turns almost a pure white, while oleomargarine made from tallow changes a deep crimson red. When lard or other oils are used in making butter the colors are diversified—showing all the colors of the rainbow.

Some butter looks that way without applying sulphuric acid, which is not always handy. A certain way to detect oleomargarine is to put a little in a frying-pan, over a moderate fire. If it is artificial butter, it will melt slowly and stand, like oil, a high heat; whereas, genuine butter froths up and burns almost at once.

BOOK NOTICES.

KINEMATICS.—A treatise on the modification or motion as affected by the forms and modes of connections of moving parts of machines. Fully illustrated by accurate diagrams of mechanical movements, as practically constructed: for the use of draughtsmen, machinists and students of mechanical engineering. By Charles William MacCord, A. M., Sc. D., Professor of Mechanical Drawing, Stevens Institute of Technology, Hoboken, N. J. New York: John Wiley & Sons.

We must accord to the author and the publisher, the distinction of having produced a work which, at a glance, commends itself to the reader and chains his attention. This arises not only from the convenient size of the work, its fine paper and typography throughout, but also from the strict accuracy and artistic beauty of the illustrations. The engineer at once recognizes their value. So far from the average illustration in technical works are they, that the impression is given that they are drawn to scale and can be worked from direct. The angles and motion-curves are all left in, and the relalations of one movement, or one detail, to an other, are distinct. In this respect, which is by no means a superficial one, the work is worthy of all praise, for the solution of the various problems offered is greatly facilitated thereby. In the text, also, the author has very clearly enunciated his propositions, and leads the student from much that is purposely elementary in the opening chapters to the close study of gearing in all its various forms and application, and with the principles which underlie it tersely and plainly laid down. If there were no other chapters, this portion alone would repay the reader for his purchase, but, as the title indicates, all details of machinery in motion have treatment in turn. For those who are desirous of rising in their profession and have a fair mathematical education, Mr. MacCord's work is of great value and well fulfills the promise of its preface. His problems are drawn from practical examples and have been verified; in which respect they are far above the diluted revisions of authorities, put forward by some as original.

* * *

An engineer of one of the large steamers out of this port was beset on a recent trip by an individual, who had a case coming on in court relating to steam engines; he wished the engineer to take him in hand and give him a full and circumstantial account of the engine on the ship, beginning at the bed-plate and ending on the cylinder-head, with reasons for every bolt and nut, together with the action of every detail that had motion, or was an appurtenance, or belonging.

The engineer was aghast at this proposition, and politely informed the passenger that he had his business to attend to and couldn't oblige him.

"Well," said the passenger, "I am not going out of this engine-room until I understand the whole thing from top to bottom—theory and practice."

The engineer said, in that case, he would be a very old man before he left, adding that he had been in the business over thirty years and didn't know it any too well himself. "But," he went on "you can go up into my room and use my library, and welcome. All the standard works on engineering are there, and may be you can learn all about the steam engine from them."

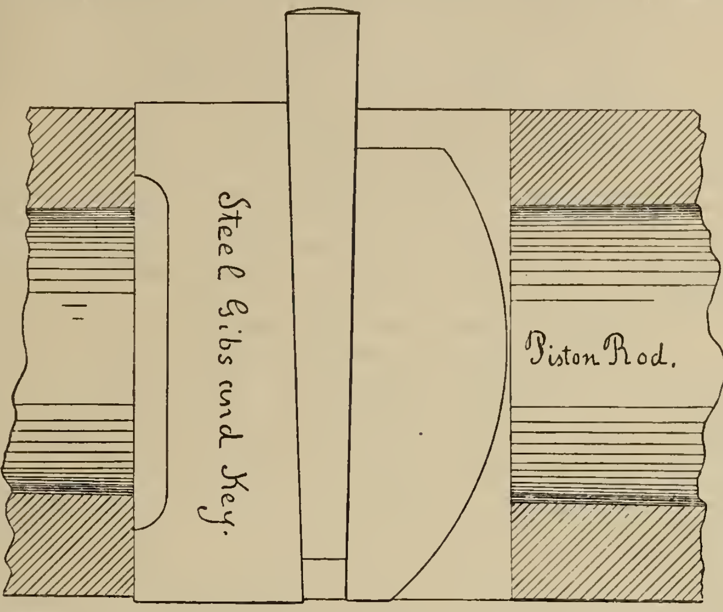
The passenger said that would do, and for the remainder of the trip was an assiduous student. When the ship reached the dock he thanked the engineer, and added, triumphantly, "I have it; I know all there is to know about the steam engine!"

* * *

It is estimated that the world's stock of locomotives consists of 66,000; of passenger cars, 120,000, and of freight cars, 500,000. The capital invested in railways, which are in all 200,000 miles long, is £4,000,000,000. The commerce of the seas is carried by 12,000 steamers and 100,000 sailing vessels, whose tonnage amounts to over 20,000,000 tons.

REMOVING PISTON-RODS FROM CROSS-HEADS.

A recent patent is a device for removing piston-rods from cross-heads, by a practical engineer, of Montgomery, Ala. This invention is designed for the purpose of removing piston-rods from cross-heads without injury to any part, and it consists in a base piece having a threaded projection, provided with a boss, and a cylinder formed with an internal nut screwing on the projection and connected to the cylinder by feathers, and adapted to bear against an annular shoulder in the cylinder.



This seems like a superfluous device, but it is not, for in some steam engines the builders have so constructed them that the cross-heads can only be taken off by a great deal of trouble. An unusually intelligent engineer and machinist spent ten hours recently in trying to get the cross-head off of a three-inch rod. Sometimes there is no chance to drive a wedge even.

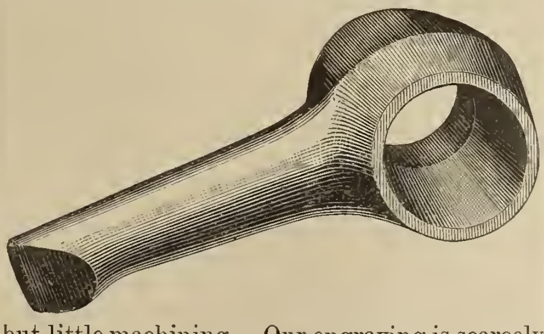
Where the rod is keyed on, it can sometimes be loosened by making two gibs and a key; the body of the back gib bears on the piston-rod in the center, and the other one bears on the cross-head, as in the sketch shown above.

This will dislodge the most stubborn rod.

* * *

A DROP-FORGED PITMAN-HEAD.

Our engraving is a *fac-simile* of a pitman head for an agricultural machine, and the forging is a sample from a lot of 50,000 now making by the Billings & Spencer Company, Hartford, Conn. It is very close to size and requires but little machining. Our engraving is scarcely more handsome than the forging itself. Any shape or size required for any machine part can be made as readily as this. Correspondence is invited from large manufacturers.



* * *

It is useful to remember that if the number of seconds spent in running a quarter of a mile be divided into 900, the quotient is the speed in miles per hour. The following table can be easily committed to memory:

			miles an hour.				miles an hour.
One mile in	51	secs. is	70·6	One mile in	61	secs. is	59
"	52	"	69·2	"	62	"	58
"	53	"	68	"	63	"	57·3
"	54	"	66·6	"	64	"	56·25
"	55	"	65·4	"	65	"	55·4
"	56	"	64·2	"	66	"	54·5
"	57	"	63·1	"	67	"	53·7
"	58	"	62	"	68	"	52·9
"	59	"	61	"	69	"	52
"	60	"	60	"	70	"	51·4

* * *

Blank postal cards are not uncommon. Out of a lot of one hundred purchased, three were without stamp or printing of any kind; put in for "jokers," probably.

A BOTCHED JOB.

The troubles attending the running of cars on the Brooklyn Bridge arise from many causes. These are defective mechanical arrangements, want of system, and a competent manager. The so-called "grip," for holding on to the cable, is an absurd device in itself, and not properly made for its design. No engineer of experience would ever attempt to move a dead weight of ten tons, without its load, by the aid of sheaves or pulleys, possibly 14 or 16 inches diameter, and having wooden faces let into the iron rims. The wood filling having nothing to hold it, or no facilities in the pulley for properly fastening it to the iron, tears out under strain, and has to be constantly renewed. Aside from this, other parts give way with the results of requiring a squad of repairers every time a car comes in. Even the bearings of the fixed shafts, over which the cable runs at either end, get hot for want of sufficient surface for the work they have to do, and the whole arrangement is a reproach to those who devised it. The cable is supported on pulleys, where it crosses the bridge, about 20 feet apart. These pulleys are, say, 16 inches in diameter, and run on insignificant bearings, one inch, possibly one and a quarter inches diameter, and about three inches long. An examination of the entire arrangements leads experienced men to feel that it was designed by amateurs, or persons who are unacquainted with the work to be done. It is unmechanical in every aspect.

As regards system there is none. At either end of the bridge the cars are switched off the cable track by a locomotive to take up passengers. They are run on again when full by the engine, but this switching off and running on is carried out in the most reckless fashion.

When we saw the operation performed, it seemed to be a matter of doubt when the car was on or off the cable road, and a man squatted at the end of a car and looked at the wheels to see, and called out, "back, back a little," (meaning back up a little). Everybody ran here and there, machinists left their jobs of tinkering at the grips, and ran up the road on messages to other disabled cars, and confusion reigned. This was not a preliminary, or trial trip, but on a day when the road was open for business. Everything was disorderly in the highest degree.

It seems unfortunate, to speak mildly, that the system of transporting passengers across the bridge should have fallen into the hands of incompetent persons, and that plans known to be serviceable on other roads, were not adopted. Instead of profiting by the experience of others, the Brooklyn Bridge Managers have purchased a little of their own, and they, and the public who are so unfortunate as to try crossing, find it very dear. As this plan is now carried out it is a failure, and until radically changed will prove a source of constant annoyance to all concerned.

* * *

This is the latest novelty in rudders:

"Mr. ———, of Fort Ann, N. Y., has patented a steam propelling rudder for vessels—a hollow rudder containing a steam engine driving a propeller wheel. The object is to assist in propelling the vessel ahead when the rudder is in line with the keel, and to assist in turning the vessel when the rudder is at an angle to the keel."

Fine!

* * *

The *Age of Steel* says:

"It has been a wonder to me for a long time how the publishers of some trade journals make a living. I have never yet gone into the office of a St. Louis manufacturing establishment without finding from half a dozen to three dozen trade publications scattered around in different stages of preservation, and nearly all as free as the waters of life. The great majority of the senders of these papers do not get a cent in return in the way of advertising, but the papers never stop, and personal items are always carefully marked."

The wonder is how this astute young man knows which are paid for and which are not! We can tell him he never will find The Mechanical Engineer in the gratuitous list.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,

150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in adavnce, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, when possible.

POUNDING.

So many things may cause an engine to pound that an engineer is excusable, sometimes, if he does not detect the fault at once. The popular remedy for pounding is to key up the connections and screw down the main shaft bearings, but it by no means follows that these details are in fault. If they are the causes, it is easily detected, and it is unnecessary to write a volume or two on that subject.

Pounding often arises from faults of workmanship or design, and, where this is the case, an engineer has no remedy. Faults of workmanship may be both in fitting up and setting up an engine, and it is left to the engineer, as the final judge, to locate the fault. In boring cranks, for instance, it very often happens that the shaft-bore and the crank-pin are not in line with each other in any direction. They may not be visibly out of truth to casual inspection, but if carefully measured it will be found that these two important parts are not exactly parallel. It is, further, a difficult fault to detect, unless the crank lies on the floor with both holes exposed. A great error could easily be found when the crank is in place, but great errors do not exist, and ordinary methods of measuring would not reveal minor faults. The crank-pin surface is so short in the direction of its length on the average steam engine, that the two bores might be out of line with each other a sixteenth of an inch in two feet and yet be undiscoverable on the crank pin by means of lines. If the crank does not stand square with the shaft, it is easy to find it out, for the crank travels in a large circle, and measurements to it can be had at all points, but the crank-pin is short and lines are unavailable. In such a case, resort must be had to a wooden straight-edge long enough to overreach the whole stroke of the crank; this straight-edge, carefully adjusted by a line through the cylinder, can be used horizontally as a base for a try-square, and if the crank-pin is materially out of place, the fault will be found at once. The action of a crooked crank is to twist the connecting-rod at some point of the stroke, and, as a consequence, throw the cross-head violently to one side or the other. It must be remembered that the error in the crank-pin, slight as it is, is multiplied many times in the length of the connecting-rod.

What has been said of the crank-pin is also true of the pin in the cross-head, and the ideal steam engine is one wherein every pin that transmits motion is in absolute accordance with the one which receives the motion. When this is the case, the pins round and the boxes well-fitted, it is a noiseless piece of machinery.

Bad workmanship in setting up is found in want of alignment and valve-setting, and these are errors easily corrected by intelligent engineers. All the skill of the latter, however, is neutralized if the fault is in the design of the engine. Frames often appear to be solid, yet buckle and spring badly, and, what is of common occurrence, the parts are out of balance. Of all defects most likely to be met with, this is the commonest. Centrifugal force and its action at various speeds is a subtle thing, by no means easily controlled or provided for; at one velocity an engine is noiseless, and at ten revolutions higher or lower it jars the neighborhood. The weight of parts, and the velocity at which they move, affect the question, and the most perfect fitting and alignment can be neutralized by unbalanced details.

The reader may not unnaturally ask where the noise arises, if all parts fit and are in line, and to this question we may reply that it comes from back-lash. No details fit so accurately that they do not have some slight lost motion, and in the case of an engine out of balance they are working irregularly. At one point of the stroke they are thrown violently forward, and at another released; the result is a pound.

A jig-saw is a simple device, with but few joints and very light details, but we have seen a tool of this class, when run out of balance, shake a whole building, and a large one at that.

An engine too lightly loaded is affected in the same way as if it was out of balance in itself, for the momentum of the fly-wheel runs away with it and the load acts intermittently, causing it to behave as though it was badly designed and set up.

The causes above mentioned all have their influences on the action of steam engines, and it is not to be wondered at, that, in some cases, an engine is given up as a hopeless and chronic pounder. The trouble may be one of the several mentioned, or it may be a combination of all, and, when it is, the case might be called a hopeless one, for it is not supposed that an engine will be rebuilt to cure a pound in it.

The evil may be alleviated sometimes by excessive cushioning, but not always, for one of the noisiest high expansion engines we ever heard showed such a card that it might, almost, be turned either end to.

OUR PROMISES.

Last year at this time we made certain announcements of our plans for the present volumes, and published in our prospectus the titles of various serials which we intended to bring out. All of these papers have been published, or are now in course of publication, and it is our intention to continue this form in the year to come. The "complete in every number" idea may find some merit with transient readers, but no technical subject can be properly discussed in a column or two. When compressed into such limits, it is discursive and of no permanent value.

This is merely a reminder to our friends, and well wishers everywhere, that all that our prospectus promised for the current year has been performed; and it is also a good opportunity to remark that in the year to come we shall have many new writers who will convey useful information upon new topics.

MATHEMATICS AS A TOOL.

When a man undertakes a certain job of work he sometimes finds he could get along faster and do the work better if he had a special tool, and he spares no pains and gives his employer rest neither by night or by day, until he has obtained it. This illustration applies particularly to mastering advanced works on mechanics. In them the science of numbers, in one form or another, plays an important part, and a knowledge of them is absolutely indispensable if we would acquire anything more than the rudiments of the profession. Perhaps the tool that our friend in the shop received is one that he never saw before; it has some puzzling peculiarities which vex and also dismay him, but he does not give the tool up and say he can't master it; he studies it and finds out its good qualities, ending by a thorough knowledge of it. Mathematics is precisely such a tool. The analytical powers of mind required to master this branch of study are not developed so well in some as in others, but they are there all the same, and can be awakened if the student is in earnest. Physiologists say that the convolutions of every human brain are alike: there is no difference in them; some weigh more and some less, but in the brains of great men and those of lesser note, no distinguishing features are externally apparent. This proves that cultivation and exercise of the mental faculties, the reasoning powers, are the only awakeners, and that all have dormant force which only needs arousing to be a mine of wealth to the possessor. We have before pointed out the difficulty under which many labor who undertake the study in question, and we will do so again, (for we have many new readers), and that is in trying to do too much at once.

An earnest man determines not to be foiled any longer by $a+b$, and he flies at an algebra with the zeal of an enthusiast; he reads that this is equal to that, and this letter divided by some other letter is equal to x. Then he gets vexed, for he cannot see how one letter can be divided by another and mean anything, and he becomes discouraged and feels there is something wrong with his brains. He thinks they are not of quite so good a quality as the occasion demands. If our suppositious friend had mastered an arithmetic first, he would find no trouble with algebraic forms and expressions, and his difficulty is in beginning at the wrong end.

As to the arithmetic, we think we can help our friends. Even that, to the untaught, is sometimes puzzling in its explanations (that is, the works written upon it are), and this winter we shall have a series expressly devoted to those who have had but few advantages in the direction named. It will be entitled, "*How I Served My Apprenticeship*," and will explain clearly the methods of finding the dimensions and action of things in common use in every machine-shop and engine-room. To such as wish to learn, it will prove of the greatest assistance, being written by a shop foreman, who knows the difficulties to be encountered.

DRIFTS AND DRIFTING.

Cutting keyways through connecting rods is now accomplished by two methods, chiefly, the slotting machine and the cotter drilling-machine. These two are used where large quantities of work, of one kind, are done, such as in locomotive shops, and in these the cotter drilling-machine has the preference. The name of this tool arises from the English term for a key, (cotter), and it is somewhat confusing to those who have never seen the cutting tool used in the machine. This cutting tool is rather difficult to describe, but it may be understood when we say it is capable of cutting endwise and sidewise. It is like a square ended drill in appearance, and is of the same size, nearly, as the key-way intended to be cut by it. When the key-way is to be started in the rod, the tool cuts endwise until it has all the cut it will carry sidewise, and is then fed horizontally along the key-way. The action is automatic, and the machine can be set to run a certain distance (like a planer) and then return. In this way the key-way is gradually worked out. As the machine requires very little attention when once started, it does its work economically. The other method of cutting key-ways is by the slotting-machine, and is too well known to require mention. Both of these tools, however, are expensive, and but few shops possess them. Even the slotting machine is not by any means universally used. Small shops throughout the country are constantly cutting key-ways, and in some large ones, for that matter, primitive methods—drilling-machine, hammer and chisel, and file, are still in vogue.

Nothing is so sure a test of the workmanship turned out in a shop as the connections, for upon them very much depends for the working of the engine. Moreover, the fitting of them requires skilled labor; it is a slow and expensive job, which cannot be hurried, but must proceed by regular stages to the end. We say it cannot be hurried, but it can be expedited by the use of special tools, which are within the reach of any shop that makes steam engines.

One tool of this class is the drift, as it is commonly termed, and it is a most useful one when properly made. It is called by some a broach, but this is not correct, for the two are quite dissimilar in shape and appearance, and are used conjointly. The drift is nothing more than a flat-ended piece of hardened steel, slightly less in width than the key-way to be cut by it, and not less than three widths in length; that is, if it is half an inch wide, it should be an inch and one-half long. Many persons have experienced difficulty with the drift, but this was because they endeavored to do too much with it. They took too rank cuts, and under such circumstances it will not work properly. All the benefit to be derived is in leaving a clear straight path for the file to work on, and to reach portions in the center of the stub-end that are hard to get at with a hammer and chisel. The drift should be made and used as follows: The end of it should be square across, not filleted out hollow, and the wide side should have but little clearance. For a key-way six inches deep through the stub-end, and three-quarters wide; the drift should be eleven-sixteenths wide at the cutting end, and nine-sixteenths four inches from the end; it does not require to be the full depth of the stub-end, for the drift should be used from both sides of the key-way. The drift should be one clean sweep on the side, from the shank to the front cutting edges, not straight part of the way from the cutting end. Made as above, it holds the cut better, and will not bind in its track and break off in the work.

To use it the fitter chips the key-way out, fair and clean, nearly to size, leaving but a sixteenth of an inch for the drift to remove. For half an inch from the outside of the key-way, the drift should enter freely, when, if it is held straight, and hit squarely on the head, it will go through to the center, carrying everything before it, leaving a bright, clean surface behind such as no other hand tool can in the same space of time. The whole secret of success with a drift lies in the management of it, and we use the expression—secret, because, simple as the tool and its management is, we have seen many in serious difficulties with it. Not once, but many times, we have seen connections bowed out on the sides of the stub-ends by too energetic drifters, who fancied they had only to hit hard enough to drive all before them. Though used by blows, it is by no means to be violently used. The drifter sees, when the tool is well down in the key-way, that the clearance between it and the drift is alike on both sides, and he knows by that the tool is going straight. Sometimes the key-way is so deep that it is necessary to use two drifts, one smaller than the other, but in this case, unless the second drift used can start on a square cut, or get hold of a cut, it does not work well, being apt to bind, or wedge in sideways. It does not get hold of the metal, but simply wedges it out sidewise.

In the hands of a skilled workman, the drift is a most useful tool, but it requires a little humoring at all times to get the best results.

A SPECIOUS PAMPHLET.

We have received a specious argument on prison labor, and the propriety of continuing to allow convicts to compete with honest mechanics in this State. We say it is specious because it attempts to show that, to the contractors, prison labor is unprofitable, and that the object of continuing it is a philanthropic one; the poor convicts will become worse than before they entered, unless they have something to occupy their time while working out their sentences. Also, in the pamphlet named, it is asserted that unless the prison is rendered self-supporting through this convict labor, the people of the State of New York will have to pay $400,000 extra taxes. This is certainly a dreadful alternative. If the question was put nakedly before the people to-morrow, solely on its merits, to wit: "Will you pay $400,000 and keep convicts from competing with honest men, or will you allow them to compete and save that sum?"—it is easy to say what the answer would be. It would be like the roar of a hurricane compared to the whisper of a flute.

We say this pamphlet is specious in that, in one breath, it argues that prison labor is unprofitable to the contractors, and in the next they appeal to the people to sustain it by vote. What for if it is unprofitable? John S. Perry, of Troy, N. Y., is the writer of the pamphlet, and we wonder what he would do if the people of the State of New York said he *must* carry out a contract whereby he lost money, and keep carrying it out, and keep losing money indefinitely? Ingenious sophistry is not bad reading. It excites the same feeling in the mind that an intricate piece of machinery does—admiration for the author's constructive ability—but a clumsy, transparent appeal (like this pamphlet) to the pockets, as against common sense and the rights of honest men, should make the writer and the printer blush.

A thing that is wrong in principle never can be right, and it is a thousand times better to pay even $400,000 by the people of this State to support convicts, if need be, than to debase honest mechanics by their competition. The pretence that convicts will suffer if not employed is of a piece with the rest. There is plenty of work for them to do where they need not come in collision with the interests of honest men, if it is necessary for them to have it.

The Indicator Series is very popular.

THE PROFESSOR IN THE MACHINE SHOP.

At the time of announcing the discontinuance of the series under this title, we had an inward, but unexpressed, conviction that Mr. Moulton would not get rid of his readers so easily as he fancied, and judging by the very many remonstrances addressed to us we were correct. For once a presentiment was verified. Witness this sample of many similar:

> "I was very sorry to read in a late issue your announcement of the discontinuance of the letters of "*The Professor in the Machine Shop.*" They were almost the first things I read when the paper arrived. They were full of *good sound sense*, and I greatly enjoyed reading them, and I hope they will be resumed at an early day."

This was sent to Mr. Moulton, with a polite request that he should emerge from the obscurity of his native wilds, and take up the pen in earnest again. In reply, we received the following characteristic letter:

To My Friends:

The editor of The Mechanical Engineer has sent me many kind remembrances from my readers during the past year, and especially since I stopped writing. After reading them I cannot but feel flattered by the expressions of good will from those who are personally unknown. It has been said, among other things, that I have no right to stop after having once commenced; meaning thereby that in my poor way I can be of some assistance to my fellow workmen. I confess that this point struck me more forcibly than any other, and though I lay no stress upon any faculty I may have, I think the idea above alluded to is sound in principle, and that all are in duty bound to help one another in this world so far as they can. With this aspect of the matter before me, I shall at an early day, say by the last of next month, resume the narration of the experiences which have fallen to my lot in life.

As to appearing in public under my own name, that I shall never do. I have nothing to gain by publicity, and, least of all, no ambition to gratify. Vanity was left out when I was cast, and it didn't hurt me a mite. I have no son who might profit by his father's name, and I am satisfied to do what I can in my own humble way without any more fuss over it.

This letter, so full of personal allusions, is very distasteful to me, and is only called out by the kindness of my readers. I should be wanting in appreciation if I did not speak plainly, without regard to egotism.

Moulton.

TALKS ON THE STEAM ENGINE.

The series of papers under this title, by Professor W. D. Marks, of the University of Pennsylvania, published in The Mechanical Engineer some two years ago, will be resumed in the new volume commencing January 1st, 1884, and continue for some time. These papers will embrace rational and practical rules covering all points of the steam engine, expressed wholly by arithmetical computations, which all can verify and adopt, if it seems good to them. Professor Marks is a radical thinker; he goes to the root of things; and our readers may rest assured that he will not dress up the rule of thumb in another garb and parade it as a new gospel of mechanical engineering. He will expound standard authorities, the great teachers of engineering, and draw illustrations from his own practice.

We think these articles will be of great service to our friends, for the author appreciates the difficulties encountered by those who have had few advantages when undertaking study. Many obscure points will be made clear to working mechanics. Professor Marks does not write gratuitously, and we mention this fact only that our readers may know that we are endeavoring to give them solid value in return for their support.

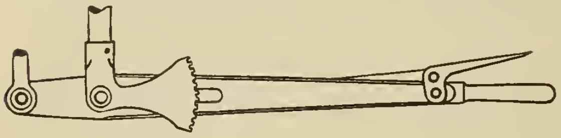
A distinguishing peculiarity of the American mechanic is that wherever he encounters any special difficulty in his business he immediately tackles it, so to speak, simply because it seems to challenge his skill. By this he learns much more than he would if he went round the trouble and found a substitute. From this very trait, also, he advances himself greatly, for difficulties arise from the unusual, not from that which is obvious. Anything that makes one think is good for the brains!

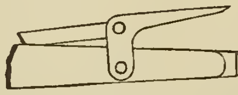
IN THE ROUND HOUSE.—No. XIII.

BY L. O. DANSE.

RUNNING.

The illustration shows the Pennsylvania Railroad standard throttle-lever, and may be taken as a fair representative of the general run of throttle-levers; but it has one serious fault—the latch-trigger is on the wrong side. To shove it in, the hand must be closed around the handle and trigger; whereas, if the latter were on the side nearest the runner, it could be pushed shut very much more easily, and would be no more difficult to pull open. The importance of shutting off quickly in times of sudden danger, or even when the wheels begin to slip, is evident to all; and any detail which adds to the facility of doing so will be readily recognized as highly beneficial. I am happy to say that many roads recognize the correctness of my belief by placing the latches as I advocate.



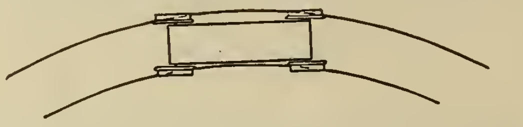


The first time I ever attempted to move a locomotive, I learned all about throttle-levers. It was on a B. & O. "Jersey." Those of my readers who never saw a B. & O. "Jersey," could never imagine what it is like. It is an eight-wheel connected engine, with four enormous driving-springs which do the double duty of springs and equalizers—bearing at each end on a saddle, and connected at the middle band, to the frame, by a large hanger. Its cylinders are 20″ × 24″, devoid of head casings; wrought iron smoke door with no number-ring; no casings on the cheeks; fire door so low that the tank has to have a "kitchen," two feet below its main floor, for the fireman, the draw bar passing under the "kitchen" and fire-box. The cab is on top of boiler, which reaches clear through, the cab-floor being about four feet above kitchen, and there is no room in it for seats, except a little folding one, which has to be knocked down every time the engine is reversed. The pumps are bolted to the fire-box, with pet-cock rods coming straight up through cab floor, terminating in T-handles, which are constantly being tramped on and kicked open. The reverse lever is right in the way; the throttle lever is a yard long; the pet cock for left hand pump up *in the roof!* Pet cock for right hand pump in the floor, under your feet; blower valve outside on dome. * * * *

Best, who had been on the P. R.R., used to growl and say: "These things ain't anything like a locomotive," as he stuffed his glove in the lever-latch to stop the rattling. One day he got down to oil around, and as the confounded things were built so you had to bend double to get around them, he called up to me to move her half a turn ahead. I jumped over the boiler, threw the lever into the end notch, gave her a notch of the throttle, and shut her off. She had not moved. I gave her a little more steam. Still she had not budged; then I gave her a pretty good head, and she started with a jump. My finger slipped from the trigger, which was made like the second figure above, and in my excitement I failed to catch the trigger, again until I had tried three times. Then I was obliged to reverse and bring the "Jersey" back, for she had gone about a hundred feet. If any one can tell all the thoughts that rushed through my head while I tried to stop that abominable relic of antiquity, I will give him him a prize chromo and a brass ring. If that throttle-trigger had been properly placed, I would have had no difficulty.

But, interesting though they be, throttles and "Jerseys" are not what I meant to talk about this week, so we will come right down to the business in hand; which is, the effect of curves on the running. Civil engineers distinguish curves by their degrees. Without going into details, a one degree curve has a radius of 5,730 feet; and the radius of a curve of any other degree is equal to 5,730 *divided by the degree of curvature.* In other words; if the radius of a curve is known, its degree $= \frac{5{,}730}{\text{Radius.}}$

A locomotive, in going around a curve, has a constant tendency to run in a straight line, which causes it to hug the outer rail (and sometimes climb it). To prevent danger of the engine climbing the rail, the outer rail of curves is always elevated above the inner. The effect of this tendency of the locomotive to hug the outer rail, is to produce a great waste of power, as the mass of the engine and train have to be moved around as well as forward. A great deal of friction is also induced between the flanges of the wheels and the rails.



From the sketch, it will be seen that the flange friction must be greatest at the front outer wheel, because it is running towards the rail, and that the hind outer wheel is next, the inner ones being comparatively free. It is evident, too, that if a third pair of wheels were rigidly connected to the two shown, they could not keep the track if they all had flanges. It is on this account that in locomotives having more than two pairs of drivers, the additional ones are made "blank," *i. e.,* without flanges.

The effect of curves on the speed is the same as that of grades—more steam being required to keep it up. To put both on one basis, I append the following table:

1 deg.	= 1½	feet per mile.	11 deg.	= 23	feet per mile.
2	" 3	" "	12	" 27	" "
3	" 4	" "	13	" 31	" "
4	" 6	" "	14	" 35	" "
5	" 7	" "	15	" 40	" "
6	" 9	" "	16	" 45	" "
7	" 11	" "	17	" 50	" "
8	" 13	" "	18	" 55	" "
9	" 16	" "	19	" 60	" "
10	" 19	" "			

On level track the engine runs slower in going around curves than on the straight portions. On grades, the grade is usually reduced on curves, so that they do not affect the speed as on levels. The runner, knowing this, handles his engine accordingly.

* * *

THE STEAM ENGINE INDICATOR, AND ITS USE.—NUMBER 2.

BY WILLIAM BARNET LE VAN.

If the indicator and its spring are in good order, the pressure given by it may be taken as correct, provided the instrument is not placed too near, or exactly opposite, a steam-port. In the former case the flow of steam past the opening into the indicator generally reduces the pressure indicated during the admission of the steam; and, in the latter case, the momentum of the steam, especially if wet, causes the pencil to give jerky and uncertain indications. The cylinder-heads are usually the best position for the indicator.

It is advisable to take diagrams from both ends of a cylinder, as the two diagrams always differ more or less, and in calculating the power the area of the piston-rod must be deducted from the area of that side of the piston.

The indicator should be run for a few minutes, so that it may become hot, before the diagrams are taken, and if any part works stiffly this should be rectified. After taking the diagram a note should be made on the back, of the date, name of builder of engine, description of engine, diameter of cylinder, length of stroke, number of revolutions, the atmospheric pressure, boiler pressure, scale of diagram, and any other particulars it is desirable to have on record.

As I have before stated, the indicator is an instrument by means of which a steam engine is caused to write on a piece of paper an accurate record of the performance that takes place within the cylinder. It gives a record which to the uninstructed eye is unintelligible, but by engineers is looked upon as the most reliable statement they can have of the work done by an engine, inasmuch as it tells at each and every part of the stroke of the piston what are the effective pressures tending to produce motion, and what are the back pressures tending to detract from the effective pressures.

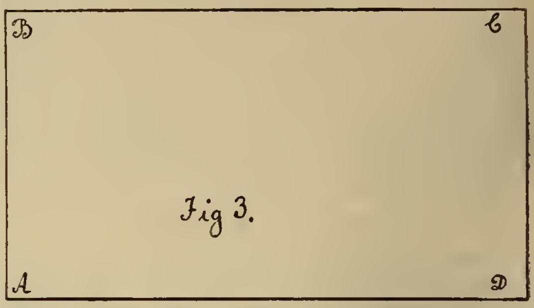


Fig 3.

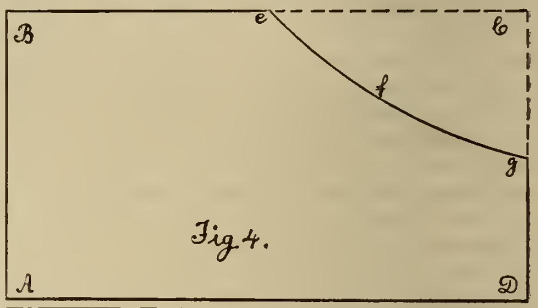


Fig 4.

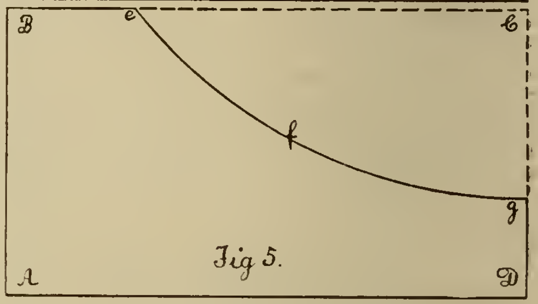


Fig 5.

INDICATOR DIAGRAMS.

Assuming that we have an indicator attached to a steam engine cylinder, and so connected that the drum containing the paper moves to and fro coincident to the piston of the engine: now, if we apply the pencil to the surface of the paper, it will draw upon the paper a horizontal line, *A* to *D,* in length proportioned to the stroke of the engine. (See Fig. 3.)

Now, if we open the cock attached to the indicator, and assume that the engine-piston has just commenced to move from *A* to *D,* the indicator-piston will also move vertically, and the pencil will trace the line, *AB,* representing the pressure per square inch of the steam in the engine-cylinder.

Assuming that the indicator spring were one which would compress one inch for every forty pounds pressure per square inch acting on the piston, then if there were 100 pounds pressure per square inch on the engine-piston, the pencil would rise two and a half inches from *A* to *B.* Now, suppose the engine-piston to have completed its stoke: the pencil having traced the line, *BC,* and the slide-valve to have opened the exhaust-port so as to allow the steam to escape, then the indicator-piston will fall, and the line, *CD,* will be traced. On the return stroke, the pencil would follow the line *DA,* with the exception of any diversion caused by steam that might remain in the cylinder in consequence of the steam not having been perfectly exhausted. Leaving this out of the question, it would have returned to the point, *D,* and thence to *A,* thus describing a parallelogram, of which the horizontal line, *AD,* would represent a proportion of the stroke of the piston, and the vertical line, *AB,* would represent the steam pressure upon the pistons. The area of this parallelogram would, therefore, represent pounds-pressure into feet moved through by the piston in its stroke, or half revolution of the engine.

Now, for simplicity, suppose that the line, *AD,* (Fig. 3), represents a foot-stroke of the piston of one foot; that the piston has an area of 99 square inches, and that the line, *AB,* represents 100 pounds pressure to the square inch, then we shall have 100 pounds multiplied by one foot, and this equals 100 foot-pounds, which, multiplied by 99 square inches (area), will equal 9,900 pounds as the work performed by the piston in one stroke, or half revolution. For both strokes, we have 9,900 multiplied by two, equaling 19,800 pounds as the force exerted by the engine through one revolution. If the engine makes 100 revolutions per minute, then 19,800 ×100=1,980,000 pounds, would be the force exerted by the piston of such an engine in one minute. This, divided by 33,000, gives sixty-horse power, which is called the gross indicated horse power.

Diagram, Fig. 3, is one that seldom if ever occurs in practice. When such are produced, they are only justified by the desire to obtain the greatest possible power from a given size of engine without regard to the highest economy. It will be seen that steam was supposed to have been admitted during the whole length of the stroke, and that no advantage whatever has been taken of the expansive property of the steam.

Diagram, Fig. 4, shows steam used expansively.

Assume the same data as in former case, the 100 pounds pressure above the atmosphere has raised the pencil from *A* to *B*; also assuming that the steam has been admitted to the engine-cylinder up to the point *e*, (half the length of the stroke), and then cut off by the valve; the steam now in the cylinder begins to expand, and as it expands it loses pressure. By the time, therefore, that the piston has arrived at *e*, from *e*, the steam will have lost pressure, and the pencil will gradually fall and trace the curved line *f*. By the time the piston has reached the end of the stroke, the pressure will further have diminished, say to *g*, and when the exhaust opens it falls down to *D*.

It will be seen by this diagram that, although only half the steam was admitted into the cylinder, as in the case of diagram, Fig. 3, the area of the diagram is very much more than half of that of Fig. 3; as a matter of fact, it is about 0·83 of that area, and thus a power 0·83 has been obtained by using the steam expansively for half the steam that was required in the case of Fig. 3.

A WRITER in a foreign periodical gives this as a rule for finding the area of steam-port for a marine engine:

> "The area of steam-port commonly given in the best marine engines, working at a moderate speed, is about one square inch per nominal horse-power."

Then a thousand horse-power engine would have a thousand square inches in the port, say 50″×20″, or 100″×10″! It don't seem to come out just right, somehow!

POSTAL NOTES may be easily raised in amount from the original sum paid for them. This has been done by simply punching a higher figure and inserting the blank cut out in the lower sum punched at the office where the note was bought. If the Government had made the punch in the form of some beast, bird, or intricate letter, this would have been avoided, for a punch of that character is not easily counterfeited.

IT IS CUSTOMARY with many builders to bore the guides of steam engines in line with the cylinder, so that the guides are, in shape, segments of a circle, the cross-head, of course, being turned or planed to fit. This is not good practice, for there is nothing to prevent the piston from going crooked in the cylinder sidewise. The angle of the connecting-rod is not the only thrust to provide against; there is a tendency in the cross-head to dodge sidewise, particularly if the wrist-pin in the cross-head and the piston-rod are not absolutely central in all directions.

THE RIDICULOUS ORDER appended is probably the work of some functionary who has lost his head, if he ever had one.

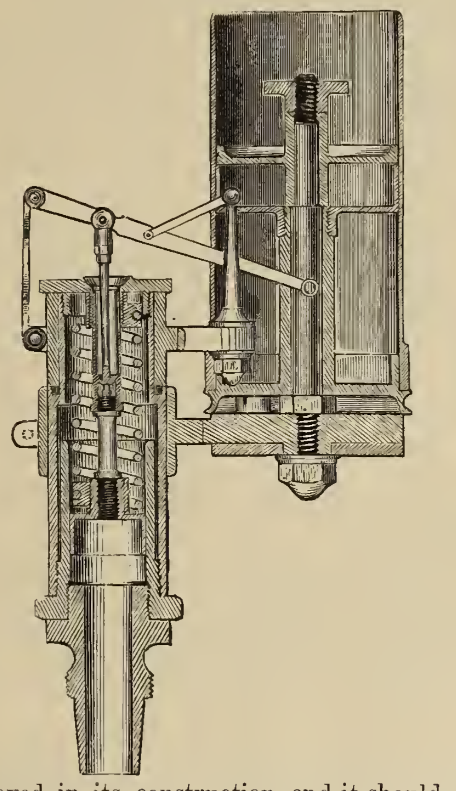
The officials of the New York, New Haven & Hartford Railroad have just issued a notice to their employees, prohibiting them from speaking in disrespectful terms of the New York & New England Railroad or its management in the presence of passengers.—*Boston Journal, Oct. 6.*

THE MANY FRIENDS of Mr. J. B. Anthony, of Providence, R. I., will regret to learn that he was very seriously injured in a railway accident near St. Louis, on the 23d instant.

THE INSIDE OF AN INDICATOR.

Many of our readers have never seen an indicator taken apart, and are, therefore, not familiar with its construction. To such the engraving herewith, of the Thompson Indicator, will be found instructive. It represents the instrument cut down through the middle, exposing all parts. The small cylinder on the left is the steam-cylinder, and connects directly with the engine-cylinder. The indicator-piston is shown with a spring above it, and this spring is attached to give the down-stroke. The paper-drum is shown above, on the right, and the partitions in it, which seem to be pistons, are merely steadiments, fast on the upright rod, and serve to carry the drum true when it is rotated by the cord from the engine. The lever seen at the top, extending partly over the paper-drum, carries the pencil which makes the diagram, and the paper-drum has a spring at the bottom which serves to give the return stroke.

The indicator is a very sensitive and delicate instrument, and is very accurately made in all parts. None but the very best workmen are employed in its construction, and it should be used carefully and kept in the very best condition. Of all other things, avoid putting any other than the finest watch oil (porpoise oil) on its bearings.



If there is any occasion to take it apart, do so only in a quiet, clean room, where there is no dust blowing about—in a word, deal with it as with a costly watch, then it will do good service and give accurate records.

A NEW USE FOR SAWDUST.

Up to the present time no method of using sawdust for any other purpose than fuel has been discovered, but we read in a foreign paper —*The Timber Trades Journal*—that a great discovery has been made. This is no less than producing gas from sawdust, and works of this character are now in operation at Deseronto, Canada. No details are given of the process or the nature of the apparatus employed, but, if their attention is directed to it, there is no reason why our own engineers should not put up works for the purpose in the West, and supply gaseous fuel to those who now burn the crude saw dust. As the material itself encumbers the earth in the vicinity of the great saw-mills, there is not likely to be any scarcity of it, now, or so long as lumber is made, and we hope to hear of some decided movement in the direction indicated very shortly.

THE HARTFORD STEAM BOILER AND INSURANCE Company report that, during July, out of 3,563 defective boilers, 662 were dangerous. The inspectors found 221 gauges out of order, 363 blistered plates, and 633 cases of badly-scaled boilers.

SOLIDITY IN MACHINE TOOLS.

BY A MACHINE TOOL BUILDER.

Happily for the true progress of our mechanics and their success as tool-builders, the period of fancy building in machine tools is fast passing away. There was a time—and not very far in the past, either—when cast-iron in tool-building was treated very much as though it possessed the value of gold, and was from six to ten dollars a pound instead of so many cents a pound. Patterns for castings were pared, and cored, and webbed, and molded, and jigged out into fanciful open work, made to represent tendrils, and vines, and intricate geometrical patterns, obviously to add to their beauty; really to save material and make them light and easy to handle. The virtue of using the material by putting it where it would do the most good, was carried to excess, and its converse was attempted —to take away material wherever it could possibly be spared, with the result of producing a machine essentially weak where it should have been essentially strong. Either the elements of resistance to burdens, of cast-iron, and its capacity to withstand sudden shocks were not understood, or the builders preferred beauty to strength.

There are very few machine tools (for working metals) that can be made beautiful and at the same time durable, unless beauty be predicated on adaptability. Some small turning-lathes, lathes for brass-finishers, and similar tools, may be exceptions, but even here assured strength and endurance are preferable to beauty of form and elegance of contour.

There should be scarcely any limit to the life of a machine-tool, if it is kept in proper repair. With a little replacement here and a slight amendment there, the lathe, the planer, the milling-machine, boring-mill, slotting-machine, and almost every tool used in the machine-shop, may outlive the apprentice that received his lessons on it. But so flimsy were the proportions of our machine tools of twenty-five or thirty years ago, that to see one of them in use now is to see a curiosity. They have long ago disappeared from the scrap-heap down the open maw of the all-receiving cupola.

One of the foremost builders of machine tools in the country has scarcely a single pattern that was his boast twenty years ago. Particularly is it the case with frames, beds, platens, legs, uprights, columns, bases and other parts that form the body and mass of the machines. The old patterns, where used, have been enlarged and strengthened, and the new ones have been modeled more on the anvil style.

It may be that this improvement, which is general, is partially attributable to foreign example. Imported tools used to be called "clumsy;" they are now considered strong. It is certain that they do their work with a stolid pertinacity, "without winking," that excites admiration. So the tools which are now turned out from our own shops perform their work without jar or tremor.

It is economy to have lathes that will carry chips as heavy as the cutters can stand. It is economy to have planers that plane just as solid when the tool-head is raised two feet from the platen as when they are planing a two-inch slab. It is economy for the builder, also, to put iron enough in his tools to entitle him to the name and profit of a good tool-builder. It is solid satisfaction to the workmen to run a tool that never refuses to do all the work they can put upon it.

THE TIGHTNESS OF RIVETS, says an English engineer, can be readily tested by tapping their ends with a light hammer; but where one or two rivets in a group are not perfectly tight, it is better to have the rivets hammered again, than to cut them out and put in fresh rivets, which is sometimes apt to loosen the adjoining rivets. In riveting the top booms, or flanges of girders, it is an excellent plan to begin riveting at each end and work on to the center. By so doing, the stretching or elongation caused in the plates by the process of riveting is avoided, and the joints are more effectually closed and tightened up.

SINCE THE commencement of the Indicator Series, our circulation has increased materially.

THE CORRECT CONSTITUTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

We surrender a considerable portion of our space in this issue to our friends the Stationary Engineers. The attention of employers is especially directed to it, as they will see there are no incendiary doctrines incorporated, and no antagonism set up between interests. We should have published this in our last issue, but as some amendations were necessary, we preferred to wait until the correct version came to hand.

Preamble.—This Association shall at no time be used for the furtherance of strikes, or in any way interfering with its members and their employers in regard to wages, recognizing the identity of interests between employer and employe; not countenancing any project or enterprise that will interfere with perfect harmony between them. Neither shall it be used for political or religious purposes.

Article I. *Sec.* 1.—This Association shall be known by the name and title of "The National Association of Stationary Engineers of the United States of America."

Sec. 2.—The objects of this Association shall be the mutual improvement and benefit of stationary engineers, provide for the formation of subordinate bodies, and enact laws for governing the same.

Article II. *Officers and Their Duties.—Sec.* 1.—The officers of this Association shall consist of a President, Vice-President, Secretary, Treasurer, Conductor and Doorkeeper; and the President, Vice-President and Secretary shall constitute a Board of Arbitrators.

Sec. 2.—Officers of this Association shall be elected when the delegates of the subordinate Associations are convened.

Sec. 3.—The duties of the president shall be such as pertain to a presiding officer of a deliberative body, sign all charters, issue the pass word, and such other duties as pertain to his office.

Sec. 4.—The duties of vice-president shall be to aid the president in the discharge of his duties, and to fill the president's chair in his absence, and discharge all other duties required by this Association.

Sec. 5.—The secretary shall keep the minutes of all meetings and all other records, books and papers of the Association, receive all money at the hands of the brethren, pay it over to the treasurer, taking his official receipt for the same, and attest all orders on the treasurer. His books shall at all times be open to the inspection of officers of the Association.

Sec. 6.—The treasurer shall receive all money from the hands of the secretary, pay all orders directed by the Association, signed by the president and secretary, and have the seal of the Association attached, and at all times have the books open for inspection by the officers of the National Association of Stationary Engineers of the United States. He shall give bonds in the sum of $1000 with surety satisfactory to the Board of Arbitration.

Sec. 7.—The conductor shall assist the president in maintaining order, introduce delegates, present officers elected for installation, and perform such other duties as the president may direct.

Sec. 8.—The doorkeeper shall have charge of the door.

Article III. *Sec.* 1.—The meetings of this Association shall be held on the first Tuesday in September of each year.

Article IV. *Sec.* 1.—All subordinate Associations shall pay with each quarterly report a per capita tax of five cents for each member on their books.

Article V. *Sec.* 1.—Whenever three or more Associations have been organized in any one State, they may, if they desire it, organize a State body to be known as a State Association, and when so organized shall have power to make such laws as they desire, which must conform to the constitution and rules of the National Association.

Article VI. *Sec.* 1.—This Association may grant charters upon the written application of ten stationary engineers (except in States having State charters) who have never been expelled from any Association of stationary engineers, upon a payment of $10, and no charter will be granted to a subsequent Association in any city or town unless the members of the Association previously chartered, shall consent to the same, after two weeks' notice of such application shall be given them, when all so petitioning for a charter shall submit application to the older associations in said city or town for approval, and no association chartered can accept as members any engineer who has been expelled from any subordinate Association.

Article VII. *Sec.* 1.—The title of each body chartered by this Association shall be called "Association," and be numbered 1, 2, 3, etc., in each State respectively.

Article VIII. *Sec.* 1.—The President shall have power to deputize any member to organize subordinate associations, said member to be recommended by his Association.

Sec. 2.—Each subordinate shall have one vote in the National Association. When a council has over fifty members, its delegates shall have one vote for each fifty members. Where a State has an organization, such State organization, by delegates, shall only vote one vote for each fifty in their organization.

Sec. 3.—No proxy shall be admitted to a seat in the convention.

Sec. 4.—The delegates, when presenting themselves, shall present their credentials from their respective associations, attested by the president and secretary of their respective associations, so that the National Association shall know that they are entitled to seats in the convention.

Sec. 5.—Subordinate associations shall annually report a synopsis of its proceedings, together with the officers and number of members, to the National Association.

Sec. 6.—When it is deemed necessary for the safe working of any subordinate association, it shall be lawful for the three principal officers to issue a local pass word for the safe working of the same.

Sec. 7.—The president of the National Association shall issue annually a travelling pass word, to be transmitted to the president of each subordinate association, to be given to members receiving a visiting card.

Article IX. *Sec.* 1.—Any officer who may be elected by this Association or any subordinate association, shall at the expiration of his term of office from any cause, deliver up to his successor or on the order of the National or State secretary, all property in his possession, and any person or officer who fails or refuses to comply with this rule, shall be punished for larceny.

Article X. *Sec.* 1.—This constitution can be amended or altered at any annual meeting of the Association by a a two-thirds vote of all delegates entitled to seats. And the adoption of this constitution shall abrogate, repeal and annul all previous constitutions.

Sec. 2.—All charters for subordinate bodies shall emanate and be issued by the National body, except in States having State associations, who shall pay to the National body $10 for each charter they issue.

Sec. 3.—All books, papers and regalia to be issued by the Association shall only issue from the National body, and shall be uniform.

Sec. 4.—All grievances and appeals that may come up to the National secretary shall be first submitted to the Board of Arbitration, who shall decide the same and return their decision to the body from which it came, and if such decision or ruling is not satisfactory to the complainants, they may appeal from such decision to the National body at its next regular meeting, and when they have decided, it shall be final.

Sec. 5.—All subordinate bodies shall be judge of the qualifications of its members, subject to the rules and laws governing this Association.

Article XI. All delegates to the National Association may become life members of the same by paying into the National Treasury an annual due of one dollar. Such life member shall have all the rights and privileges of this body except voting.

Article XII. At all meetings of this body a short time will be allowed the delegates to present the claims of new devices pertaining to the business of engineering.

Article XIII. Roberts' Manual shall be the law of this body.

CONSTITUTION FOR SUBORDINATE LODGES.

Article I.—This Association shall be known by the name and title of——————Association of Stationary Engineers, No.——State of——————.

Article II.—The object of this Association shall be the elevation and maintenance of the rights of the Association and the recognition of all other business matters in which the engineer in his jurisdiction may be interested or involved, but no Association shall fix a standard for wages of its members.

Article III.—It shall be composed of engineers who shall be admitted to membership according to the articles and provisions of this constitution. Every person admitted to membership in this Association must be an engineer of good standing and of known qualifications, having followed his occupation at least one year, and be of good moral character. This Association cannot be dissolved as long as five members object thereto.

Article IV. *Sec.* 1.—This Association shall elect delegates to represent it in a general convention of Engineers' Associations for the settlement of all difficulties and to have the only power in connection with qualified representatives from other Associations of like character to amend, reconstruct, or repeal any article of this constitution; and they shall elect, when thus convened, a president, vice-president, secretary, treasurer, conductor and doorkeeper.

Article V. *Sec.* 1.—Every person admitted to membership in this Association shall be an engineer of good standing and of known qualifications, and be of good moral character. Such shall become members of this Association by payment of the sums which the by-laws prescribe into the treasury of the Association, and be duly elected according to the provisions of this constitution and by-laws.

Sec. 2.—Any candidate for membership must be proposed by one member, seconded by another who can speak knowingly of his character and proper qualifications for admission and balloted for must receive such number of votes as the by-laws of the Association may require. If a candidate is rejected he cannot be balloted for again for the space of six months, and is not eligible to membership in any Association without the consent of the Association where rejected. At the time of proposing a candidate the proposer shall pay such a sum as the by-laws shall specify, and if in any case the candidate should be rejected, the fees shall be returned to the proposer and by him to the person rejected. If a canditate is rejected all other Associations shall be notified of his rejection.

Sec. 3.—Every proposition for membership must be made one week before being balloted for, and all Associations in that city notified, and before the ballot is cast the president shall request the members to state such knowledge as they may have of the candidate's character and qualifications, and whether there is any serious objection to his becoming a member.

Article VI. *Officers and Their Duties.—Sec.* 1.—The officers of this Association shall consist of president, vice-president, treasurer, financial secretary, recording secretary, corresponding secretary, conductor, doorkeeper and three trustees.

Sec. 2.—The election of officers shall be at the last regular meeting in June of each year, and they shall be installed at the first regular meeting in July.

Sec. 3.—The president shall appoint the majority and the vice-president the minority of all its committees unless otherwise ordered.

Sec. 4.—In the absence of the president the vice-president shall take the chair and appoint a vice-president *pro tem.* Should both be absent then the secretary shall call the meeting to order, and elect a president *pro tem.*

Sec. 5.—It shall be the duty of the president to preside at all meetings of the Association. preserve order, enforce articles of the constitution and by-laws, and watch faithfully over the interests and affairs of the Association. He shall be assisted by all the officers. He shall decide all questions of order, he shall have power to call meetings whenever he deems it necessary, or is requested by five or more members, and perform such other duties as the Association may request. The president may call the vice-president to the chair when he wishes to discuss any question.

Sec. 6.—It shall be the duty of the vice president to aid the president in the discharge of his duties. He shall preside in his absence, and perform all duties devolving upon the president which the Association may require.

Sec. 7.—The recording secretary shall keep the records of all minutes of the Association, and shall have his books ready at all times for inspection, as the Association may direct, by a committee appointed for that purpose.

Sec. 8.—The treasurer shall receive from the financial secretary all moneys collected by him, pay all orders directed by the Association to be drawn on him signed by the president and recording secretary. He shall keep a correct account of all money received and paid out by him, and have his books open for examination at such times as the Association may direct by a committee appointed for that purpose.

Sec. 9.—It shall be the duty of the financial secretary to keep true account between the Association and its members, receive all initiation fees, dues, fines and assessments, and pay the same over to the treasurer. He shall notify all delinquents who may be in arrears for dues; fines and assessments, and have his books open for examination at such times as the Association may direct by a committee appointed for that purpose.

Sec. 10.—The corresponding secretary shall carry on all correspondence, answer all communications, issue all summons and notices required and serve them; also read all communications before the Association. His official letters must bear the seal of the Association.

Sec. 11.—The duties of the conductor will be to introduce all candidates and render assistance to the president when required, take charge of all paraphernalia pertaining to the secret work.

Sec. 12.—The doorkeeper shall have charge of the door.

Sec. 13.—The past president shall act as chaplain of the Association, receive and introduce all visiting brothers, and instal officers.

Article VII. *Vacancies in Office.—Sec.* 1.—Should any vacancy occur in any office by death, resignation, or other cause, the Association will proceed to elect a successor to serve the remainder of the unexpired term.

Sec. 2.—It shall be the duty of the president to appoint local secretaries in each subordinate Association where no mutual aid exists.

Article VIII. *Dues and Assessments.—Sec.* 1.—Each subordinate Association shall have power to regulate its own dues, assessments and penalties.

Sec. 2.—The Association shall have power to assess its members for extraordinary purposes, but not to exceed the sum of five dollars, and shall not levy a fine to exceed five dollars.

Article IX. *Funds.—Sec.* 1.—Any subordinate Association disbanding shall transmit to the secretary of the National Association all moneys, books, papers, seals and charters, and in the event of reorganizing the State Association it shall be entitled to receive back the same by payment of the usual charter fee.

Sec. 2.—No charter shall be granted for the reorganization of a disbanded association unless the application be signed by twelve applicants.

Sec. 3.—Any subordinate Association failing to make an annual report of the condition of their Association to the National Association for each year shall be assessed their portion of expenses for the same, and after being notified of their neglect to comply with this article the charter of the State Association shall be revoked.

Article X. *Sec.* 1.—Any member of this Association who shall in any way violate any of the principles of the Association, or offend against any article or section of this constitution or by-laws, or rules of order, shall be fined, expelled or suspended, as the by-laws or constitution provide, or the Association may determine.

Sec. 2.—Complaints must be made in writing and handed to the president and by him to a special committee. The committee shall investigate the complaint, and if sufficient grounds for a charge be found, the committee shall report to the Association forthwith together with the charge, and if the charge or charges are sustained, the accused will then abide by the decision of the Association.

Article XI. *Sec.* 1.—Every member of this Association shall hold himself in duty bound to recognize every other member's good standing as a brother, and shall not traduce or slander his character, or willfully or maliciously injure him in any way, on penalty of being suspended or expelled from the Association.

Sec. 2.—Occasional intoxication shall subject a brother to the censure of the Association, and habitual intoxication shall be considered sufficient cause for expulsion. If any subordinate Association shall deem it necessary to expel a member for the violation of its constitution and by-laws, he shall remain expelled for all time to come, unless the said subordinate Association shall be granted permission by the Board of Arbitrators to reinstate him by stating his cause of expulsion.

The rules of order for subordinate associations were taken away by the committee to revise, and your reporter did not see them; but he is informed by the secretary of the National Association that there are no such titles to the officers as "*worthy*" and "*most worthy*;" also that the secretary has received the rules of order, and they are being printed with the subordinate constitution.

THE ATLANTIC STEAMER OREGON.

The *Oregon* has been designed to excel in speed all other vessels at present running on the Atlantic, and her trials give promise of the realization of the design, the steaming giving results never before attained in ocean-going vessels. In a distance of 29½ knots, with a remnant of the tide against her, she steamed over twenty knots, or more than 23 ordinary miles per hour. The indicated horse power was upward of 12,000. The *Oregon* has been built by Messrs. John Elder and Company. She has been constructed on lines similar to those of the *Arizona*, built in 1879, and the *Alaska*, in 1881, but with modifications suggested by experience, and designed to secure greater speed and stability. Her length is 520 feet, her breadth 54 feet, and her depth 40 feet 9 inches. Her gross tonnage is about 7,500, and she is fitted to accommodate 340 first-class, 92 second-class and 110 third-class passengers, or, if need be, 1,000 in place of cargo. The engines represent a capacity greater than any yet put on board a vessel, and the boiler power is correspondingly large. The engines are exceedingly simple in construction. The two low-pressure cylinders stand on each side of the high-pressure, and the cranks balance each other and produce a smooth and equal motion. The high-pressure cylinder is 70 inches in diameter, and the low-pressure 104 inches. The stroke is six feet. The shaft is made of crucible steel and is "built up." The boilers are nine in number, and entirely of steel, are 16 feet 9 inches long and 16 feet 6 inches in diameter. Each has within it eight corrugated furnaces, four at each end. These boilers are tested to the extent of 220 lb. pressure on the square inch, though they are not intended to bear more than 110 lb. The consumption of coal for the high speed intended amounts to 240 tons per day of 24 hours.—*The Mechanical World.*

WATER BALLAST TANKS.

Water ballast tanks are not the creation of the last few years. For twenty years or more it has been the practice to employ water ballast in steam colliers so as to enable them to return speedily to the coaling port and re-coal without incurring the delay and expense incidental to the use of dry ballast. Water ballast was not, however, adopted generally in cargo-carrying steamers until a few years later, and as this change was soon followed by the loss of a number of vessels, a large proportion of which was so fitted, the opinion began to be held that the water ballast was the cause of loss. All kinds of theories were formulated as to the causes. It was contended that the imprisoned air in the empty tanks is continually endeavoring to capsize the vessel, and it was sought to justify this contention by an illustration of the effect of tying bladders filled with air to a man's feet while in the water. It must be admitted as probable that some of the vessels lost at the time referred to would not have been so lost had they not been fitted with water ballast tanks, but this was due to the fact that, as designed, their proportions were not suited for water ballast, and not through any inherent capsizing tendencies in the ballast tank itself. These vessels were, as a rule, made very narrow in proportion to their depth; and the lifting of the cargo caused by the fitting of the tanks was in many cases sufficient to compromise the already narrow margin of stability. This defect in design is now being remedied. Vessels are being built much broader in proportion to their depth, with the result that they are enabled to carry their water ballast in safety.

The real effect of water ballast, in so far as it prejudices the stability of a vessel, cannot be too clearly set forth. The theory that the imprisoned air in the tank strives to come to the surface, and thus produces a dangerous upsetting tendency, is so much nonsense, and must be abandoned. Such difference as does exist between the stability of two similar vessels, one having floors of the ordinary type, and the other water ballast, is entirely due to the difference in the height of the center of gravity of the cargo in the two cases, and can be accurately determined.—*The Engineer.*

POOR SHOW FOR THE ELECTRIC LOCOMOTIVE.

Judging from the results of some experiments abroad on the transmission of power by electricity, reported in *Engineering*, the immediate adoption of electric locomotives is not probable, the experiments carried out by M. Desprez, at Grenoble, France, were far from being a success. The generator was placed in a cement factory, where there was an 80 horse-power turbine. A double wire of silicate bronze passed on the telegraph posts along the road, a distance a little over nine miles. Around the receiving instrument were grouped a band saw, a circular saw, a printing press and a centrifugal pump, all to be driven by electricity; but only the centrifugal pump was seen in operation by the disappointed public on the day of exhibition.

A committee charged with the preparation of an official report, certified an actual force of *seven* horse-power, at Grenoble, while the generator at Vizille was making 1,257 revolutions and indicating from 45 to 50 horse-power. This, *Engineering* states, amounts to a practical transmission of 15 per cent., a result in accordance with the calculations of M. Cabanellas, but not at all with the hopes of M. Desprez.

Seven horse-power realized out of 80 expended is certainly discouraging in a distance of only nine miles. At this rate the locomotive would come to a standstill a little further on. It must be borne in mind that the electric force which moves the locomotive is generated by dynamos and transmitted to the engine through the track. The scheme is feasible, if it would only work; that appears to be the chief difficulty.

HOW PAPER BOATS ARE MADE.

A wooden model is prepared in exact form of the desired boat, on which the paper skin is moulded, sheet after sheet being superposed, one upon another, until the desired thickness is obtained, the boat in process of construction being composed of nine thicknesses of strong manilla paper, making a thickness of about one-eighth of an inch. In preparing the paper, the lines of the boat are carefully drawn out full size and the paper which comes from the mills in rolls, similar to that which is made for printing on perfecting presses, is cut to the full size desired for covering the entire length and breadth of the boat, so as to leave no joint of any kind. For racing shells the best manilla paper is used, but for gigs, dingeys, canoes and skiffs, paper made from undressed linen stock only is used.

In manufacturing the racing shells the first sheet is dampened, laid smoothly on the model, and securely fastened in place by tacking it to certain rough strips attached to its upper face. Other sheets are now superposed on this and on each other, and suitably cemented together, the number depending upon the size of the boat and the stiffness required. If linen paper is used, but one sheet is employed, of such weight and dimensions that, when dry, it will give just the thickness of skin necessary. Should the surface of the model be concave in parts, as in the run of boats with square sterns, for instance, the paper is made to conform to these surfaces by suitable convex moulds, which also hold the paper in place until, by drying, it has taken and will retain the desired form.

The model with its enveloping coat of paper is now removed to the dry-room. As the paper skin dries, all wrinkles disappear, and it gradually assumes the desired shape. Finally, when all moisture has been evaporated, it is taken from the mould, an exact *fac-simile* of the model desired, exceedingly stiff, perfectly symmetrical and seamless. When the skin is removed the boat, as it then appears, is waterproofed, the frame and fittings completed, and the boat varnished. The advantages possessed by these boats over those constructed of wood are strength, stiffness, durability and being without joint, lap or seam to admit of leaking by strain or shrinkage; they have no grain to crack or split, never shrink, and paper being one of the best non-conductors, no ordinary degree of heat or cold affects them, thus rendering them admirably adapted for use in any and all climates.—*The Paper World.*

THE GLOSSOGRAPH.

One of the most interesting exhibits at the Vienna Electrical Exhibition is Gentilli's glossograph, a little instrument by which speech is automatically reproduced as soon as it is uttered. A small apparatus is placed in the mouth of the speaker—in contact with the roof of his mouth, his tongue and lips—and on being connected with an electro-magnetic registering apparatus, the sounds are committed to paper. It is constructed in such a manner as not to cause any inconvenience to the speaker; neither is it necessary that the voice should be raised, as it reproduces a whisper as exactly as a shout; the only condition is a correct and distinct articulation. According to the inventor's calculation, it will be possible to write four or five times as fast by means of the glossograph as has hitherto been possible even by the quickest writer. At first sight it appears as if this invention were but an improvement upon Edison's phonograph; it is, however, of a much older date. It rests, unlike the former, on an acoustic principle, and does not reproduce the sounds in a microscopical form. The chief obstacle to the introduction of the glossograph, says the *Pall Mall Gazette*, will be the difficulty in deciphering the characters, but it is not impossible that with the help of a second automatic apparatus, the characters produced by the glossograph may be translated into our common type-writer.

MINERAL OILS AS LUBRICANTS.

However much their physical properties may vary, in their chemical nature mineral oils are closely related to each other. They all consist (of course, only real mineral oils are included) of a mixture of carbureted hydrogen, in different organic combinations, which possess neither acid or basic properties. They do not decompose either at very low temperature or at degrees of heat which far exceed those prevailing in the steam cylinders, etc., where they are employed. They do not undergo any change either on contact with the air, or with water or steam; they do not attack metals, even the most easily oxidizable, such as potassium or sodium, and are as little changed or decomposed by the metals themselves.

This chemical indifference is the principal advantage possessed by mineral oils over all fat oils, whether they are of vegetable or animal origin. All those fat oils decompose in time on exposure to the air, at high temperatures, on contact with metals or their oxides, and thus destroy, sometimes more quickly, sometimes more slowly, the parts of machinery they are intended to preserve.

Notwithstanding the great excellencies which mineral oils have over fat oils, great difficulties were at first experienced in introducing lubrication with the former more generally. Convenience, attachment to custom, and want of intelligence were among the obstacles that had to be overcome. Mineral oils were looked upon as entirely unsuitable for lubricating machinery, and fat oils as alone possessing the specific property of a lubricant; apprehensions were raised as to the easy "inflammability" of mineral oils, etc. But the introduction of mineral oils for lubricating purposes was also greatly retarded by the want of sense, and partly also by the want of honesty, on the part of individual producers and dealers. Properties were claimed for the crude mineral oil only possessed by carefully purified oil; when, finally, the price of the lubricating oil exceeded that of the oil used for burning, part of the latter was left in the lubricant, so that especially if great pressure took place, it was found unsuitable. Nothwitstanding all this, lubrication with mineral oil has, within the short space of the last five years, made such progress that it may justly be called, not only the lubricant of the future, but that of the present day. As the mineral oils, on account of their chemical properties, are far more valuable than the fat oils, and, on the other hand, owing to greater variety, physically, they may be adapted more readily for different purposes than fat oils, there is nothing to prevent their general introduction.

It will be gathered from the foregoing that the displacement of fat oils for lubricating machinery by mineral oils is a great technical progress. But the use of mineral oils is a great advantage, also from the point of cheapness. The best mineral oils are now only half the price of fat oils. With suitable construction of the parts to be lubricated and a correct choice of the most suitable lubricating materials, the consumption of mineral oils is no greater; on the contrary, it ought to be less, as with mineral oil no hardening or thickening takes place, and thus there is no loss. Finally, in lubricating with mineral oil, the parts oiled are not destroyed, but, on the contrary, preserved; while the destruction of machinery parts, such as pivots, regulator valve-rods of locomotives, etc., is only too often a consequence of the use of fat oils.

◆

FIELD FOR IMPROVEMENT IN MARINE ENGINES.

The reduction in the weight of the engine that could be effected by improved design and workmanship, and the use of stronger material, although most important, does not, of itself, offer so large a scope for improvement as increase of speed, both of piston and of revolution. These have been highly developed by Mr. Thornycroft in the engines of the fast torpedo-boats, which at full power make about 440 revolutions per minute, and have a piston speed of 880 feet per minute. The total weight, of the machinery, including boilers and water, is below 60 lbs. per I. H. P. In the "Inflexible" the number of revolutions per minute was 71·5, speed of piston 572 feet per minute, and the total weight of the machinery 358 lbs. per I. H. P. Even in the "Polyphemus," in which the nearest approach to the torpedo type of machinery has been attempted, the estimated number of revolutions per minute is 120, speed of piston 780 feet per minute, and total weight of machinery 178 lbs. per I. H. P.

In this part of the subject we are met with many difficulties, arising from the action of the propeller. The generally accepted theory of propulsion is, that the propeller produces a sternward momentum in the water on which it acts, which momentum measures the thrust exerted on the ship. The larger the quantity of water acted on, therefore, the greater will be the thrust. The usual practice has consequently been to make the diameter of the propeller as large as possible. The surface and edgewise friction of these large propellers is very great, and the large mass of water acted on in each revolution entirely precludes the engines being worked at a high speed of revolution, while they are connected direct to the present type of propeller.

From experiments made by the late Mr. Froude, it would appear that considerably more than one-half of the total energy transmitted to the propeller is wasted from various causes. It is, therefore, probable that the design of improved propelling arrangements affords a large field for invention, from which increased economy of propulsion may be reasonably anticipated in future. A large proportion of the loss of efficiency in existing screws arises from the augmented resistance of the ship from the reduction of the pressure of water under the stern produced by the propeller, so that it is very probable that improved propulsion may result, as much from some alteration in the form of ship or in the position of propeller, as from modification of the form and arrangement of the propeller and fittings.

The substitution of steel blades in lieu of gun-metal or cast iron, by offering less resistance, will enable the engines to be driven somewhat faster; but a more radical change than this is needed to effect any very substantial reduction in weight and space occupied. It is probable propellers of smaller diameters, driven at higher speeds, may be used with advantage in many cases. This was clearly shown in the "Iris," in which ship, by reducing the diameter of the screws from 18′ 6½″ to 16′ 3½″, the speed of the ship was increased from 16·577 knots to 18·573 knots; the I. H. P. developed by the engines being practically the same in the two trials.

For the present we shall have to continue to use, with probably slight modifications in size and form, the existing screw-propeller, driven at a comparatively slow speed. It is, therefore, I think, worthy of consideration whether or not it would be wise to proceed in the direction of making any material increase in the speed of engines, to reduce their dimensions and weight, until a form of propeller adapted for high speeds of revolution has been devised. If high speed engines were used for driving the existing propellers, it would be necessary to interpose gearing to reduce the rate of revolution. This is much objected to by many engineers, but it is possible that the advantages that would be gained thereby would outweigh its disadvantages.

In order to drive engines at high speeds of revolution it is desirable that the resultant driving forces on the crank should be made to be as nearly as possible uniform. To effect this, the *weights of the reciprocating parts* of the engines should be carefully adjusted to suit the required maximum speed, so as to cause the resulting tangential pressures on the crank-pin to vary as as little as possible. It is very important that this should be carefully attended to in all high speed engines. The ordinates of the indicator diagram only give the pressures on the piston; and to obtain the corresponding pressures on the crank-pin, it is necessary to combine, with the indicator diagram, a diagram showing the work expended on the acceleration and given out during the retardation of the motion of the reciprocating parts of the engines. It is therefore clear that *strength* is not the only point that should be considered in the design of these parts; but that, if possible, their *weight* also should be so arranged that, when the engines are working at full speed, the effect of the inertia of the reciprocating parts may tend to produce uniformity in the tangential forces acting on the crank-pin. I am unable to do more than simply mention this point; which, however, is one that may make all the difference between a smoothly and quietly working engine and one whose motion is irregular.

One other point requires to be mentioned with reference to the probable increase in the working pressures of steam, which although it primarily affects the economy of steam, is also important as regards the strains on the framing and shafting, &c. The ordinary two-cylinder compound engine, with initial steam pressure of 80 to 90 lbs. per square inch, has now practically arrived at the same position, with respect to range of expansion and temperature in each cylinder, that the simple expansion engine, with steam of 30 to 40 lbs. pressures, was in, when it was superseded by the compound engine. If, therefore, the pressures are increased beyond this limit, it will be necessary to divide the expansion of the steam into three stages in order to increase its practical efficiency, and to reduce the maximum strains on the shafting, framing, &c. This has been carried out in a few ships, one of the most recent being the steamship "Aberdeen," built by Messrs. R. & J. Napier, of Glasgow, and fitted with triple expansion engines, designed to be worked with steam at a pressure of 125 lbs. per square inch.—*Richard Sennett, C. E. Royal Navy.*

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A SCALE which records the weight of articles placed upon it is thus described in the *London Engineer:*

"A record of each weighing can be printed upon a ticket or slip of paper by the machine itself; this record entirely prevents any of the errors which so frequently arise through mistakes in reading the weight. By means of this apparatus an indellibly stamped single, duplicate or triplicate record can be kept of the weight of the goods weighed, taken at the time of weighing by the machine itself. The machine is of the steelyard type. On the top of the yard are the usual marks or notches for the sliding weight. Underneath, and corresponding to these notches, are raised figures of hardened steel. When the goods to be weighed are placed upon the platform of the machine, the slide is moved along until it reaches the nearest division, when a small bar, which moves through this slide, and has figures likewise corresponding with its divisions, is moved until the beam attains a true balance. The card or slip of paper is then inserted in a small slot in the large slide, and a handle underneath pulled, which presses the card against the figures, thus giving the record. The inventor is M. Chameroy, of Paris."

◆

"THERE IS in the English navy," says the *Iron Age*, "a gunboat named the *Frolic*, the ways of which are so frolicsome and free, and which is afflicted with such a constitutional 'bias' toward the starboard tack that one set of engines is required to develop 100 horse-power more than the other to keep her in a straight line. The eccentricity is inconvenient, but totally inexplicable. Her propellers are of the same type, the screws of the same pitch, and the blades in perfect accord. Ordered to the Cape, her commander found himself going direct for New York, and concluded to put into Portsmouth before he got any further on the way. Now, had it been the *Polyphemus*, one could have understood it, but for a respectable boat, blessed with a pair of everything necessary to keep her in a straight path, to exhibit such a rakish preference for devious courses, suggests truly painful explanations."

[Crooked keel, may be!—EDS.]

RECENTLY, on the New York Central Railroad, a new locomotive, No. 611, driven by William Cook, made the run from Syracuse to Buffalo, a distance of 150 miles, in 188 minutes. It made four stops, of 15 minutes in all, giving an actual running time of 173 minutes. The train consisted of seven heavily-loaded mail cars. This is at the rate of 52 miles per hour, and is a most astonishing performance.

◆

THE POSTAL NOTE is not a great convenience. It requires as much time to collect twenty-five cents as $4.99, and there is too much fuss in either event. If the note could be handed in at the nearest window and cashed at sight, it would be convenient, but, as it is in New York, one has to go up a long pair of stairs, join a caravan of waiters, get the note viséd by the authorities, and then go to another window and get the money, all of which takes more time than the note is worth, in a majority of cases. We do not like the postal note.

◆

THE NEW ENGLISH STEAMSHIP *Oregon* made on the last day of her first trip to this port 21½ miles for 24 hours, or 19 knots an hour.

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Twenty-five cents a line for each insertion under this head.

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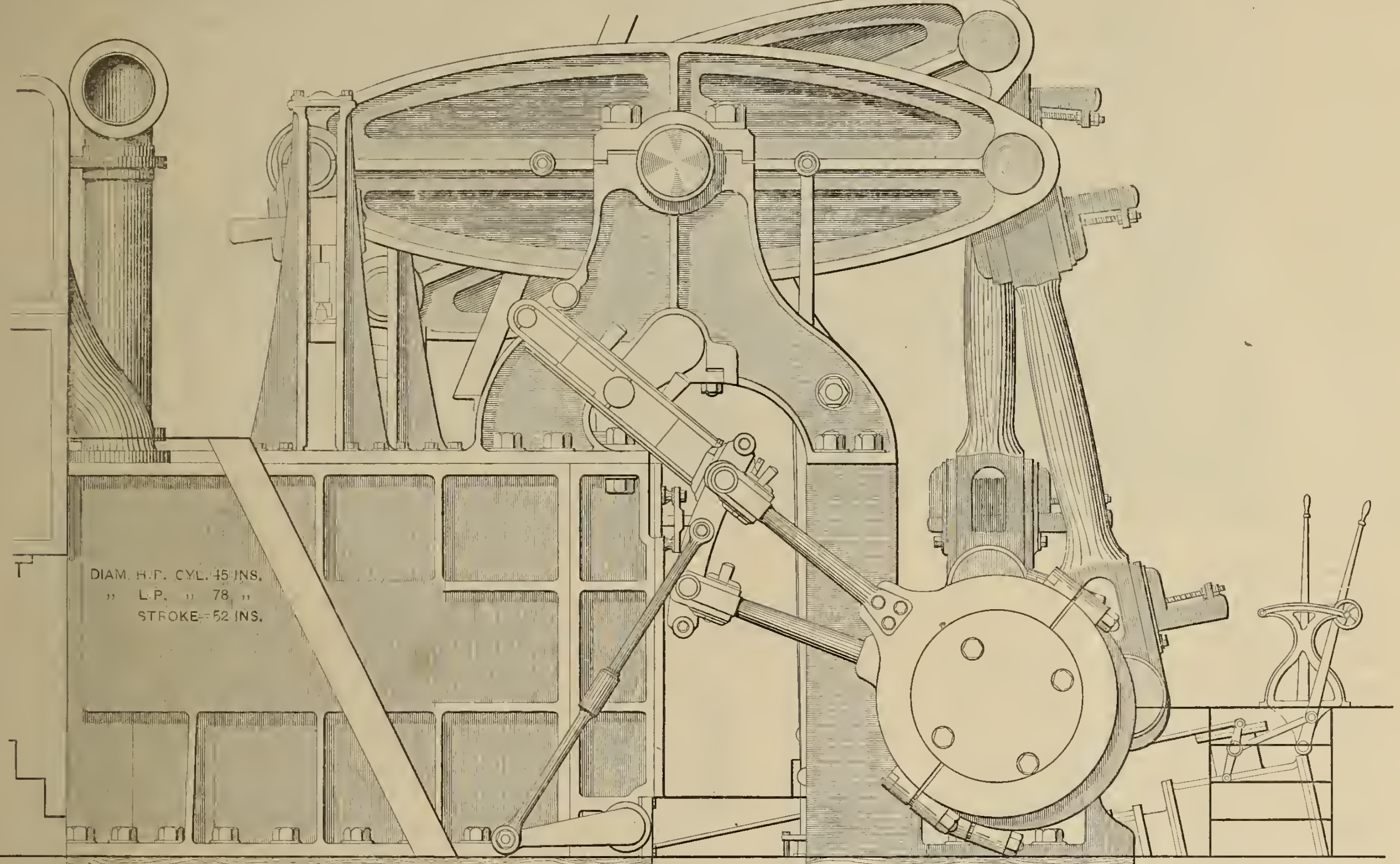
New York, November 24, 1883.
Single Copies 8 Cents $2.00 per Annum.

ENGINES OF THE NEW CRUISER "CHICAGO."

In our last issne we presented an illustration of the new United States Cruiser, *Chicago*, with details of her principal dimensions, as also an end elevation of her boilers with fire-brick furnaces. We now give the engines as finally decided upon, and also the side elevation of the boiler. In our previous issue, we stated that the engines were to have poppet-valves. At that time this was correct, but since then the Naval Advisory Board has reconsidered the question, and decided to adopt slide-valves.



ENGINES OF THE NEW CRUISER "CHICAGO..

The engines are, in dimensions, as follows:

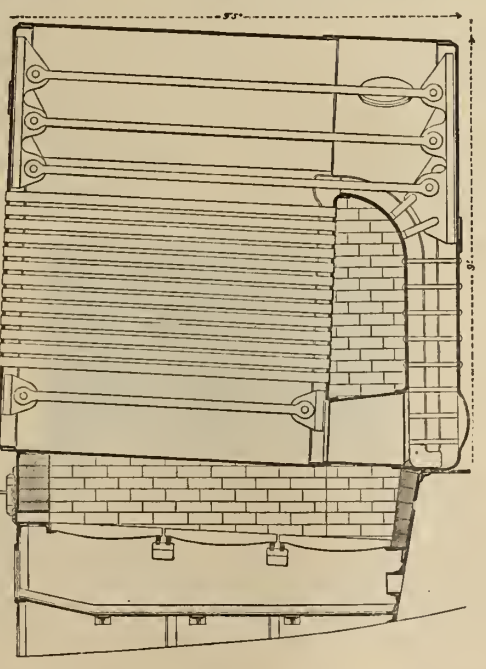
The cylinders are 45 and 78 inches, by 52 inches stroke. The high and low pressure cylinders are side by side with their axes vertical; and each engine, with all its machinery, will be inclosed in a water-tight compartment 22 feet long. The cylinders will be jacketed. The engines will be capable of working high pressure if accident to one cylinder demands it. The low pressure cylinder can also take steam direct from the boiler, and may be worked high pressure. The crank shafts will be built up of steel forgings in two separate interchangeable sections, and secured by couplings forged on the shafts. The propellers are of steel with four adjustable blades, diameters 15′ 6″, and mean pitch 22′ 6″.

The walking beams for the engines are made of two steel castings, 1½″ thick, parabolic in form; they are 11′ long and 4′ wide, on the edges they are 3″ wide and 2″ thick. The center-bosses are 20″ in diameter. The beam pillow blocks and the frames are also steel, 16″ wide and 1½″ thick.

The engraving shows only the general plan without the condensers, which are omitted to save the room.

The advantages of the brick furnaces, which are novel, as applied to marine boilers, were fully alluded to in our last, but we recapitulate them as some persons may not have seen them. These furnaces are now in use in the merchant service on the SS. *Louisiana*, of the Cromwell Line, where they have proven very satisfactory. The great benefits arising from them lie in lessening the first cost of the boiler, as also in the very even temperatures obtained in every part of it. It will be seen, further, that the circulation must be improved, from the fact, that the water is all above the fire; no part of it lying below the grates, as is the case where common furnaces are used. Also, the large furnace flues are dispensed with, thus removing one great element of danger and anxiety.

Our engravings are taken from the *Proceedings of the Naval Institute*, a magazine published at Annapolis, Md., by an association of naval officers. A letter from the Secretary, Lieut. Thomas, will be found in "Letters to the Editor."



⁂

RECENTLY there were, in San Francisco, two sticks of timber, one 150 feet long, 16 inches square, almost without knots; the other 144 feet long and 18 inches square, practically clear stuff. They came from Washington Territory.

A FRIEND WHO IS SOLICITOUS for our peace of mind writes that a contemporary in another State is continually commenting on us in one way or another, and he wishes to know why we do not open fire in return. We were not aware that this iniquitous thing was going on behind our backs, so to speak, but even if we had been, our course would have been the same. In the scheme of creation, Omniscience comprehended all things. Some men are white; some are a little off color; some are genial, others are "grumpy;" each and all have their places to fill. It is not becoming in us to question why such exist, least of all do we attempt to account for their motives. We simply go on in the even tenor of our way, and let others pursue their little, or great, schemes as best pleases them. Noticing personal attacks seems to us akin to noticing polecats.

⁂

REFERRING TO WHAT WE SAID upon books for mechanics, an expert mathematician writes as follows:

> "I would say I agree with you perfectly as to the points you have taken in regard to writing for mechanics. You must, however, appreciate that those who write tersely and simply, and do not make use of algebraic formulæ, require clearer ideas than the mathematical writers on the same topics."

We do appreciate our friend's remark, and we try to put it in practice ourselves.

⁂

A CONTEMPORARY says:

"Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage."

By what is probably a fortuitous train of circumstances, however, we notice that advertisers in that paper usually get the most glowing exhibits in the "Manufacturers'" Column. There is nothing like castigating Satan around the butt end of a tree.

⁂

THE FIRST TRAIN crossed the Niagara suspension bridge March 18, 1855. It belonged to the Great Western railway and consisted of 22 heavily loaded cars weighing 370 tons, drawn by the locomotive "Elk."

COMPARISON OF DECIMAL WITH THE BINARY AND OTHER SCALES.

The following Table has been prepared for the use of Machinists and other mechanics who have occasion to use ordinary steel scales, as found in the market at the present time. These scales are usually divided into eighths, sixteenths, Thirty-seconds, sixty-fourths, tenths, twentieths, fiftieths, hundredths, twelfths, twenty-fourths, etc. The Table shows at a glance the relative value of these divisions, and their decimal equivalents.

8ths.	16ths.	32ds.	64ths.	Decimal.	48ths.	24ths.	12ths.	6ths.	40ths.	20ths.	10ths.
			1	.015625							
				.020833	1						
				.025	..	..	..	..	1		
				.03125							
		1	2	.041667	2	1					
			3	.046875							
				.05	..	..	..	..	2	1	
	1	2	4	.0625	3						
				.075	..	..	..	..	3		
			5	.078125							
				.083333	4	2	1				
		3	6	.09375							
				.1	..	..	..	..	4	2	1
				.104167	5						
			7	.109375							
1	2	4	8	.125	6	3	..	..	5		
			9	.146325							
				.145833	7						
				.150	..	..	..	..	6	3	
		5	10	.15625							
				.166667	8	4	2	1			
			11	.171875							
				.175	..	..	..	..	7		
	3	6	12	.1875	9						
				.2=1-5	..	..	..	..	8	4	2
			13	.203125							
				.208333	10	5					
		7	14	.21875							
				.225	..	..	..	..	9		
				.229167	11						
			15	.234375							
2	4	8	16	.25=¼	12	6	3	..	10	5	
			17	.265625							
				.270833	13						
				.275	..	..	..	..	11		
		9	18	.28125							
				.291667	14	7					
			19	.296875							
				.3	..	..	..	..	12	6	3
	5	10	20	.3125	15						
				.325	..	..	..	..	13		
			21	.328125							
				.333=1-3	16	8	4	2			
		11	22	.34375							
				.35	..	..	..	..	14	7	
				.354167	17						
			23	.359375							
3	6	12	24	.375	18	9	..	..	15		
			25	.390625							
				.395833	19						
				.4=2-5	..	..	..	..	16	8	4
		13	26	.40625							
				.416667	20	10	5	..			
			27	.421875							
				.425	..	..	..	..	17		
	7	14	28	.4375	21						
				.45	..	..	..	..	18	9	
			29	.453125							
				.458333	22	11					
		15	30	.46875							
				.475	..	..	..	..	19		
				.479167	23						
			31	.484375							
4	8	16	32	.5=½	24	12	6	3	20	10	5
			33	.515625							
				.520833	25						
				.525	..	..	..	..	21		
		17	34	.53125							
				.541667	26	13					
			35	.546825							
				.55	..	..	..	..	22	11	
	9	18	36	.5625	27						
				.575	..	..	..	..	23		
			37	.578125							
				.583333	28	14	7				
		19	38	.59375							
				.6=3-5	..	..	..	..	24	12	6
				.604167	29						
			39	.609375							
5	10	20	40	.625	30	15	..	..	25		
			41	.640625							
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—*The Locomotive.*

AN INGENIOUS DEVICE.

The engraving represents a cup and saucer designed for use on board ship. Every seafaring man knows that in heavy weather crockery is very "slippery," and does not "stay upon the order of its going, but goes at once" when occasion arises. This cup has a rubber ring set in its bottom as shown, as has also the saucer, with the result of holding them securely in any position. Says the *London Engineer*, from which we take this article:

"Another severe test was to place a china tray with one end on the raised table and the other on the bulwarks, overhanging a couple of inches, and on this to put a decanter, the tray being at an angle of nearly 45 deg., and whatever motion was given to the boat the decanter remained perfectly safe in its position."

A CURIOUS CUSTOM of Norwegian fishermen is thus described in *Engineering:*

"When the crew see that there is no hope of keeping the boat afloat in the ordinary way, they will purposely give her such a lurch, by a simultaneous movement of their bodies, that she will turn completely over, and the fish or ballast that may be on board will fall out, and the boat float keel up through natural buoyancy. Then the fishermen scramble on to the flat bottom, and by sticking their knives into the keel try to hold on until the storm is past or they drift ashore, their most frequent fate is to be swallowed by the sea. It is a common saying among the fishermen that two out of every three meet their death by drowning. Norwegian fishermen on some parts of the coast consider a boat unsafe that cannot be turned over by the movement of the crew on board."

A PINE FLOOR LAID IN A GOLDSMITH'S SHOP in ten years becomes worth $150 per foot. A Syracuse jeweler bought for less than fifty dollars some sweepings that gave $208 worth of gold. In his cellar a tub into which is blown the dust from a polishing lathe accumulates fifty dollars a year. A workman in that shop carried off at various times, on the tip of his moistened finger, thirty dollars of filings in a few weeks. Workmen sometimes oil their hair and then run their fingers through it, leaving a deposit of gold particles, which they afterward wash out.—*Syracuse Herald.*

Yes, but they wash them out in the shop, not elsewhere; they are also compelled to clean their nails and thoroughly wash their hands before leaving the shop. All the wiping rags are burned and the ashes saved for the gold in them. —EDS.

SCRAP FORGINGS.

In another part of this issue, an English ironfounder makes out a strong case for his wares, in the form of cast iron shafts as against wrought iron, his chief point being that bad scrap is used. As against poor forgings and first quality castings there is certainly not much margin, but how would it be if the blacksmith retorted that he had seen just as many bad castings as he had bad forgings. He might say this with truth.

Scrap forgings are not necessarily good or bad; it depends wholly upon the scrap. Blacksmiths are fully aware of this and take pains to select it carefully. What the practice in England may be we know not, but in this country scrap is carefully culled, not by boys, however. Forgings are not made from a pile of old skate-irons, curry-combs, pokers, and rubbish generally, but from boiler-plate, (cuttings and punchings included), which does not vary greatly in quality, and is generally the very best. Horseshoes are also utilized, and concerning these last there is no question at all as regard quality. Forgings may be made now, as they have been in days past, from the scrap-heap direct, but they are quite apt to be unworkable in machine tools. There is sure to be a hard streak in the journals of a shaft which no tool will touch, and the surfaces where planed are of as many shades as there are kinds of iron.

Thirty years ago links for locomotives were made of scrap taken anyhow; they were casehardened, and we have a vivid recollection of the condition in which they came out after hardening. They were all finished previous to hardening, of course, and the slot was of all widths and the surfaces winding in all directions. In such cases they had to be put under a screw press, and straightened and ground with emery to make them uniform. Once right they wore almost indefinitely without needing repair. Scrap forgings, made of best selected material, are better for shafts than the best cast iron, which has its place only where slow running shafts, without jar can be used.

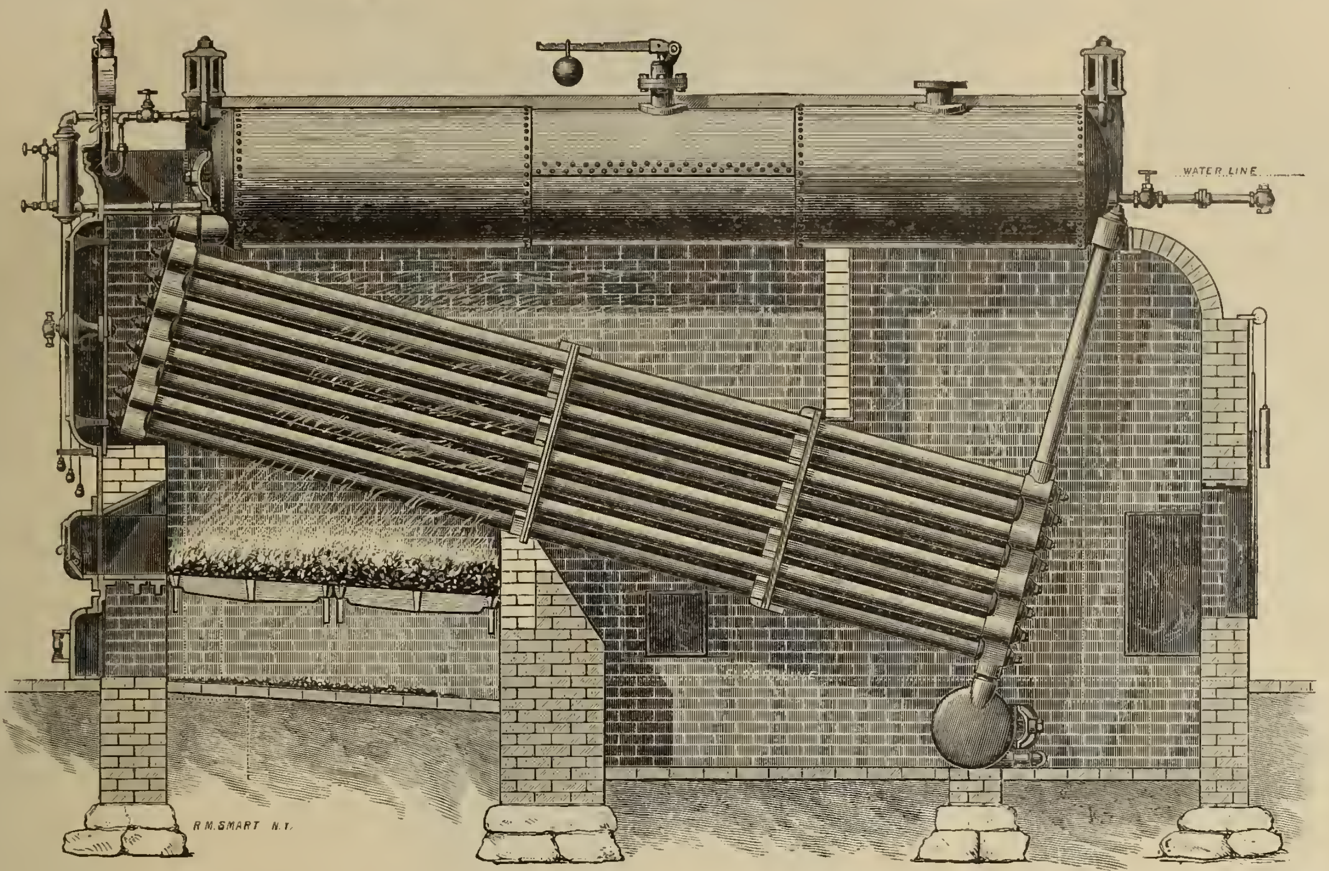
A SPECIAL MEETING of the Keystone Council, No. 1, Stationary Engineers of Pennsylvania, will be held at their Hall, N. E. Cor. Ninth and Spring Garden Streets, Tuesday Evening, November 13th, 1883. A Lecture by Bro. Frank M. Merrill, of Massachusetts, on the Merits of the different Indicators, and Brown's Drum Spring Testing Instrument, and the Measure of Back Pressure of Indicated Cards.

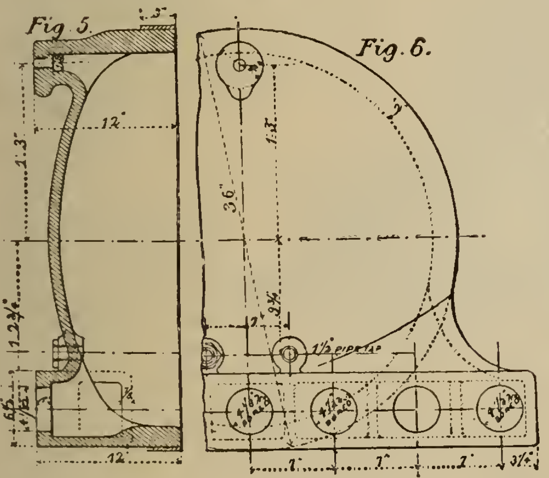
GEO. F. PEIFER, *Sec.*

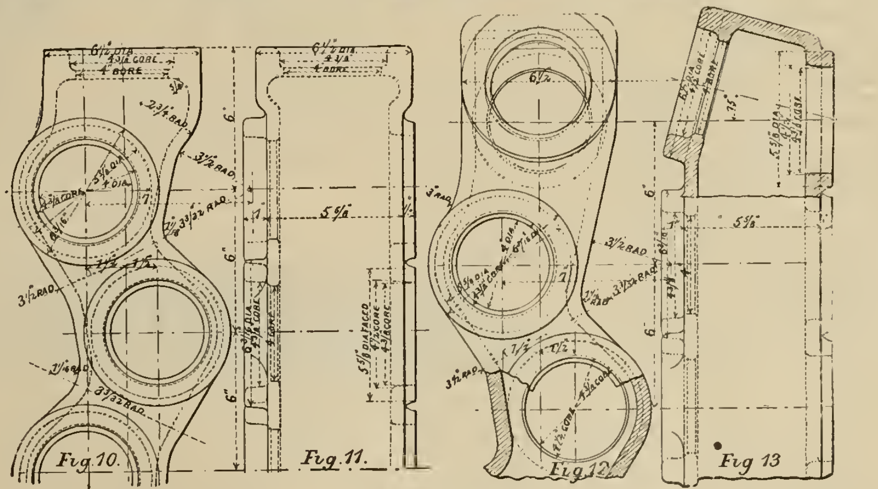
A MOULDER in the Bath foundry has earned the title of "Cast Iron Bill," because he passes his hand through the molten iron with impunity when pouring off. Any one may do the same, if he has nerve enough, by simply dampening his hand, but we can't see any particular benefit arising from the performance.

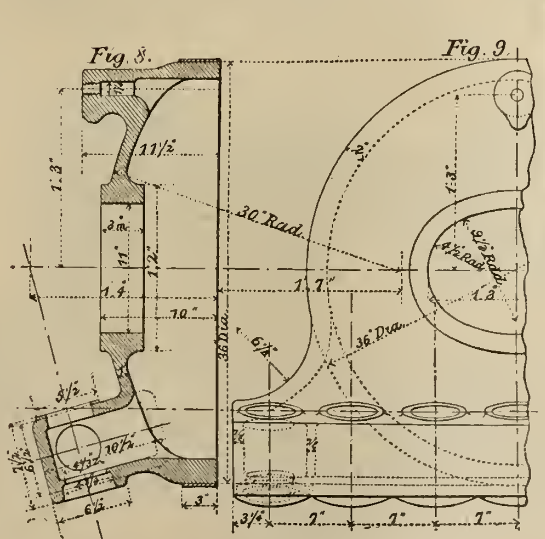
DETAILS OF THE BABCOCK AND WILCOX COMPANY'S BOILERS.

The reason for the failure of many promising projects in mechanics is that the designers seem to think that patentability only is necessary to secure success. Labeled "patented" in one corner and bearing that ever truthful legend, "the greatest invention of the age," in the other, they are placed on the market for the unsuspecting public to buy and experiment on for the benefit of the patentee. Both designers and consumers seem to forget that everything worth having is a matter of growth. Mechanical projects must go into actual practice and achieve success by graduating from the school of adversity. Take sectional boilers, for instance: The number that have been born and buried in the past fifteen years is legion. Some from want of correct fundamental principles, some from lack of means, but far more from lack of vitality enough to outlive the age of experiment, during which accidents will happen; in fact, they do not live long enough to reach maturity.









The details of the Babcock & Wilcox boiler, which are here illustrated for the first time, are a case in point. Starting with the idea that the sectional principle was the correct one, so that boilers could be produced by machinists, the Babcock & Wilcox boiler was first placed on the market with all the essential principles it contains to-day, but with many defects in mechanical detail which long usage only could develop. That these have been successfully overcome is clearly enough shown by the large number in use, and their increasing popularity, and we doubt not, if the story of the changes made in it were told, they would be substantially as given in the first part of this article, for the details on these pages bear but little resemblance to the cast-iron boiler first designed by these well-known engineers. The fundamental principles were:

A division of heating surface into small units, so placed as to insure rapid circulation of the water and thorough distribution of the heat through it; and an absolute separation of steam from the water as fast as formed.

The necessity of carrying a liberal supply of water to act as a reserve power, the same as a fly-wheel acts on an engine, was one of the lessons taught by experience; as were also the arrangements for cleaning the surfaces externally and internally. Mechanical details have been essentially changed, even the material, from cast to wrought iron; the joints, from face-joints held together by bolts, to joints formed by expanding tubes in the ordinary way; and the minor details have been so much improved that the boiler first placed on the market in 1868 would hardly be recognized in the one made to-day.

◆

THE *Inter-Ocean* says the tug owners of Chicago are "up in arms" against the smoke consumers. It is found that the steam introduced into the fire-boxes makes the boilers leak and endangers boiler, boat and crew from explosion. Yesterday twenty-seven tugs were laid up with leaky boilers, caused by the steam plan of smoke consumers. There will be an organized protest to the city authorities against the consumers. It is understood that the United States Steamboat Inspectors will rule against the consumers, and the contest will then be between the city and the general government. If the steamboat inspectors say so the tug owners will at once abandon the consumers.

◆

LOVERS OF THAT MYSTERIOUS EDIBLE, the "Frankfort" Sausage, may be interested in knowing that the factory is in Chicago, from whence they are shipped to Germany, returning doubled in value, and with a pronounced aromatic flavor. No less than 130 tons are turned out daily.

◆

IN THE HANDS of Messrs. Day and Carter, the new proprietors of the *Trade Review*, Cleveland, Ohio, the paper has been much improved, and it is now more of a technical paper and not so much of "a Messrs. John Smith & Co. have added two new belt-laces to their tool-room" paper as it used to be.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

LETTER FROM AN APPRENTICE WHO IS IN EARNEST.

Editors Mechanical Engineer.

I am an apprentice at the machinist's trade, and try to get along, and believe I do with my work satisfactory, but I cannot with mathematics. I bought "Dixon's Calculator," even that stalls me, I cannot, it seems, commit to memory well. I try, by studying over and over again, yet after a few hours I cannot do the sum, or remember the rule without looking at the book. Now on page 276, "to find the diameter of cylinder and length of stroke for a given H. P. for any size engine," he does not explain sufficiently, for me, how he gets that 17 × 28 in., or what is the meaning of $\sqrt[3]{}$. That 3 I see no explanation of in any part of the book. So on page 278, where does he get that 2 from to divide by, and what does he do with the $\frac{2}{3}$ in multiplying? I have tried over and over to get it right, but cannot; nights I spend at it, but it seems I cannot conquer. It may seem very foolish to you for me to write thus. I do not fool my time away with anything, but my work and figures I keep at, but the figures won't come. I can do anything in the first four rules of arithmetic.

I am ashamed to tell you the shop I am serving my time in, as I and many others, take your paper, and they may find out who it was wrote this. Now, if you can help me by your advice, in such a way as to the figures, it may start me all right. I will keep on trying until I hear from you; I may get it yet. Excuse me for writing this long preamble.

New York. Apprentice.

[Now here is a young friend evidently sincere and frank enough to explain his difficulties and ask advice. We will give it in the same spirit, and have no doubt but that he will profit by it. His voice is, doubtless, the voice of many, and we hope all in similar straits will receive benefit This trouble is one frequently encountered by students, and our young friend may take heart of grace and know that, from Adam down to this day, all learning is obtained only through arduous and unremitting toil. Let our friend bear in mind that to-day professors, in colleges, have to study quite as hard as any of the students. All persons, engaged in scientific pursuits of any kind, have to give constant study and attention to their work in order to advance. Look at the musician, for example, or the singer, and see the actual hand-work and head work they put on their calling! The most advanced, and those who stand the highest, are the hardest students. Even a billiard player must keep playing billiards, day in and day out, if he would not forget his cunning. There is no royal road to learning; it is nothing but earnest and intelligent application which overcomes obstacles.

Now as to the exact difficulty of our young friend, it is this. He has attempted too much at once. He has stumbled on the signs of square root and cube root, and does not know what it means. This shows that he has got along too fast, and that he must go back and learn more than the first four rules of arithmetic. Let him go through fractions, decimals and simple mensuration, etc., all clearly explained in the book named, and he will find his sums come out right. A knowledge of the first four rules of arithmetic does not go very far, but through their aid he will rise if he keeps at it earnestly. Let him not attempt too much. That is a great mistake. If he can put in this winter on fractions and learn them thoroughly, he will do a good thing with the little time he has to spare. Above all let him not be ashamed of asking for information. Ask everywhere; knock at every door that seems likely to contain knowledge, and those who have it, seeing he is in earnest, will cheerfully aid him. Let him find out the principal of the public school in his district, and go to him personally with some specific question. Tell him the facts—that our young friend is a poor boy seeking to improve himself—and we will warrant that advice will be cheerfully given.

As to memorizing, that is a matter of no moment whatever, so far as regards the ability to perform certain work. He can memorize, however, for he has learned, and can repeat by rote the first four rules of arithmetic, and having done this, he can do more. But, we reiterate, don't try too much at once. If our young friend eats too much, his stomach rejects it; if he reads or studies too much his mind rejects it. Mental dyspepsia is just as possible as bodily. Go slow but go sure.

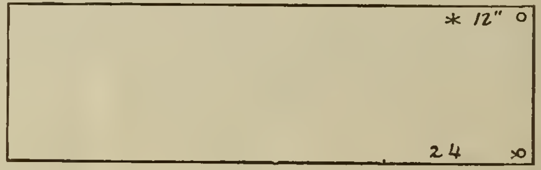
Our friend's perseverance is worthy of all praise, and we assure him of our sincere sympathy in his earnest efforts to work out his own advancement. Such a spirit is sure to win; and if we can aid him in any way, let him speak again, it will fall on friendly ears.—Eds.]

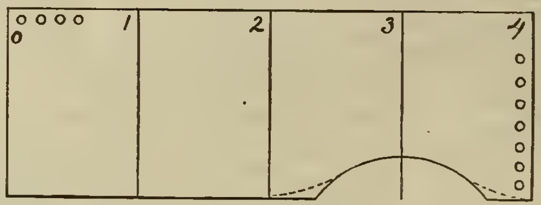
LAYING OUT BOILER-PLATES.

Editors Mechanical Engineer:

I send you two simple rules of laying out boiler-plates which may be of service to some. The first is to determine the courses for a 36″ shell. To the diameter required, 36″, 40″, 52″ or any other size, we add the thickness of the plate. In the case of 36″ shell, this will be 36¼″. The circumference of any circle is nearly 3 1-7th times the diameter, so we multiply the diameter by 3 and then divide the diameter, 36″, by 7; adding both together. This gives 113⅞, say 114″, as the length for a 36″ shell without lap. This is the large course; the small course is found in the same way, except that instead of adding the thickness of plate to the diameter required we subtract it.

In laying out sheets many use a square; this sometimes gets out of truth and makes trouble. A pair of trams are better and more easily handled. Lay off on the long side 24″ from the rivet-hole (see Fig. 1). Then spread the trams and strike a line on the opposite side from the 24″ mark as a center, and then strike another from the lap or rivet-hole as a center. The point where the two marks meet will be equidistant, or in the middle of the 24″ mark, and will be square with the end row of rivet holes.





In laying out dome curves to fit the shell, it is quite a job, as explained in the text books, and it will take a quick workman an hour or more to do it. By using the sweep of the boiler we can do it in about twenty minutes. Divide the sheet into four equal parts, as in Fig. 2, and lay off the diameter of dome one-half each side of 1 and 3. Then lay the sweep so it strikes the diameter points, and draw the curve as shown There will, of course, be a reverse curve, as shown by the dotted line, which will require to be cut off; then mark off how much flange is wanted and center it

N. Y. Boiler Maker.

[It seems to us that the dome having been laid off, as above mentioned, and cut as nearly as possible to shape required, then if it was well chalked and set on the boiler, by taking a pair of dividers and opening them out, say six inches, resting one leg on the boiler and the other against the dome by following around the shell, an exact outline of the base would be drawn on the dome. It is necessary to keep the points of the dividers exactly perpendicular. From this line the flange can be laid off and fit perfectly, if the work is properly done, after it is turned.—Eds.]

SETTING VALVES.

Editors Mechanical Engineer:

Roper says, in his engineering books, to reverse an engine, proceed as follows:

"Place the crank on the dead-center and remove the bonnet of the steam-chest; observe the amount of lead, or opening, that the valve has on the *steam* end; then loosen the eccentric, and turn it round on the shaft, in the direction in which it is intended the engine should run, until the valve has the same amount of lead on the *other* end."

Does he mean that the valve must open the port at the other end of the cylinder? If he does, he is mistaken. When the crank is on the dead center, the same port will be open the amount of lead it has, regardless of which way the engine is to run.

The throw-line of the eccentric of a horizontal engine would be above the center line of the cylinder when the engine is intended to run one way, but below if the engine is to run the other way.

Mr. Roper says: "As the bearing in the rocker arm that carries the eccentric-hook is lengthened, we increase the stroke of the valve; if the same bearing is shortened, we lessen the stroke of the valve."

In my experience, I have always shortened the arm of the rocker to increase the stroke of the valve, and lengthened the arm to shorten the stroke of the valve.

Kentucky. R. L. S.

[Our correspondent is correct.—Eds.]

ANSWERS NEEDED TO THESE QUESTIONS.

Editors Mechanical Engineer:

Will some one of your many readers tell me how I can condense very wet steam, at about ½ lb. pressure or less, without using water? The steam is from a 16″ × 42″ engine, and exhausts through about 500 or 600 feet of piping, with two outlets. It is the condensed water that I want.

I had some trouble with engine oil (kept in a galvanized iron tank) becoming flaky, with what appeared to me to be flakes of tallow. I strained the oil and in three months it was as bad as ever, and I could not use it. Has any other engineer had that kind of trouble? What is the cause of it?

I was very well pleased to know that "the Professor" is going to tackle the pen again; its very "mighty," but he can do it; and I have no doubt but that many of your readers (myself included) would like to read some more of N. W. Williames' lectures, for they were surely very good and instructive. I learned something from one lecture of his that is worth to me, at least, the price of five years' subscription to The Mechanical Engineer. The indicator series are very promising thus far; and I will conclude this letter by saying that, I think, every engineer in the United States ought, for his own benefit, to read the The Mechanical Engineer.

Steam Space Feeder,
Canton, Ohio.

MEAN EFFECTIVE PRESSURES.

Editors Mechanical Engineer:

In a late issue of your paper I notice that you say the mean effective pressure on a piston is the average pressure throughout the stroke. Please give the rule for this without using an indicator.

New York. J. McCaulley.

[The only rule in general use is that steam loses half its pressure when it doubles the area previously occupied by it. For example: steam of sixty pounds per square inch let into a cylinder and expanded once—that is, cut off at half stroke—would have a mean effective of forty-seven pounds throughout the whole stroke, theoretically; actually not that, for no account is made of clearances, leakages, condensation, etc. For a closer approximation to the mean theoretical pressure at any point of stroke, we may divide the stroke into eight equal parts. Supposing the pressure to be 100 pounds in the steam-chest and the valve to cut off at quarter stroke, the mean effective will be as follows: The first quarter equals 100 pounds; the third division ⅜ of 100 pounds; the fourth 4-8; the fifth division ⅝ of 100 pounds, etc., etc. These sums, added together and divided by the number of divisions, will give the mean theoretical pressure throughout the stroke.—Eds.]

THE UNITED STATES NAVAL INSTITUTE.

Editors Mechanical Engineer:

The U. S. Naval Institute is a voluntary association of naval officers for mutual instruction and the advancement of the service, and is supported entirely by the annual dues of members ($3), life membership fees ($30), annual subscription from libraries, clubs, colleges, firms, etc., ($3.50), and the sale of single copies ($1). We have not the slightest aid from Government.

Our constitution authorizes a roll of association members for foreign army and navy officers, U. S. army officers, and those of the revenue marine, also civilians who may take interest in the matter published in our proceedings. For your further information I send you a table of contents of the first eight volumes.

If you know of any civilians interested in naval and marine affairs, ordnance and armor, naval architecture, shipbuilding, steam engineering, electricity, the chemistry of explosives, torpedoes, etc., etc., who would like to receive our proceedings regularly, we shall be happy to have you notify us of their names. The annual dues for associates is the same as for regular members, ($3.)

Chas. M. Thomas,
Lieut.-Commander, U. S. N., Secretary.
Annapolis, Md.

TO ENGINEERS AND ENGINEERS' ASSOCIATIONS.

There are a few mistakes in the Constitution as printed, being overlooked in the readings of the proof.

1st. The Treasurer of the Aid is I. H. Baker.

2d. In Sec. 2, Art. 10, page 7, omit $10 after State Associations.

3d. In Art. 9, page 10, should read "Shall not exceed $10."

4th. Sec. 1, Art. 9, page 22, the fourth line should read "Reorganizing the Association," omitting State.

If engineers will note the above, it will save some trouble and writing, especially the error on page 13.

Now let me once more urge upon all who can to join the Mutual Aid. If 1,000 should join, then the benefits would be $1,000; if 500 members, $500, and so on.

The Constitutions are ready for distribution. Engineers wishing the same may apply to the Secretary of the National Association.

We start the financial year with bright prospects. Application for charter has been received from Atchison, Kansas, R. G. Cheney, 1012 Atchison street, Secretary. There are at present fourteen other cities where the engineers are organizing, and it is the intention of the officers to organize 100 associations before the next annual meeting, in September, '84. Applications and instructions will be forwarded at once to parties applying for the same.

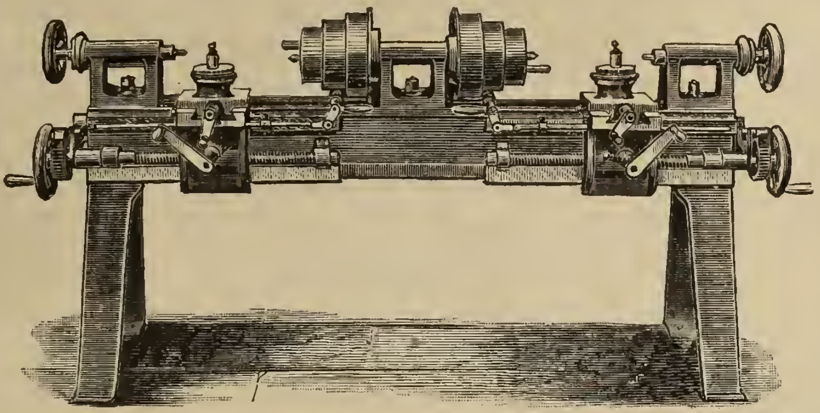
A. M. Davy,
Sec N. A. of S. E. of U. S. A.
Detroit, Mich.

The Count of Murillo, of the Ingenio Mercedes, island of Cuba, is fitting up his steam boilers with the Jarvis Patent Furnace to burn wet begasse, without drying. He is also erecting the largest chimney ever built on the island of Cuba. It will be 130 feet high.

A DEAD-CENTER DOUBLE STUD LATHE.

We find in the *Mechanical World* an illustration of a convenient lathe which has many good points. We quote:

"The illustration represents a double dead-center lathe, each end of which will take in fourteen inches between the centers and will turn up to two and one-half inches diameter. It has been designed specially for turning large quanties of duplicate work, either straight or tapered. Its design is good and the arrangement simple, and an automatic stop motion for the feed enables a boy to attend, with perfect safety, the two ends at once. The collars and set screws shown on the horizontal rods in front of the machine are for the adjustment of the stop motion, and the two handles in the center may also be used to stop or start the feed at either end. For turning bolts, spindles, or shafts with collars, the automatic stop motion is useful, as the collars can be turned at one end while the shanks are being turned at the other.



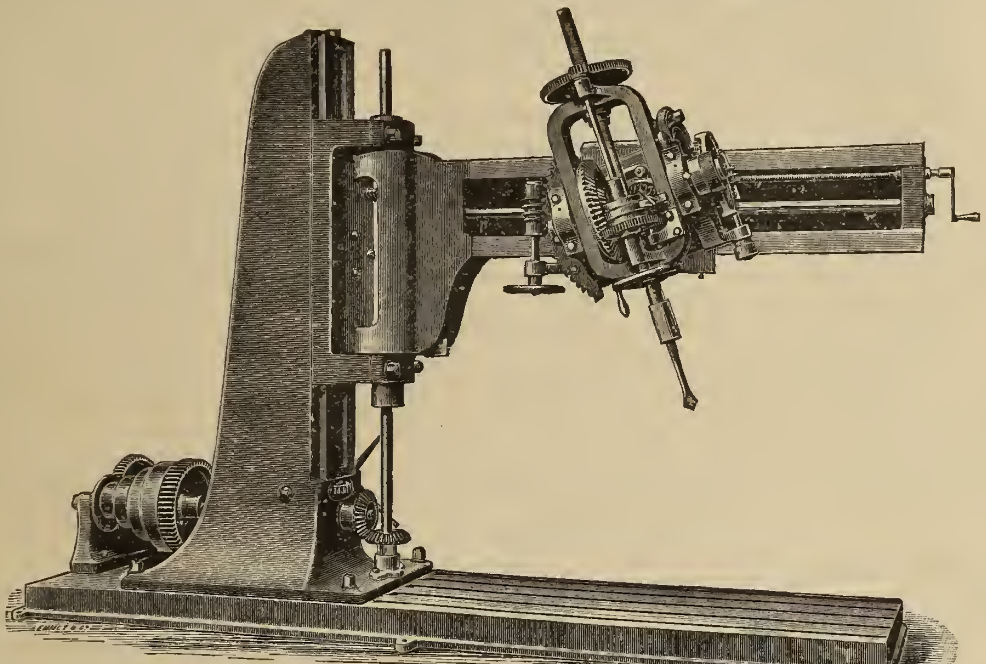
"The top of the rest in which the toolholder is fixed is screwed into a socket, and is thus capable of being raised as the tool wears, or to suit any particular purpose. The saddles have quick return motions which save a considerable amount of time. At the side of each rest a gauge is fitted for the purpose of determining the finished diameter of the work. The work runs at the rate of about twenty feet a minute, and it is claimed that it is generally more accurate than that done in an ordinary slide lathe, as the former has dead-centers, and there is therefore much less chance of their running out of truth. The machine is a handy one, and meets with much approval where used."

SOME NEW ENGLISH TOOLS.

Our engravings represent some new designs in English machine tools which will commend themselves, in some points, to our readers. The horizontal drilling machine is a very useful one in very many places, particularly in locomotive shops, as, with a long drill very much of the work now done with ratchets could be done by this machine. All the parts could be drilled in place after being clamped up. It would be well for our tool makers to give their attention to the production of tools of this class, for it opens up new suggestions.

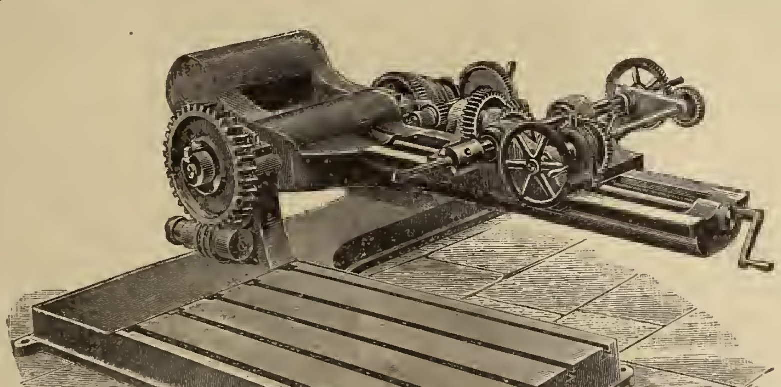
The drill spindle is of steel, 2¼ in. diameter, and the table is 7 ft. 3 in. by 3 ft. Work of any height can be got on the table, and the arm being capable of movement into any position up to 90 degrees from the horizontal, and the head stock being readily moved to any position by the ordinary nut and screw, makes the machine a very useful one for drilling such objects as cannot be got under an ordinary drilling machine without the necessity of sinking a "pit." The bolt-holes in long pipes and cylinders, for instance, might be easily drilled by means of this machine, and it may, when required, be used as a boring machine, the boring bar being driven by the drill spindle and supported by stays from the table or foundation plate.

The machine shown in Fig. 2 is a vertical radial drill, with an arm 7 ft. long, carrying in the headstock a steel spindle 2½ in. diameter, which may be put into any position from 2½ ft. to 5 ft. from the surface of the table, and which has a feed of 15 in.



The special feature of this machine is the means provided on the headstock for swiveling the drill spindle in any direction to any angle between 45° and its vertical position, and for indicating by means of a quadrant and index-hand the exact angle at which the drill is set at any time. The hand-wheel, worm—1¼ in. pitch—and segment on the left of the headstock, and a similar arrangement on the right side of the latter, make the moving of the spindle to any angle an easy matter, and this movement is specially valuable where holes are required to be drilled at different angles in objects that are weighty and inconvenient to lift or set on the machine, and also for facilitating the drilling of holes at right angles to uneven surfaces, such as those of boiler plates; also bridge, ship and armor plates.

Our engravings are taken from the *Mechanical World*.



STEAM VS. WATER POWER.

The minimum capacity and height of fall of some of the leading water-powers of the United States is as follows:

Holyoke, fifty feet, 17,000 horse-power.

Cohoes, No. 3, one hundred and five feet, 14,000 horse-power.

Lewiston, fifty feet, 11,000 horse-power.

Lowell, thirty-five feet, 10,000 horse-power.

Lawrence, twenty-eight feet, 10,000 horse-power.

Turner's Falls, thirty-five feet, 10,000 horse-power.

Manchester, fifty-two feet, 10,000 horse-power.

Paterson, thirty-five feet, 1,100 horse-power.

Passaic, N. J., twenty-two feet, 900 horse-power.

Birmingham, twenty-two feet, 1,000 horse-power.

Fall River, with at least 500,000 more cotton spindles than any other town or city in the United States, is operated wholly by steam power.

Manufacturers have been heard to say they would not move across the street for the sake of substituting water for steam, considering the irregularity of most water powers. A more moderate statement is that of the manager of a prominent woolen mill on the seaboard, whom the writer asked if it would not be cheaper to run his mill by steam than by water. The answer was: "For a mill located as mine is, steam is the cheaper. I use half anthracite screenings and half culm coal from Nova Scotia. The average cost of both kinds of fuel landed on our wharf is $3.25 per ton, and at that figure steam is cheaper than water."—*Textile Gazette.*

IT IS A SINGULAR FACT that while in China they grow sorghum for bread, its sugar producing qualities are unknown. For two thousand years they have lived in ignorance of this great fact, and are now learning it from us. While China has grown a great many varities of sorghum, she has been ignorant of the sugar sorghum variety that we have. China knows of it now, or will as soon as the intelligent and enterprising Minister she keeps in this country makes his report. It will not be long before China becomes a sugar producing country from sorghum on a scale of quality and profit equaling other countries.

A SOUTHERN farmer recently found what he supposed was a huge emerald, while ploughing, and refused $1,000 for it. He was sorry to learn, after sending it to this city, that it was only a curious quartz formation, worth $5 as a cabinet curiosity.

Another Southerner found in a brook what was pronounced a blue sapphire, half an ounce in weight and worth $50,000. He, too, was undeceived by Tiffany & Co., of this city, who found it to be only a piece of bottle-glass, polished by running water and sand.

COMMISSIONER MARBLE, of the Patent Office, recommends a reduction of the fees. If he would find some means of distinguishing between useful and useless inventions, he would greatly expedite the former. It is stated that the examination of 3,000 claims is delayed for want of help.

THE POPULARITY of the Stationary Engineers' Association movement may be inferred from the fact that in one day the Secretary received 22 letters. We shall have to subscribe for a type-writer for him.

THE RATIO of average weight of brains among the different races is as follows: Scotch, 102; German, 98·5; French, 98; English, 97.

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TO FIND THE SIZE OF CYLINDER REQUIRED FOR A GIVEN INDICATED HORSE POWER.

One method of making and selling steam engines is to call a certain size cylinder so many horse-power, regardless of what the mean pressure may be, or point of cut-off. This frequently results in disappointment, for where the boiler is not purchased of the engine maker it often happens that the boiler is much too large, or too small for the work; it may be either.

A better way, especially in building engines, is to calculate the size of cylinder required when all the conditions are taken into account. For example: a customer comes to us and says he wishes to have an engine of fifty horse-power, and wants to know what size the cylinder will be. If we turn to builders' catalogues we find that there is a great variation in them; the ratings varying materially. Further: perhaps our customer does not wish to run at the speed or pressures named in the catalogues for a given horse-power. Under such circumstances the dimensions set down are of no use, and are, at best, mere guesses.

The first thing we ask our customer is what pressure of steam he wishes to carry. He answers, possibly, 60 pounds. We then inquire whether he means to work expansively or full stroke, and to this he replies that he wants to work as economically as possible, but don't know anything about points of cut-off. He wants a simple slide-valve engine, and so we set him down for a cut-off at half stroke, which is the lowest he can get with ordinary valve motions.

We have now the boiler pressure and point of cut-off, from which it is easy to find the mean effective pressure throughout the stroke. We turn to tables made for this purpose and published in nearly every manufacturers' catalogue, and find that the mean effective of 65 pounds boiler pressure, cutting off at half stroke, is 40·5 pounds, and we then have merely to find the number of square inches of area in the piston, and the speed of the same in feet per minute to tell what size of cylinder will give us 50 horse-power, indicated, under certain conditions; not 50 horse-power guessed at under wasteful conditions.

All this is a very simple process for any one, as the reader will see. The area of piston may be found by multiplying the total power required (in this case 50 horse) by 33,000; that is the standard for one horse-power. Now divide the product so obtained, which is 1,650,000, by the speed of the piston in feet per minute. We get this speed from the number of revolutions we intend to make. This is according to the kind of work to be done. If we want to run slow the piston speed will be low, and the cylinder larger than if we ran faster. We assume that the speed in revolutions per minute will be 75, an ordinary figure, and that the stroke is 24 inches. This gives us 75 × 4; piston traveling four feet (two forward and two back) at each revolution. We have then a piston speed of 300 feet per minute. Now multiply this by the mean effective pressure, 40·5 pounds, and we have the sum of 12000·5. From these figures we find the piston area for a fifty horse-power engine, indicated, as follows:

$$\text{Area of piston} = \frac{33{,}000 \times 50}{300 \times 40{\cdot}5} = 137{\cdot}5 \text{ inches.}$$

The diameter equivalent to this area is 13¼ inches nearly, but we should probably make the cylinder 14 inches diameter, so as to give a wide margin for loss of efficiency by leaky valves, and pistons, and careless management.

In a subsequent issue we shall give further details of ports and passages, derived from the best modern practice.

◆

COLOR BLINDNESS, so called, may be merely a want of knowledge of the name of any given shade. Many men know blue from red or green well enough, who cannot distinguish shades of red. They call crimson and scarlet red, when strictly speaking they are not red at all, but shades of it. Such nice distinctions as these are not at all necessary to pilots or engineers.

HIGH PISTON SPEEDS.

The difficulties experienced by many persons with high speed engines lies in the engines themselves, in some cases, and not from any fault in the system of high speed. The practicability of this is well established, but it depends for success upon construction and design. Obviously, if we require 20 horse-power from an engine, whose piston will develop only ten horse-power, under usual conditions, we must have the dimensions of a twenty horse engine in the bearings and working parts. We must also have thorough lubrication, and a system whereby it is rendered possible, and positive, at all times and under all conditions. It must be so certain that the attendant will have no more anxiety or labor, with his high speed engine, then with one at ordinary speed, for in any other event the engine is a failure. In this one aspect, more high speed engines have been unsatisfactory than any other, for it has been considered a matter that would take care of itself. Given, a bearing and an oil hole and a man to pour oil in, and the lubrication is provided for—in the minds of some. So it is, so long as the engineer gets around in time, and does not forget anything, but the question is not so settled. It depends greatly upon pressures per square inch on journals and wearing surfaces, and this is only another way of saying that dimensions settle the question in the main—as they do. Of course we are not to be taken as saying that a high speed engine is to be lubricated through an open oil hole, in any event, but this plan is one which is very frequently necessary.

A trouble experienced with high speed engines is in the tight fits of the main bearings. These are frequently ground truly cylindrical, and they hug the main bearings as a kid glove fits the hand. With such absolute contact, the oil has no chance for distribution, and is prevented from forming a film over the surface. True, it enters at the top, and is supposed to be distributed over the bearings, but if these are so tight in the boxes that they touch in every part, there is great liability to heat.

Nothing is better settled than the fact, that at certain pressures per square inch on bearings, they will run cool and without trouble, while any excess causes it.

High speed is as feasible, practically, in a steam engine as in any other machine, the only conditions necessary being ample bearing surface to secure moderate pressures per square inch; perfect balance, so that no unusual or unequal work is thrown on the bearings; moderate compression, so that the bearings shall have a moment of rest when approaching the center, and thorough and economical lubrication; good workmanship is, of course, assumed. With these conditions there is no reason why a stationary engine should not run regularly at 1,000 feet per minute, piston travel, which is what we mean by high speed.

◆

FAR-FETCHED THEORIES.

It is curious that generation after generation of a certain class seize upon old theories and announce them as great discoveries. This arises, in great part, from a want of acquaintance with what has been done and what has been discarded as untenable years ago. As an illustration of the above remarks, we instance a writer in a French journal—M. Vignes—who has been repeating the experiments of Donny, in 1846, as to a possible cause of boiler explosions. This is, in brief, the spheroidal condition of water under some circumstances. For example: if we throw water upon hot plates at certain temperatures, it forms globules, rolls around, and finally bursts into steam with great violence. From this peculiar action of water on heated plates, casual experimenters have jumped to the conclusion that a boiler may be so exploded, and that it is, in fact, "a possible cause of boiler explosions." Also, other experimenters have asserted that, by heating water under certain conditions, it is converted into a magazine of heat, which needs only agitation or sudden disturbance to be as dangerous as nitro-glycerine. This water, so heated, does not boil, be it remembered; it simply absorbs heat and retains it. We do not controvert the theory of absorption in this way, for it is too well known to be questioned, but how does it apply to steam boilers? In no way, for the conditions under which water may be so treated are widely different from those occurring in steam boilers. It is a very difficult experiment to perform in a laboratory—heating water to saturation—and almost impossible in a steam boiler or iron vessel of any kind. The surfaces must be absolutely clean and the absorption of heat must proceed slowly and without the least ebullition. We do not say that it is impossible to explode a steam boiler by such an experiment; but we do say that it is so improbable that we do not credit it as a source of danger to boilers in everyday use. Many persons have endeavored to bring about this condition of water, artificially, in glass tubes, but have not succeeded.

So far as the spheroidal condition of water—that is, its forming into globules and suddenly flashing into steam—is concerned, we regard it as a still more remote cause of danger, for the simple reason that, under ordinary circumstances of care and attention, no such action can occur. Under conditions of neglect and indifference, anything is possible, and it is begging the question to charge to the spheroidal state of water what belongs to the recklessness of mankind.

We have opposed for twenty-five years all remote theories in connection with boiler explosions, and have, early and late, in season and out of it, asserted that the promulgation of them is mischievous from every aspect. Once we entertain them, we assert that sound material, good workmanship and careful attention are useless, for there is an agent lying in wait which may prevail against all these.

There are no such agents existing under usual circumstances. All sorts of experiments may be performed with water. The very air we breathe may be resolved into dangerous gases, which will, and does, destroy life, but this does not prove that it is dangerous to breathe common air. If we make good boilers, and take good care of them, we may laugh at all the theories which can be started; the tensile strength of them, to use a mixed metaphor, is weaker than the rottenest boiler plate ever made.

WHO INVENTED THE MULTICHARGE GUN?

Many years ago, when the writer of this was at the Novelty Iron Works, of this city, Horatio Allen came into the shop one day and showed an astonished group of men a block of solid wrought iron five inches thick, penetrated by a half-inch steel bolt eight inches long. This bolt had been fired from a rifle through the iron block by the inventor of the gun, Mr. A. H. Lyman, of this city. There was no question as to the fact, but there was some trouble in believing it; seeing was not believing in this instance. Many could not credit the possibility of the half-inch bolt being driven through the wrought-iron block in the manner stated. From this experiment a gun of some size was made. Cannon, perhaps it should be called. The bore was only two and one-quarter inches, and the length some nineteen feet over all. It was drilled out of the solid iron, and so sound was the material, and so skillful was the workman—William Wade—that the hole went dead-true from one center to another without variation. This was no small feat with ordinary appliances. The bore was afterwards rifled one turn in thirty inches.

As before stated at that time, 1860, we believed A. H. Lyman was the inventor, but it now appears that a Mr. J. B. Haskell claims the honor, and Mr. Lyman is nowhere mentioned. The gun elsewhere described as to its general features, was taken over on Long Island and tested, and rumor asserted that the shot was never found. It went so far that it could not be traced; which, considering its small dimensions is not improbable.

We have made this brief allusion to the subject for the purpose of giving credit to the actual inventor, and perhaps eliciting an explanation from the present inventor.

NOTICE.

It has been represented to us that our date of expiration of SPECIAL OFFER for clubs, limited, falls upon an intermediate day which prevents many from accepting it, as their pay day is monthly and occurs on the last of each current month. We have therefore extended it five days, until the first of December, desiring to accommodate all who wish to avail themselves of the very low rates offered. This is the last notice we shall give, as the date fixed, December 1st, will be so near our next issue as to leave no time for working up clubs. We request all who are interested in the success of a strictly engineering paper to give us the benefit of their kind offices.

DOMESTIC SUGAR.

In our last issue we adverted briefly to the fact that sorghum has been successfully crystalized in this country, and the manufacture of hard sugar from it become a fact. The importance of this is very great, not alone in the prospect of cheapening a great staple, but in the opening of a new line of trade to our friends everywhere. Engines will be needed, mills, boilers, steam pipe, sheet-iron work, brass fittings, in fact all the paraphernalia of large sugar factories will be in demand. Old engineers will remember what a craze there was twenty-five years ago on the subject of sorghum sugar. Farmers went into the cultivation of the cane, bought mills and evaporators, and expected to turn out granulated sugar as easily as it is made from maple sap. They were disappointed, for, through some unknown cause at that time, the sorghum syrup would not granulate; the only product being a concentrated syrup of rather disagreeable taste and appearance. As previously stated this fault has been overcome, and sorghum sugar is now made and sold in open market. Some facts relating to it will be found elsewhere.

PURELY IMAGINARY.

We find in the *Iron Age* of late date, this paragraph relating to prison labor and contracts:

> "The State could not employ managers who would be as skilled and experienced as successful contractors need to be, for such men could earn more money outside of prisons than in them The result would be a flood of cheap and generally inferior products, which would be sold at prices calculated to demoralize regular trade all over the country. This is what the State-account system means. The contractor, on the other hand, has not only a profit to make, but a reputation to establish and conserve. He may lose his contract, and must acquire while he has it such a hold on the trade that he can continue manufacturing with citizen labor. The contract system may be abused, but the abuses are subject to correction Free and fair competition among those seeking contracts will guard against favoritism, and good prison management will do the rest. There are no inherent objections to the contract system under proper legislative regulation, and the injury which it does to citizen mechanics is purely imaginary."

Purely imaginary! This is quite equal to General Hancock's immortal assertion during the last presidential canvas. When asked his views on the tariff question, he replied "that it was wholly a local issue."

It is, of course, purely imaginary that shoe manufacturers have to compete with prison work and meet it. It is doubtless "the baseless fabric of a dream" that Western forkmakers, prison contractors, fix the prices for Eastern forkmakers who use free labor. It is purely imaginary, of course, that prison goods find a market for themselves without coming into compction with free labor goods.

In the first few lines we have quoted, our contemporary sets up a target and proceeds to fire at it, and like the sportsman in the *Pickwick Papers,* who put up a partridge two feet off to practice on, our contemporary blows it clean out of sight at the first fire, "and nobody ever seed a feather of it afterwards," to quote Mr. Weller.

If competent managers cannot be secured for prison labor, it is because of the odium which attaches, instinctively, to such occupations, but the assertion itself is incorrect, and stultified by what follows. "If," says these capable men were not employed, the result would be a flood of inferior products, which would be sold at prices calculated to demoralize trade, etc." That is just the state of things at present.

Let the *Iron Age* tell us, if it can, how the best manager in the world could produce good work from men who do not understand their business; who are inert, disaffected, compelled to labor whether they will or not, vicious by nature and poorly paid. Men who look upon their labor as part of their punishment, who from very hatred of it have become what they are—prisoners.

The idea in itself is monstrous—opposing prison labor to free labor—and if our people were not so apathetic upon questions that do not fairly sting them into action, there would not be a contract in existence at this moment.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLIII.

I suppose if a man wants to get into trouble, and make himself unpopular with railroad men all he has to do is to say something derogatory of the link-motion, and he will have plenty of business on hand. If he intimates ever so delicately that it is an obsolete and inefficient device for its purpose on a locomotive he will be considered as a theoretical crank, than whom no more disagreeable and unnecessary person exists. For many years I held the same opinion as to the great and general utility of the link for every function of valve-motion—but I have modified these views, and think that perhaps those radicals who have for years argued against it have reason on their side. I was brought to this state of mind by the casual inspection of an indicator card taken from a locomotive at high speed, and it certainly was rather discouraging. Most persons know that the work done by an engine, and shown by the card, consists, broadly, of the area of the diagram; this varies, of course, with the velocity at which the engine moves, and the point of cut off. At high velocities in locomotives the cut-off is low; as low as possible in fact, compatible with the work, and therefore the relative area is small. If it was all honest and straightforward work there would not be much, but when it comes to taking away a goodly portion of this, merely to satisfy, or justify, or retain the link-motion, it seems to me that it is rather an expensive device. Of course, at low speeds the question assumes another aspect, but at high speeds assuredly the link-motion is a stumbling block. I believe it has been retained solely on account of its convenience for reversing and general handling of an engine, and I further believe that if it was just invented, and claimed as a great invention, no locomotive builder would look at it, much less adopt it. The great fault I find with it is its back pressure capacity. When I want a clear field and no favor for my exhaust that is the time the link-motion says I shall not have it, and it proceeds to throttle the exhaust at the very moment it ought to hold it open, and keep holding it open until the laggard steam gets out. That's what the matter is with the link, and though some forms of it are less open to this objection than others, there is no link that I ever read of which will give a high speed card without a cucumber in it. That is to say, all high speed cards at short cuts with the link-motion, bear more resemblance to a bent cucumber than anything else. In some cards, and with some forms of link-motion, back pressure begins at half stroke, apparently, and increases, until at the end it is quite three-fourths of the boiler pressure. No one can assert that this costs nothing. It does cost something. In fact it is about as expensive as it would be to have a brake on the wheels of the driver intermittently. Back pressure is a brake, no more and no less, and if any one can see in this useful instrument a source of power, they can see more than I can.

I put steam on a piston to drive it through its work, and I don't see what benefit it is to have steam on the other side holding me back. The link-motion takes me by the collar and says "go slow my friend," when I am putting out money to go fast; but I don't know what to do about it. If I had the opportunity I think I would make a high-speed locomotive without any link-motion, and see what it would do. I don't know how I would make it, or what I would move the valves with, but I would make it somehow, and the valves would move at the right time, and the steam would come out when I got ready to have it. I would get high expansion and all the power there was in the steam, and I wouldn't have my wind shut off just when I wanted it the most. I think I could get along with less boiler; that is, I think I could do more work with the same boiler and with less coal. I am just foolish enough to believe that putting, to speak moderately, ten pounds per square inch back pressure on a piston, when I don't want any more than ordinary atmospheric trouble, is a piece of silliness that, somehow, has to be paid for. As I have said before this is the most popular detail in the whole locomotive, if I may use such an expression, and most people would say—"take away the smoke-stack if you want to, but spare the link-motion. Meddle with anything else, don't touch the link. It is costly to make, expensive to keep up, and don't do the work, but no matter, let it be, and don't say anything more about it." What's the use of a man saying he is liberal-minded, anxious to keep pace with the times, and open to conviction on any point of error, when there is the link-motion on his engine; on every engine, petted, protected, and its daily peculations winked at, nay encouraged!

It's a good thing for me that I can stand (some might say sneak), behind an anonymous contribution and blackguard the link, for I can say what I want to without fear of contradiction, (as to this last I am not so certain), but I cannot be charged with having some pet device, or equally erroneous scheme of my own to foist upon those long-suffering men—the master mechanics. This article is not preparatory to a western trip with a suspicious brass-bound box, ten inches square, bristling with a new jimcrank of a valve-motion. I arraign the link on its record; on its daily walk and carriage, and that this is far from meritorious every unbiassed engineer knows.

I think that with the Chinese the link must go, and I hope it will go before they do, for from present appearances they seem to be a little slack in starting.

THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER III.

By William Barnet Le Van.

Figure 6 is a real diagram taken from a Corliss engine 8 inch diameter and 24 inches stroke; 90 revolutions per minute.

Starting from the top corner, *B*, the steam pressure remains uniform to about point, *e*; here the cut-off valve closed, and the pressure commenced to fall, as represented by the curved line, *f*, until it reached the point, *g*, when the exhaust-valve opened (allowing the steam to pass into the atmosphere), and quite suddenly drops from *g* to *D*; when the piston commences to return. There remains a slight pressure in the cylinder, until the time the piston gets to *h*, that is the back-pressure throughout the stroke, so that it keeps the line of the pencil about 0·6 of a pound above the atmospheric line, *A*, *D*, until the closing of the exhaust-valve, which occurs at the point, *h*, after which time the steam remaining in the cylinder is compressed, raising the indicator-pencil and forming the curved line, *h*, *i*.

In this case, the effective work done by the engine is represented by the area contained within the irregular figure, *B*, *e*, *f*, *g*, *D*, *h* and *i*. This is after allowing for the back-pressure and the compression, which are contained between that figure and the lines, *B*, *A* and D.

We have now described how a diagram is taken from one end of the cylinder. To obtain it from the other, all that has to be done is to make a pipe connection from the two cylinder-heads fitted with a two-way cock (as before described), and diagrams may be got on the same piece of paper, and would, if the engine were perfectly equal in performance at the two ends, be represented as it was in this case by the dotted line on Fig. 6. The sum of these two areas will represent pounds pressure through the length of the stroke of the piston in a whole revolution, which multiplied by the area of the piston and the number of revolutions per minute, will give the foot-pounds. This divided by 33,000, will give the gross indicated horse-power of the engine.

USE OF THE INDICATOR FOR SHOWING THE CONDITION OF THE ENGINE.

The indicator tells us not merely the power exerted by the engine, but the nature of the faults by which the power is impaired. Thus, the shape of the indicator diagram may show that the steam or exhaust-ports are too small, or that the valve has not sufficient lead or is improperly set. Let us take, for example, the following diagram, Fig. 7.

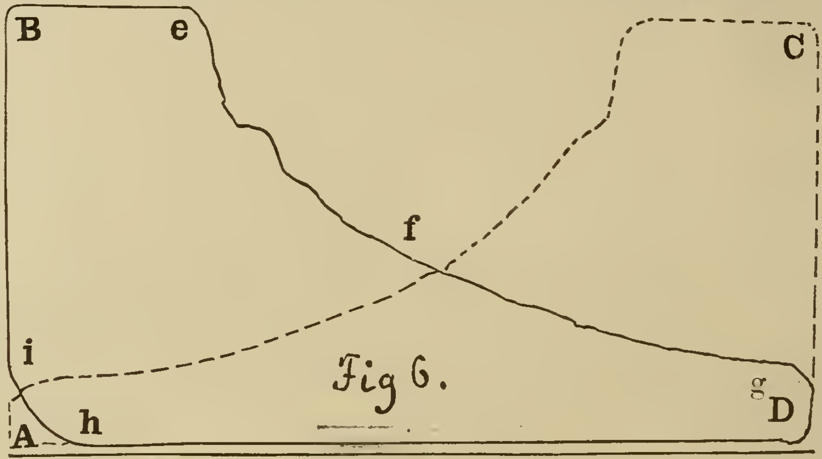


Fig 6.

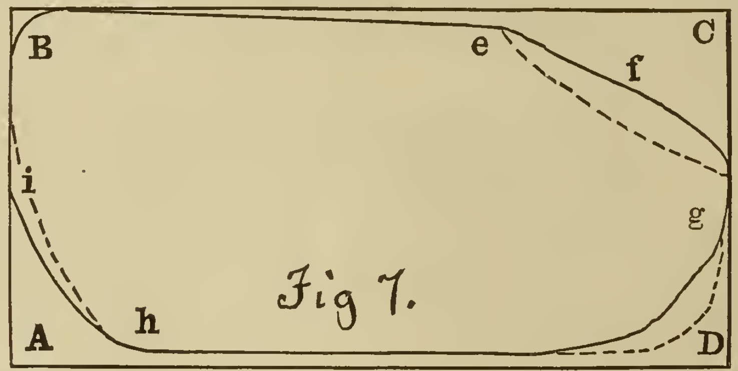


Fig 7.

When the indicator-pencil is at the point, *B*, the engine-piston is at the commencement of its stroke, the paper-drum in motion. The line is traced from *B* to *e*, and thence to *g*, at which point the stroke is finished in this direction. At the point, *e*, the valve closed the steam-port, or, in other words, was cut off, and while the line, from *e* to *g*, was being traced, the steam pressure in the engine cylinder was expanding, and its pressure, consequently, decreasing, as shown by the falling of the line, *f*. The line from *e* to *g*, instead of being convex, should be concave (as per dotted line), the former shows that either the slide valve or the piston, probably both, were not in good order, and admitted steam during expansion. The fall of the steam line from *B* to *e* also shows that the steam-ports are too small. At the point, *g*, the exhaust-valve is opened to the atmosphere, the steam escapes, the pressure in the engine cylinder falls, and the pencil descends towards *D*. The diagram, as here indicated, shows that the exhaust-port is opened too late, for this corner of the diagram should be very nearly square (see dotted line *p*). The engine-piston now commences its return stroke, and the line, *g*, *h*, is traced, representing the exhaust-line, and before reaching the end of its stroke, it commences to rise again at *h*, thus indicating that there is some pressure arising from the compression of the steam and vapor remaining in the cylinder. This is due to the closing of the exhaust-port at *i*, before the end of the stroke, causing the curved line, *h*, *i*. The rounded corner at *B*, shows that the valve is wanting in "lead," or in other words the steam-port was opened too late, as is also the case at the exhaust-end; in the latter case showing that the release of the exhaust-steam is not early enough, and that in consequence of this the back pressure at the commencement of the return-stroke is much too high. This shows that the slide-valve was improperly set, a defect which can be remedied by shifting the eccentric slightly ahead. This will improve the exhaust by causing an earlier opening, shown by the dotted curved line *g*, also causing earlier compression, as shown by the dotted line at the point of compression, as well as the increased lead at *B*. The power exerted is thus increased at least ten per cent. with the same amount of steam. The steam-line should be parallel with the atmospheric line up to point of cut-off, or nearly so. Should it fall, as the piston advances, the opening for the admission of steam is insufficient, and the steam is *wire-drawn*.

The point of cut-off on all engines should be sharp and well defined, if otherwise the valve does not close quick enough.

By having an indicator at each end of the engine cylinder, the back and forth action of the steam in the cylinder is simultaneously recorded in the form of a diagram, as before stated, by horizontal and vertical lines and curves. This diagram comprises time of admission, steam-line, point of cut-off, expansion curve, terminal pressure, point of exhaust (or relief exhaust) line, back-pressure line, compression curve, initial pressure and initial expansion. From these records the total work done by the steam can be accurately ascertained. Very accurate measurements have been made by the indicator, but the average area of indicator cylinders is only about one-half of a square inch, while that of cylinders indicated may vary from ten square inches to as many square feet. By the use of the indicator, the determination between *nominal* (calculated), *indicated* (real) and *effective* horse-power is found; the variations between which are very marked.

The indicator also furnishes one of the data for ascertaining the power exerted by the steam engine; namely, the *mean* or *average* pressure of the steam during the stroke, on each square inch of the piston; stated more accurately, it shows the excess of pressure on the steam side of the piston to produce motion over that on the exhaust side to resist it; and from no other source can it be so accurately ascertained.

The pressure in the boiler is readily known, but the steam in its passage to the cylinder is subject to various losses, such as wire-drawing, condensation, friction, etc., so that, frequently, the pressure on the piston does not exceed two-thirds of that on the boiler.

A WELL-KNOWN ENGINEER, whose handbook is a standard of reference for the profession, lately built a new boiler for a steam yacht. The boiler was flat-bottomed, and the designer omitted to note the rise in the ship's bilge where the boiler went. As a consequence several beams had to be taken out, and even then the boiler stood 15″ above deck, and a trunk had to be built over it. It is very easy to make a mistake.

A NEW and simple method has lately been discovered for ascertaining the number of feet in a log, which will be found very convenient in case a log rule is not at hand. It is as follows: Multiply the diameter in inches by one-half the diameter; then multiply this product by the length of the log in feet and divide by eight. The quotient will be the number of feet in the log.

CORRESPONDENTS will confer a great favor by putting their address on every letter. For want of it we are unable to reply to many favors. One from Mr. John Erwood, of Chicago, lies before us, to which we cannot reply from this cause.

IN THE ROUND HOUSE.—No. XIV.

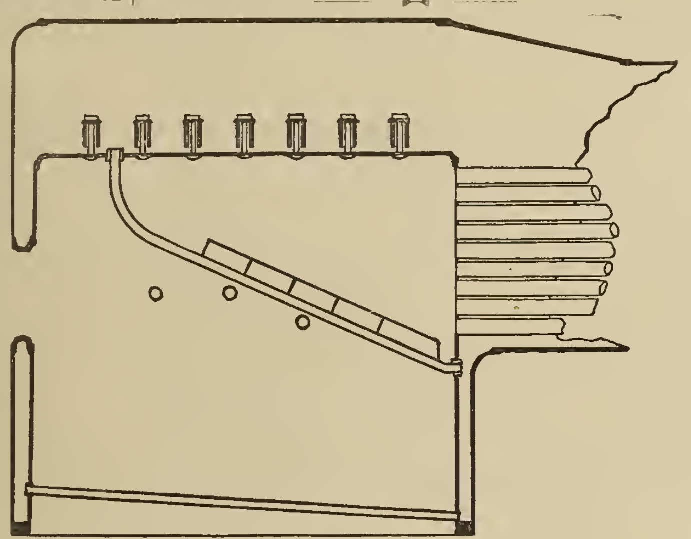
BY L. O. DANSE.

SMOKE BURNING AND COMBUSTION.

The conditions of rapid combustion under the powerful forced draft existing in locomotives are the worst possible for the perfect combination of the gases evolved from the fuel, with atmospheric oxygen, which is necessary for perfect combustion and smoke burning. Where there is a large grate area and an ample combustion-chamber, smoke burning (or, at least, its prevention) is an easy matter; but these conditions are impossible in locomotives.

Experience has demonstrated that, with bituminous coal as a fuel, the smallest possible grate area combined with the largest possible combustion-chamber, produce the best results so far as economy of fuel is concerned, because intensity of fire is essential to produce the high temperature which the gases must have in order to heat the plates and tubes properly. When we think of the enormous velocity at which the heated air and gases pass through the tubes, it will be evident that the time of contact between a given volume of the former and the latter is very limited, and that they can part with only a corresponding portion of their heat.

From this it is evident that, to secure the best results from a given consumption of fuel, we must have the most rapid, complete and intense combustion, and the most protracted contact of the products of combustion with the heating surfaces. To obtain this, we must have as small a grate as possible to consume the coal on; for intensity of combustion as large a fire-box as convenient, that the current through it may be sufficiently slow to absorb heat enough, by remaining long in contact with the fire; as much tube areas and volume as there is room for, to retain the products of combustion in contact with heating surfaces as long as possible, and a large smoke-box to reduce the "jerking" action of the blast and make the draft continuous and regular.



Fire-brick arches are now commonly used in the fire-boxes of coal burning locomotives, to retain the gases longer in contact with the incandescent fuel, and promote the combustion of those which are not already burned, as also of the particles of carbon or soot which are suspended in them. To produce the latter result, air is admitted above the fire, by means of short stay-tubes, about one inch and a half in diameter, passing through the side sheets of the inner and outer shells. This air, mingling with the heated gases, instantly oxygenizes or burns the combustible portions of the smoke with which it comes in contact. The details of a fire-brick arch are here shown, including the water tubes on which it rests, although some roads still use angle irons instead of tubes.

On some roads, a "water-table" is substituted for a brick arch. This consists simply of a projection of the water-space into the fire-box, located in the same manner as the ordinary brick arch, except that it is straight instead of being curved.

Fire-boxes are sometimes so arranged that the water-table extends entirely across, dividing them into two separate chambers, with only a small opening about the same size as the chimney, through from the lower to the upper. They are very efficient, but their expense and the difficulty of making repairs has prevented their extensive introduction.

With the introduction of fire-brick arches and water-tables, a return was made to the straight stack. In this, however, it was impossible to use an ordinary cone and netting; so, to overcome the difficulties presented, the two were combined, and the netting made conical, of perforated sheet-iron, reaching from the nozzles (which it usually embraces) nearly to the top of the stack.

There is a successful smoke burning contrivance in use, called a baffle-plate, which consists simply in an inverted shovel-shaped piece of sheet-iron, hinged inside the fire-box, above the door, in such a manner that when the door is partly open, it deflects the current of air which enters down toward the fire. As a very large quantity of air is requisite immediately after fresh coal is fed, to burn the smoke, the baffle-plate proves an efficient mode of mingling that extra supply with the smoke and gases. Of course, as soon as black smoke ceases to rise from the fuel the door is entirely closed, and the baffle-plate ceases to act. When the door is wide open for coaling, the baffle-plate is raised up out of the way.

Fire doors should always be provided with registers, so that the air supply can be controlled by the fireman. A catch, to hold the door slightly open, is also advisable.

The old practice of drilling the stay-bolts to admit air above the fire has been almost entirely abandoned in favor of the large stay-tubes, as the former proved quite inefficient. It is, however, a good plan to have the stay-bolts drilled to within $\frac{3}{4}''$ of the outside, as water and steam entering the fire-box through the orifice thus provided will give warning in case the stay-bolt should break.

The Hartford Boiler Inspection and Insurance Co. recommends drilling the three upper rows. The writer knows of an engine which had thirty of her stay-bolts broken when she went into the shop for overhauling. It is evident that this was a grave source of danger.

AN IMPROVISED BLOWER.

At a recent test of pumping engines, the natural draft of the boilers was bad, and Mr. Chas. I. Porter, who was making the test, improvised the blower described below. He says:

> "The natural draft of the furnaces was poor. This is to be accounted for, first, by the contracted air space in the grates; second, by the length of the horizontal flues relatively to the height of the chimney; and, third, by the location of the pumping station in a narrow valley.
>
> "A forced draft was employed, formed as follows: The ash-pit doors were tightly closed, and a cylindrical sheet-iron pipe, fourteen inches in diameter, was inserted into the side wall of the ash-pit under each boiler. These pipes turned upward outside the walls, and rose to the height of five feet. Their diameter at the top was sixteen inches, and they were contracted to a diameter of six inches in the middle of their vertical length. A steam jet was brought from the boiler in a three-quarter inch pipe, contracted at the end to half an inch, and terminating in an orifice one-eighth of an inch in diameter, located centrally in this air pipe, about a foot below the top. The force of the steam was regulated by a valve in the half-inch pipe. The induced air current was all that could be desired, and only a small portion of the full force of the jet was employed."

SORGHUM SUGAR.

There are a number of places in the country where sorghum sugar making has been prosecuted for years, and where the results differ very widely. Not to refer to factories in Illinois, Wisconsin, Iowa, Missouri, Michigan, Kansas, and other States in the West, the Rio Grande plantation in New Jersey presents conclusive tests. It consists of about 2,000 acres, to which considerable addition is to be made during the coming year. It is conducted on business principles with an intention to give sorghum the benefit of an intelligent and honest handling at every stage. It is to be observed that the manufacture from sorghum at the Rio Grande plantation has some time since passed beyond the domain of an experiment, and is now prosecuted on purely business principles, and with a success in the highest degree assuring.

The works are equipped with all the necessary machinery, including the latest, for sugar making on an extensive scale. The cane grinding and sugar making there have been going on several weeks, so that there is no guessing at results. Instead of one hundred pounds, which is Dr. Loring's test, the Rio Grande plantation is producing at the rate of one thousand pounds of sugar per acre. The sugar sells readily alongside of the best specimens of Louisiana or imported sugar of the same grade. The outcome per acre at Rio Grande in weight and money value is about equal to the average of the Southern sugar plantations.

What has been stated of the Rio Grande plantation, interesting and important as the facts are, they are not the most so of those to be mentioned. The seed of sorghum, when analyzed, is found to be identical with Indian corn. In China, sorghum is grown exclusively for the seed, as breadstuff. Not in China alone is this the case but in other parts of the world. It is probable that the reader would not be prepared to accept as true the ascertained facts as to what is the proportion of the human family whose principal subsistence for bread is sorghum seed. It exceeds that of wheat, corn, and rice combined. The identity of sorghum seed and Indian corn, and therefore of their breadmaking qualities, became known in this country only quite recently.—*N. Y. Sun.*

THE MULTICHARGE GUN.

J. R. Haskell, inventor of the multicharge gun, led a party of gentlemen down to Sandy Hook to witness the experimental firing of this new war implement. The gun is a mass of iron, 25 feet long, weighing 25 tons, looking like a section of a mast with four tumors in line upon its under side. The tumors indicate the pockets for the explosion of supplemental charges of powder, which are the distinctive features of this gun. The bore is 6 inches in diameter and the pockets are each 22 inches in depth, their greatest diameter $11\frac{3}{4}$ inches, the width of each opening into the bore 4 inches, and angle of inclination toward the muzzle of the gun 55 degrees. The entire interior of the gun, bore and pockets, is of steel, over which is a mass of iron.

In the bottom of each pocket, and about a foot back from the muzzle, pressure gauges are introduced. There are two kinds, the Rodman and the "crushing," and, though the best yet discovered, neither possesses anything more than relative accuracy, and both are subject to great errors. Both are based upon the effect of pressure on a soft metal—copper. The Rodman gauge determines the pressure by the depth to which a piston forces a knife-blade into a copper disk of determined density. In the other, the compressibility, lengthwise, of a cylinder of copper $\frac{1}{2}$-inch long and $\frac{1}{4}$-inch in diameter, inclosed in an air-tight chamber beneath a piston which is acted upon by the pressure of the gases in the gun, affords the required indication of force exerted upon it. It is this latter kind that is used in the multicharge gun. The delicacy of the reading of the information it imparts may be inferred from the fact that its compression under 19,000 pounds of pressure, is only one-eighth of one-thousandth of an inch, and under 20,600 lbs. only three-fourths of one-thousandth. Unfortunately, it is not possible, whatever the care exercised in preparing it, to obtain copper of such absolute uniformity of molecular construction as will give always accurate results.

The theory of this invention is the gradual accumulation of power by a succession of charges exploded as the shot passes along the bore. In the old-fashioned gun a single charge of powder does all the work, and the strain upon the breech is enormous, the pressure in the single-charge gun running from 33,000 to 50,000, 60,000, and sometimes over 100,000 pounds per square inch. In the multicharge system, a small charge of slow burning powder in the breech overcomes the inertia of the shot, the velocity of which, after its start, is easily accelerated by the successive explosions of subsequent charges of quicker burning powder, fired in the pockets by the gas of the breech charge following the shot.

The velocity of expansion of gun powder gas is 7,000 feet per second, and it would be impossible for it to move any projectile with even an approximate speed. The instant that the throat of the pocket is uncovered by the passage of the shot, the gas in its rear, with a pressure of say 15,000 pounds to the square inch, surrounds every grain of powder in the pocket, converting it instantly into more gas, at an increased pressure, and like manner flashes the contents of the next pocket, and so on until the combined power of all the powder in the breech and the four pockets has been utilized to keep up the speed of the projectile.

The inventor claims that it will give to projectiles greatly increased velocities when fired with full charges; increased range in proportion to the greater velocity, and power to penetrate four calibres of four times the diameter of the bore through armor plates, with pressures very much less than in ordinary or single-charge guns. This is a gain over the old system of about 50 per cent. in velocity and range and 100 per cent. in penetration.

There seems to be no limit to the amount of powder which can be effectively burned, which is not true of the old system. In all single-charge guns a certain quantity of powder, variable according to the calibre of the gun, produces the maximum result, and any addition to that amount decreases the velocity of the shot, because the extra powder is thrown out unburned, and is just so much extra weight to be moved in addition to the projectile.

The term "velocity" is apt to be misleading to the ordinary mind. A high velocity is occasionally produced by the one-charge guns, but velocity of itself has no effect on the mind of an ordinance expert. It is mere fancy work, and not such as is done in actual service, to get an excessively high velocity by firing an unusually large charge of powder behind an uncommonly light shot. A great velocity imparted to a heavy projectile produces the most effective work on an armor plate, and that is precisely what the multicharge gun is destined to accomplish. It is a difficult matter to draw comparisons between this and other guns because the data are so dissimilar as to weight of shot, charge and quality of powder, &c. This gun, in the thirteenth round, threw a shot of 109 pounds with a velocity of 1,735 feet, which is equal to 2,300 feet velocity with the 68 to 75-pound shot usually fired in single-charge six-inch guns, and the pressures in the multicharge gun were maintained at about 20,000 pounds to the square inch. The service charge of powder in the ordinary six-inch gun is 34 pounds behind a shot weighing from 68 to 75 pounds. If a shot weighing as much as that used in this multicharge gun in this series of trials were used in a single-charge gun of six inches calibre the charge would either have to be reduced, with consequent reduction of velocity, or the pressure would run up to a dangerous point. In a report of the Secretary of War there is one instance at least approximate. A six-inch steel gun of Krupp's manufacture was fired with a projectile of 112 pounds, which is about 60 per cent. heavier than that used in service, producing a velocity of 1,676 feet per second under a pressure of 40,320 pounds to the square inch. In the thirteenth round a projectile weighing 109 pounds was given a velocity of 1,735 feet per second with a pressure of about 20,000 pounds, and in the nineteenth round was given to an 111-pound shot a velocity of 1,832 feet per second under about the same pressure.

Instead of projectiles two diameters in length, weighing from 68 to 75 pounds, we are firing now shot that are three diameters in length and weigh 109 to 111 pounds. Before we get through we will be firing shots four diameters in length, weighing 155 pounds, from our multicharge gun, at a velocity sufficient to penetrate 24 inches of solid wrought iron, or the armor of any war vessel that floats. No single-charge gun could throw that shot, but would burst in starting it, in all probability.

Mr. Haskell threw open the breach of the gun and the reporter peered through the long tube. It was as carefully finished as the interior of any sporting rifle, with fifteen grooves 6-100 inches deep and one twist in twelve feet. The breech merited and received special admiration. It is entered and retracted by an interrupted screw, hinged to throw aside for the introduction of the shot, gas check wad, and breech charge, and double locked by a simple and ingenious device that works almost instantaneously. The work upon it is as fine as that upon the mechanism of a good watch, and it can be operated with surprising celerity by the men accustomed to handling it. Mr. A. G. Sinclair, master mechanic, superintended the loading of the gun. Mr. Sanborn, who has official charge of all the powder, aided him. Mr. Sanborn has gray hair and beard, but stood in the storm quite unconcernedly, in his check shirt sleeves. "Hayn't you anything under that shirt?" Major McKee asked him in a tone of astonished curiosity. "Got my hide," replied the old fellow placidly. Four other men assisted those three. There didn't seem to be any too many of them. The big steel plugs containing the pressure gauges were firmly screwed into the bottoms of the pockets. Then, one by one, four other steel plugs, with handles on them like those on hand organs, were unscrewed on the upper sides of the gun and taken out. Into each aperture thus made was thrust a long copper funnel, through which the charges of powder were poured from tin cans into the pockets, 18 pounds in each, after which the organ-handle trimmed plugs were quickly screwed into place again. Into the pocket nearest the breech was put powder in grains as big as peas; into the second pocket grains half as large; into the third grains not more than quartered peas in size, and in the fourth pocket ordinary musket powder was used. Those gradations in size were made because the finer powder grains are the more quickly they burn, and it is desirable to have a rapidity of gas development in the bore of the gun proportionate to the constantly and swiftly accelerating speed of the moving projectile. When the pockets were charged the breech was thrown open, and, through a copper shield, or guide, to carry it accurately into place, a conical shot—iron, banded with copper to take the rifling—weighing 110 pounds, having been daubed with grease and plumbago, was shoved into place, and solidly rammed to the shoulder at the end of the breech chamber, where it must begin to be compressed to take the rifling. Behind it was fitted a gas-check wad, composed of disks of sole leather and copper, and greased like the shot. Last of all was slid into place a coarse flannel bag holding 15 pounds of powder in hexagonal grains as big as hickory nuts. Then the breech was closed and locked, a cannon primer, with electric wires attached, was shoved into a small central hole in the breech, and Capt. Starring ordered everybody into the bombproof.

There were eighteen men in that bombproof, which is a subterranean construction of enormous timbers, over which many feet of sand and gravel are heaped. The reporter fired the big gun, by permission of Major McKee. To do so he simply had to press a little ivory button in a box on the wall. There was a dull roar, nothing like so loud as had been expected by those who now heard it for the first time. But the recoil of the steel and iron mass from that shot was four and a half feet. Of the two frames of electric wires, 100 feet apart, between the muzzle of the gun and the heavy barricade backed with sand which catches and saves the shot, the first was blown out, cleared of every wire; the second lost about half its wires.

The use of these frames is to test the velocity. Up in the office, under the careful scrutiny of Mr. Henry A. Sinclair, the electrician of the Board, are the velocity recording machines. There are two of them, to act as a check upon each other. Sometimes they differ a little. On the twentieth shot, for instance, one of them registered a velocity of 1,793 feet to the second and the other 1,789 feet. In such case the average is taken, and this shot went down at 1,791. The apparatus for measuring the flight of the ball is as simple as it is accurate. A heavy steel rod, covered with a thin tube of soft metal, is held up by one end by magnetic attraction. The breaking of the wires in the first frame cuts off the electrical current which destroys the attraction and the rod falls. When the ball goes through the second frame of wires, 100 feet behind the first, similar action takes place, and the dropping of a second rod liberates a knife that makes an indentation in the first falling rod. Another slight indentation is made by a second knife, liberated by a division of the current that drops the second rod, which by allowance for the time lost in the dropping of that short second rod to free its knife, gives accurately the time, resolved into distance between the slight nicks on the rod, of the flight of the ball through 100 feet of space. The time occupied in making that distance by the projectile that the reporter turned loose was thus discovered to have been just 0·055838 of a second, and from that it was easy to compute, by the aid of certain accepted tables, that the velocity of the ball was 1,791 per second.

Thus it was shown that the nineteenth shot fired, with its velocity of 1,832 feet per second, would have had a range of about 7½ miles; would have gone through 18·82 inches of solid wrought iron, and that an energy of 2,608 foot tons was developed for the tossing of it. Mr. Haskell expects that before these trials are ended his multicharge gun will throw a 155 lb. projectile fifteen miles, or through 24 inches of solid wrought iron armor.—*N. Y. Sun.*

CAST IRON VS. WROUGHT IRON SHAFTS.

Many users of shafts have a horror of cast iron shafts, and we find in most specifications, "to be made of best scrap iron, hammered." Now, consider how difficult it is to ensure this being carried out and to be relied upon. After the order gets into the forge you will generally find the scrap to make the shaft is piled indiscriminately from a quantity that has been bought from many sources. Some from shipbuilding yards, boiler yards, and smithies of all kind; much comes from abroad, where most of our common iron goes, and a lot is collected all over the country by scrap dealers, so the various kinds get generally grouped together. Then the lads usually employed pick up the pieces required from the ruck, picking those of most convenient shape to make and build up the required pile to size or weight required, and with no qualified supervision to select the best, even if it could be selected under such circumstances. The engineer who draws the specification usually submits to this, thinking perhaps that all scrap is good; or perhaps it is through the general idea that scrap is the best because some makers of good iron use up their own scrap, and hence sell it as extra quality in consequence of its undergoing an extra process. But it is well known amongst practical forge men that we do not get this in forged shafts.

Hence, it is contended that wrought iron scrap used to produce a large shaft loses its initial strength. If wrought iron is to be preferred for a shaft, it should be made by prepared iron from the puddling forge. This should be done by puddling best pig iron, and producing puddle balls ready for the hammer, and the iron should be puddled somewhat raw, as it is termed, meaning that somewhat more cinder should be left in, so as to be of use in the forgings to be made from it. It should, after hammering, be rolled into convenient sized square bars; these should then be fagotted together according as required, and so prepared for the heating furnace in the forge. The cinder thus left in the prepared puddle bars is then useful in liquifying the metal in its progress of producing the shaft, inasmuch as the iron heats more thoroughly through, and is not so liable to burn, and the iron from such bars works up in forging nearer to the approach of fibrous iron, as it would be if dry scrap were used, and therefore a much softer and thoroughly welding heat is produced—which is less liable to laminations, which is another most important matter, as these again often occur in wrought shafts—and a more nearly homogeneous piece of iron in the shape of a forging obtained. The difference in the strength of wrought and cast iron to resist torsion is not so much as other modes of applying the strains or loads. From various torsional tests some give about the following: Wrought iron, 12,063 lb., and cast iron, 11,943 lb. per square inch, the difference being only 120 lb.

In the manufacture of cast iron shafts good iron of equal quality can be obtained throughout without any difficulty, and in melting its strength can be very materially increased with ordinary care. It is well known, that where air furnaces are in use for foundry purposes, to produce large castings, such as shafts and rolls for rolling, armor plates, and steel and iron generally, the air furnace is always used. Large rolls cannot be made with any degree of reliance by means of melting with a cupola; and when melted in the air furnace castings are much stronger, more dense, and have the maximum wear. These—the rolls—are always cast vertical, and the shafts, too, should be where there is the proper convenience, and, in addition to the vertical column of metal forming the casting, a large and high head of metal is cast on its top—which is afterwards cut off—to assist in producing the density, and also for facility in feeding the casting during the process of its shrinkage and cooling. One may say, is not the iron in process of melting liable to become burned by overheating? The answer is, no, with the most ordinary care and skill. Iron can be melted in the air furnace without being burned, and by this process it is much improved in density, toughness, and strength; whereas wrought iron, being subject to so many contingencies of overheating and all the concomitants enumerated, becomes entirely changed and reduced from what wrought iron should be in its ordinary state, to a weak, unreliable, and unsafe material when manufactured into large bodies by heating and hammering. The writer has known a few instances over a long period of years in which cast iron shafts which had been at work very many years, having heavy work to do, have broken and been replaced by wrought iron ones, but these have very soon succumbed to the heavy work, and been again replaced, this time by cast iron ones, with success. Until somewhat of late years cast iron shafts were generally used in the driving of heavy rolling mills and forges in Staffordshire and all over the country with the greatest success, and it will no doubt be admitted that there is no kind of machinery more subject to violent changes and strains than such machinery.

Just observe what cast iron rolls have to stand in rolling mills—say, for instance, a plate mill train. First there is the 300-horse power engine transmitting its power into a fly-wheel about 22 feet diameter and about 45 tons weight, running 48 revolutions per minute, then a pinion wheel on the fly shaft, bringing down the speed of the train of rolls to 24 revolutions per minute. All in full work, running empty, suddenly a plate of iron is put into the rolls, the strain being so great that instantly one can perceive the momentum of the fly-wheel reduced. Without running through any figures to ascertain what must have been the effect so to sensibly reduce the cumulative power of this great wheel and engines, it is apparent that the shafts must be undergoing an immense strain, especially the last from the prime mover, which is the second motion, or that immediately connected to the mill train. Then the whole train receives also these constant and severe shocks, *i. e.*, the coupling spindles, boxes, wobblers on rolls and roll neck bearings. There are occasional breakages of the first and second, the rolls rarely breaking from these constant and actual strains.

Large wrought scrap shafts become much weaker in the course of manufacture. Cast iron shafts, cast vertically from air-furnace, and made of good iron, very materially increase in strength in course of manufacture; or, to put it in other words, the wrought iron deteriorates while cast iron greatly improves in the process of manufacturing large masses—shafts, and such-like productions. Wrought bars of iron can be produced in small sizes of maximum strength, but not in large bodies, as previously mentioned; and as the tests are from 1in. bars of iron, it follows that, although wrought iron is the strongest in the tests, when worked up to large sizes the circumstances become entirely changed, and cast iron has practically the advantage in a most marked degree. Therefore, for large shafts, &c., the writer says, use cast iron for safety and economy.—*London Engineer.*

FUNNY WAY OF TESTING CASTINGS.

A foreign contemporary, whose name is purposely omitted, says:

"The practice of putting test pieces on very large castings is followed by not a few engineering firms. Usually these pieces are broken off with a sledge, and the only test obtained is that of the number of blows required for the purpose, and appearance of the fracture. If these pieces, instead of being, as they usually are, oblong in section, were made rectangular and sufficiently long to put a proper spanner on, a better result might be obtained. By putting a spring balance on to the handle of the wrench or spanner, twisting them off, and noting the pressure required for the work, a very definite idea could be obtained in regard to the character of the metal in every casting, and a step made toward more accurate testing of metals generally."

A test piece cast upon a large shape is not a correct exponent of the strength of the mass. The larger the body and the slower it cools, the coarser its crystals, and the weaker its structure or cohesion. A test piece an inch square, cast on a shape two feet square, or more, might be twenty-five per cent. stronger than the mass.

THE TRANSMISSION OF ENERGY.

Some few days ago, during a conversation with a friend, I remarked that I was going to give some lectures at the Society of Arts upon the transmission of energy, whereupon my friend inquired, "Is that the transmission of energy by electricity?" To this I replied, "No." The fact is that we have heard so much about electricity that I began to think it was time to recall attention to the fact that there are other means of performing mechanical operations.

Now, during the last ten or fifteen years, an entirely new aspect has been given to mechanics by the general recognition of the physical entity which we call energy, in different forms.

We recognize one thing under different forms in the raised hammer, the bent spring, the compressed air, the moving shot, the charged jar, the hot water in the boiler, and the separate existence of coal, corn, or metals, and oxygen. We see in the revolution of the shafts and the travel of belts in our mills, the passage of water, steam and air along pipes, the conveyance of coal, corn and metals, and the electric currents, the transmission of this same thing—energy—from one place to another; and in all mechanical actions we perceive but the change of form of the same thing.

Taking this general or energy point of view, we may get rid of all the complications arising from special purpose; and recognize nothing but the form of energy in its source, the distance it has to be transmitted, and the special form that must be given to it for its application. And this view, although not the best in which to study the special purpose of mechanics or contrivances, is of great importance, inasmuch as it has revealed many general laws, and many fundamental limits to the possibilities of extension in certain directions. My object in this lecture is to direct attention to some of the leading mechanical facts and limits revealed by this view. There is one general remark I would wish to make. I hope nothing I may say will be interpreted by my hearers into a prediction as to what may happen in the future. I shall try to deal with nothing but facts.

Science teaches us the results that will follow from a known condition of things; but there is always the unknown condition, the future effect of which no science can predict. You must have heard of the statement in 1837, that a steam voyage across the Atlantic was a physical impossibility, which was said to have been made by Dr. Lardner. What Dr. Lardner really stated, according to his own showing, was that such a voyage exceeded the then present limits of steam power. In this he was within the mark.

Although the terms energy and power are in familiar use, such use is seldom in strict accordance with their scientific meaning. In many ways the conception of energy has been rendered popular, but a clear idea of the relation of energy to power is difficult. This arises from the extreme generality of the terms; in any particular case the distinction is easy.

Power may be considered to be directed energy; and we may liken many forms of energy to an excited mob, while the directed forms are likened to a disciplined army. Energy in the form of heat is in the mob form; while energy in the form of a bent spring, or a raised weight, matter moving in one direction, or of electricity, is in the army form. In the one case we can bring the whole effect to bear in any direction, while in the other case we can only bring a certain portion to bear, depending on its concentration. Out of energy in the mob form we may extract a certain portion, depending on its intensity and surrounding circumstances, and it is only this portion which is available for mechanical operations. Now, energy, in what we may call its natural sources, has both these forms. All heat is in the mob form, hence all the energy of chemical separation, which can only be developed by combustion, is in the mob form; and this includes the energy stored in the medium of coal. The combustion of one pound of coal yields from ten to twelve million foot-pounds of energy in the mob form of heat; under no circumstances existing at present can all this be directed, nor have we a right, as is often done, to call this the power of coal. What the exact possible power is we do not know, but probably about four-fifths of this; that is to say, from eight to ten million foot-pounds of energy per pound of coal is the extreme limit it can yield under the present conditions of temperature at the earth's surface. But before this energy becomes power, it must be directed. This direction is at present performed by the steam engine, which is the best instrument art has yet devised, but the efficiency of which is limited by the fact that before the very intense mob energy of the fire is at all directed, it has to be allowed to pass into the less intense mob energy of hot water or steam. The relative intensity of these energies are something like twenty-five to nine. The very first operation of the steam engine is to diminish the directable portion of the energy of the pound of coal from nine millions to three millions. In addition to this, there are necessary wastes of directable energy, and a considerable expenditure of already directed energy in the necessary mechanical operations. The result is that, as the limit, in the very highest class engines the pound of coal yields about one and a half millions of foot-pounds; in what are called "first-class engines," such as the compound engines on steamboats, the pound of coal yields one million, and in the majority of engines, about five or six thousand foot pounds. These quantities have been largely increased during the last few years; as far as science can predict they are open to a further increase. In the steam engine art is limited to its three million foot-pounds per pound of coal; but gas engines have already made a new departure, and there seems no reason why art should stop short of a large portion of the nine millions.—PROFESSOR OSBORNE REYNOLDS.

ENGLISH IDEAS OF AMERICAN MECHANICS.

We took up an English technical paper recently and found in it an article entitled, "*The True State of American Industry,*" and it is such a singular exhibition of a want of information upon the subject that we make a few extracts for the amusement of our readers. We quote:

> "We have for a long time held the opinion that the social status of the working classes was better in this country than in either America or the Australasian colonies. It is true that the nominal rate of wages is higher, but the purchasing power of money is far less than in England, and the unsteadiness of employment, excepting for a few leading hands, is far greater also; and it is no uncommon thing, even in what are called good times, for steady and good workmen to be out of work for one third or even half of the year. This, combined with expensive living rates and high rentals, brings down the yearly income to something far less than the nominal rate of wages would lead one to expect."

We may be in error ourselves, but so far as our reading goes we were not aware that English mechanics had any social status in their own country. This word, or expression, is a misleading one, but it is our contemporary's. Certainly, all later English authors and writers make the down-trodden and abject condition of English workmen sufficiently plain to the most casual readers. The great cotton spinning districts in Manchester, described by Dickens, Reade, etc., as to the want and misery in them, have no parallel in this country anywhere. We quote again:

> "Perhaps the most iniquitous proceeding to which American employers are addicted is that known as 'black-listing.' A correspondent in the cotton manufacturing district recently wrote to us and informed us that this practice consists in each employer putting down the name of any person against whom he holds a real or imaginary grudge. The lists of all such employees are then printed or written in a single sheet and circulated amongst all the employers, who bind themselves to give work to no person whose name appears on the 'black list.' A somewhat similar practice obtains in our southern colonies, and we have known of men having been literally hunted to the verge of starvation. Such an infamous proceeding is unknown in this country, and we have yet to meet with a case where private feelings have operated to prevent future employment When a workman is discharged in our own free country, nothing is attempted which will interfere with his future welfare. Great things are said of American education, and yet it is stated that so great is the difficulty of obtaining a livelihood, that even so far west as Chicago nearly half the children attend no school, being compelled to assist their parents to exist, and pauperism is rapidly growing, over 6,000 being returned for five States alone. It is indeed quite clear in the States that the condition of the working class is daily becoming more deplorable, and it would appear that they are becoming alive to the fact that whilst the articles they have to buy are enhanced in price by heavy protective duties, the only article which is in their power to sell—namely, their labor, skilled or unskilled—is admitted freely and without stint, to compete in the open market with those who, out of its price, are compelled to purchase in the dearest. That such a condition of things can exist in a country whose traveling representatives and a large proportion of whose press proclaim as a land of freedom, is really marvellous"

This is not satire. The writer evidently believes what he says, but it is strange that any one with education enough to write his own name should be so credulous. His views, however, seem to conflict with those of one of his countrymen, Hon. Thomas Burt, to wit, who is now on a visit to this country. Mr. Burt was a coal-miner, who rose by his own industry, and he said in a recent address at Pittsburg:

> "In the United States labor is better remunerated than in the old country. In England no man can make a fortune simply by the labor of his own hands; he is lucky in the end if he escapes ending his days in the workhouse. The working classes in the United States enjoy all the educational advantages that the wealthy people of the old country alone can command."

THE UNFORTUNATE AUSTRAL.

The *Austral* is a new ship; she has three cylinder engines. According to Captain Murdoch they were in a dreadful state when the ship reached Sydney. Here are his words: "The engines had all gone to pieces on the voyage out and there were heavy repairs to be done. The forward length of shafting had a heavy flaw in it. The high-pressure and the two low-pressure pistons were cracked. The high-pressure valve gear was completely useless. They were trying a little patent with regard to rings inside the valves, and the low-pressure valve gear was in very bad order. When the high-pressure valve gear gave out it broke the cross-head." We are told that the chief engineer was a highly competent man. We can believe it, but we cannot help asking how it is that new engines went to rack and ruin as these did? It is not easy to understand how so much mischief could have happened in the time. Messrs. Elder & Co., the builders of the engines, are always extremely reticent about their work. They never permit the outer world of engineers to know much about the proportions they adopt, and criticism is, of course, easily baffled in this way. If such a thing had happened in a man-of-war we would not have been surprised, because it is well known that men-of-war are engined at enormous cost on very peculiar principles, and the engines never have fair play; but the breaking of anything but a crank or propeller shaft is so rare in the merchant service that this failure of the *Austral's* engines cannot be passed over in silence. When pistons are broken it is usually the result of priming. Was this the case with the *Austral?* This is only one of many questions that may and will be asked. Whether they will obtain answers or not remains to be seen. It is well known that a certain amount of reticence is observed concerning the performance of the machinery of most of our great ocean steamers, but we are willing to believe that the cracking of three pistons, the flawing of a crank shaft, and the ruin of the valve gear do not often all occur on the same voyage. We believe the *Austral* has got piston valves. There have always been grave doubts among engineers as to their excellence. The experience had with them on board the *Austral* is not reassuring.—*London Engineer.*

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which, with one exception, make a reduction in their rates in connection with us. All complaints of irregularity in receiving other papers must be made directly to the publishers of them, not to us.

	Publication Price per Year.	With The Mechanical Engineer.
Railroad Gazette	$4.20	$5.25
Scientific American	3.20	4.40
North-Western Miller	2.00	3.80
American Miller	1 00	2.50
Modern Miller	1.00	2.50
Builder and Wood-Worker,	1.00	2.40
Manufacturer and Builder,	2.00	2.50
American Machinist	2 50	3 50
Trade Review	3.00	4.30
North-Western Lumberman,	4 00	4.80

We have heard of firing tallow candles through boards, but the following yarn eclipses that performance. Speaking of a runaway locomotive, a contemporary says:

> "Meeting with no obstruction on the way, it plunged into the depot at a rate of speed estimated at 60 miles an hour. The first obstacle encountered was the heavy bunter at the end of the track, which was torn up and lodged on the cowcatcher; it next tore up the planking and beams of the floor and demolished one end of the baggage house; it next encountered a brick partition about 18 inches thick, which was scattered in all directions; after passing through this wall it traversed the length of the express office, and struck the outside wall of the depot *with such force as to drive the bunter which had lodged on the cowcatcher, clear through a solid granite rock a foot in thickness, making a hole about* 15 *inches in diameter.* This put a stop to its progress in that direction, and as the floor was not strong enough to longer hold the weight, the whole mass broke through into the cellar, where it came to a standstill."

Naturally the locomotive came to a standstill after falling into a cellar, but we don't believe the granite rock business.

Messrs. Weems had a curious experience in the attempt to produce brass tubing by hydraulic pressure, says the *London Engineer.* For this purpose they constructed a water press with a 33 in. ram. It was found that when the brass block out of which the pipe was to be formed was subjected to a pressure of 4,000 tons, the zinc left the copper, thereby producing a zinc pipe and leaving the copper behind. This result, which was surprising and unexpected, formed really a contribution to science, by proving that the atoms of the brass composition united together by fusion were only mechanically arranged, and not chemically combined; practically demonstrating the truth of the atomic theory of Professor Tyndall, that in compound substances the component materials were held together by pressure, and could thereby be separated by greater pressure.

Spontaneous outburst from a friend in Ohio, showing how he derived a false impression from The Mechanical Engineer:

> "I thought, when I first subscribed for The Mechanical Engineer, that it was just the thing for an engineer's brain to be packed with and that it could not be better. but I was wrong; it is getting better all the time, and the Lord knows where you will land us all if you keep on the same tack. Keep her on it, anyway!"

We will, we will!

THE MECHANICAL ENGINEER FOR 1884.

In return for the many favors accorded us in the past by the trades we represent, we put forth renewed energy to merit a continuance of the good will shown. To this end we announce the following serials, which will appear in all of 1884.

HOW I SERVED MY APPRENTICESHIP.

This will run through many issues, and is an account of an actual service by a mechanical engineer now in charge of work. It deals with such matters as will be of interest to all in similar positions—not merely beginners, but others who have not had the fullest opportunities for informing themselves. The opening chapter takes a common wheel-press, such as is in use in every locomotive shop of any size, explains its principles and construction, the action and how to calculate its power. The problems are all in simple arithmetic and quite within the reach of mechanics. The style is easy and in narrative, so that, aside from its intrinsic worth, it is very entertaining.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks, of the University of Pennsylvania, will, in a series of papers, touch upon various points in the construction of steam engines, rendering the principles involved in their action clear to all. These papers will be as useful to designers and constructors as to working engineers, for the author will not follow others and expound text books already published, but reason from his own deductions and observation.

BOILER MANAGEMENT.

Under this head, Mr. A. H. Goff, a practical engineer of St. Louis, Mo., will give his experience with boilers of various kinds, as to the care and course to be pursued to insure the best results The author will consider the subject from a practical standpoint, so that persons in similar situations can apply the instruction conveyed if it seems good to them.

A SERIES BY H. L. STELLWAGEN, ESQ.

These papers cannot be announced definitely as to the title, but we have made an engagement with the author, who is an engineer of ability, to give our readers the benefit of his experience, and from his previous contributions we know that the writer will both interest and instruct us.

In addition to these positive announcements, we shall have many other short papers through the year, which will be of permanent value. The Indicator Series, now publishing, will be continued well into 1884. and all who wish to know what their engines are doing as well as inform themselves upon the use of an instrument indispensable in every engine-room, should not fail to renew for 1884.

Locomotive work will have special attention in construction and management on the road. The success which has attended the efforts of the publishers during the past year is evidence to them that their enterprise will be supported, and the very considerable outlay involved in the serial papers announced above—all of which are paid for—is some evidence of an intention to deserve the reputation for practical value to workers in its line The Mechanical Engineer has won.

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Ten Subscriptions,	"	1 60
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One copy free to the party who organizes a club of ten or more names.

Egbert P. Watson & Son, 150 Nassau St., N. Y.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
W. Barnet Le Van, 3607 Baring Street, Phila,, Pa.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. John Beoker, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering Send for catalogue before purchasing. F. Keppy, Publisher, Bridgeport, Conn.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

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THE MECHANICAL ENGINEER.

New Series. Vol. VI.—No. 12.
Enlarged 1883.

New York, December 8, 1883.

Single Copies 8 Cents.
$2.00 per Annum.

HAYS' AUTOMATIC-PUMP STEAM ENGINE LUBRICATOR.

The engraving subjoined represents a novel form of lubricator for steam engines, which merits more than a passing glance. Externally it is not unlike other devices for the purpose in that it has a glass reservoir to contain the oil forced in, but here the likeness stops, for instead of depending upon the action of currents of steam, or a balance of pressures, to convey the oil to the cylinder and valves, it is forced in exactly as water is fed to the boiler. This system is insured by the same device generally used for that purpose; to wit, a plunger pump contained in a small space in the instrument, as shown herewith. The pump proper is contained within the glass resevoir, *G*, as shown, and the plunger, *K*, which operates it, extends, down into the globe-valve, *N*, so that it can be examined at all times to see if it works properly. The globe-valve connects, by a nipple, to the cylinder, and steam acting on the end of the plunger at each stroke forces it up. On the return stroke the plunger is operated in the other direction by the spring, *I*. This is, in brief, the construction of the apparatus, and its action will be readily seen by engineers. The oil is forced directly into the steam-pipe through the feed-pipe, *C*, and carried on to the valve-seat, and into the cylinder. The amount fed in can be regulated at will, and when the engine stops the feed stops at once. We deem this a most useful lubricator and one that will give satisfaction wherever applied. Its reasonable price is also greatly in its favor. Address the manufacturers, JARECKI, HAYS & Co., Erie, Pa., for price lists.

FIRE-BRICK FURNACES.

In regard to fire-brick furnaces for marine boilers, the *London Engineer* says :

> "'The type of boiler,' we are told, 'is new to the naval service, but is in successful operation in merchant steamers.' We should very much like to be told in what merchant steamers. Certainly not in any British ship. The *Chicago* will have no fewer than fourteen boilers, each nine feet in diameter by nine feet ten inches long, set over a single furnace, with one grate seven feet eight inches wide and seven feet six inches long. The shells are to be five-eighth inches thick, and the pressure is to be 100 pounds. To go to sea with such boilers is simply to court destruction. If the fires are ever urged such boilers will prime furiously. If from any cause the plates over the furnaces become overheated they will crack, and the result may be anticipated. Nothing could be more injudicious than the use of furuaces made up with plates and fire-bricks in a sea-going man-of-war."

Our contemporary argues in the face of facts. The fire-brick furnaces were put in the *Louisiana* as a temporary device, and with the expectation that they would give out in a short time. They did so well that they were retained, and have now been some two years in service, with such satisfactory results that they will be applied to new boilers in the future.

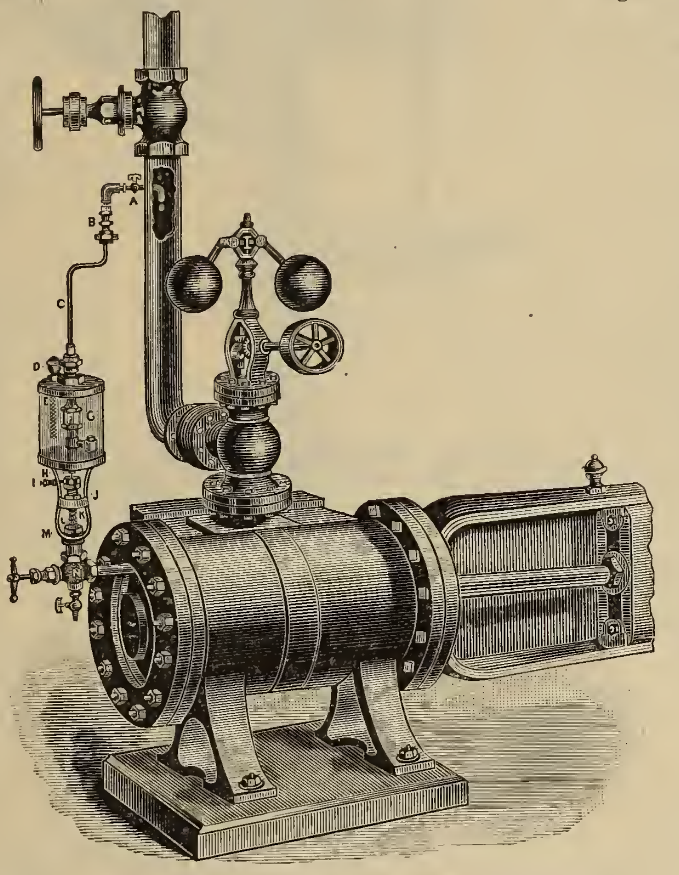
THE WINDMILL AS A PRIME MOVER, is the title of a new work in press of John Wiley & Sons, N. Y., by Alfred R. Wolff. The author is a professional engineer of ability, and what is rare, with literary talent of a high order. Although the subject in itself is not what might be called popular, we have no doubt but that Mr. Wolff will be able to present facts of value to those using and needing small powers.

* * *

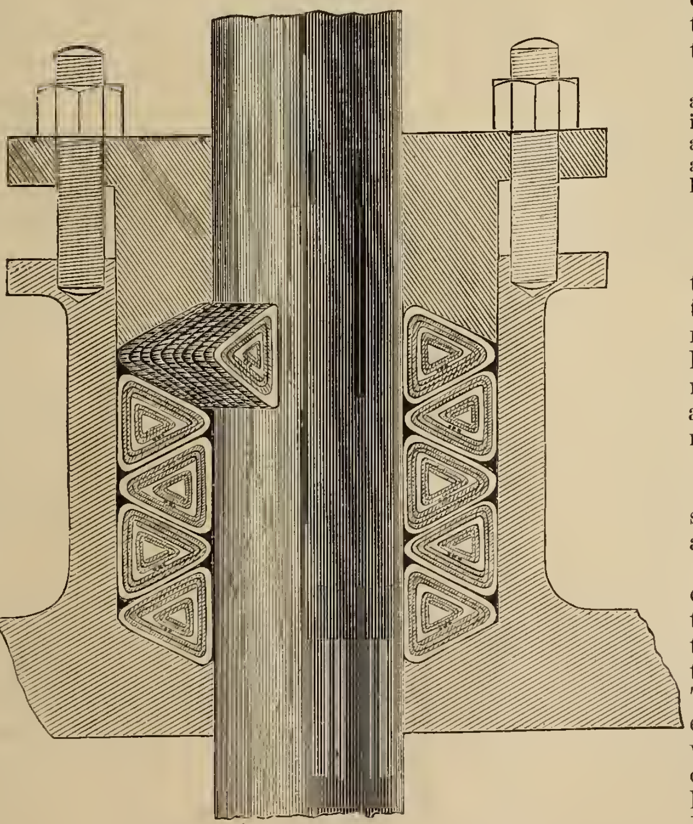
APPLICATIONS FOR NEW CHARTERS for Stationary Engineers' Associations have come from four new parties this month, Atchison, Kansas, Warrensburg, Mo.; Omaha (No. 1) Neb., and Fall River, Mass.

AT THE DAL VERME Theatre, in Milan, recently, an American named Shepherd created a great sensation by appearing with a luminous scarf-pin, which was nothing more nor less than a tiny electric lamp, warranted to go for five hours, by means of a small generator concealed in the waistcoat pocket.

* * *



NEW AUTOMATIC-PUMP LUBRICATOR FOR STEAM ENGINES.



KATZENSTEIN'S NEW METALLIC PACKING.

KATZENSTEIN'S PATENT, TUBULAR, FLEXIBLE, METALLIC-PACKING.

The engraving represents a new form of metallic-packing, which has peculiar features, notwithstanding its metallic character it is adapted to use in ordinary stuffing-boxes, and requires no special arrangements or devices to render it available in all situations. Its construction is such that the fluid under pressure, whether air, water, or steam, finds access to a portion of the packing, and instead of forcing past it, as it generally does, aids in making the joint on the working surfaces. In form, the packing is triangular, as shown, and it is constructed of sheet brass, as to the internal tube, which is also wrapped with a soft white metal wire externally, and alternately, as shown in the engraving, the whole being covered with asbestos, or soft white metal, as desired. The packing is put in rings or sections, breaking joint with each course, and the inner tube is so constructed that the edges overlap instead of forming a butt joint. By this means it can expand and contract under pressures, and fill almost any shape of rod or box.

This packing has been tested in many places and found to answer the purpose as an economical and durable article. L. Katzenstein & Co., 169 Christopher Street, New York, are the manufacturers.

IT IS AMUSING to observe the innocent manner in which certain Western trade-journals systematically publish articles purporting to be written for their columns by William M. Barr, but in reality copied from his books on engineering matters published years ago. Doubtless there may be readers whom such transparent proceedings may for a time impose upon, but it is satisfactory to know that the truth generally catches up in the end—*American Machinist*.

Well, what of it? It takes very little to amuse some. Mr. Barr's sayings or opinions are none the less correct for having been written years ago. None of these journals say the articles were written for them.

AMERICAN ENGINEERS will think the statement appended a remarkable one. It is from the *London Engineer*, and occurs in a letter written by a very positive gentleman concerning some engine tests. He says:

> "I dispute both, because I know there is not an engine in Birmingham, fairly tested, but what is taking double 2 lb per horse-power per hour and the great m·jority of engines working here are consuming 5, 6, 7, and up to 10 and 12 lb. per horse-power per hour.
>
> JOHN SWIFT.
> Ayrfield, Stanmore road, Edgbaston, Eng.

Does Mr. Swift wish his coadjutors on this side of the world to understand that there are *no* compound engines, or automatic engines in Birmingham under 4 lbs. of coal per H. P. per hour? Common slide valve engines may take any amount of coal, but we fear there is some mistake in the facts as to others.

HERE IS AN EXTRACT from a recent consular report, which carries its own moral and needs no microscope to discover it:

"Imitation Swedish iron is an article of commerce manufactured in England for the India and China markets, and, beyond the name, it usually bears no resemblance to the article it is supposed to imitate. The Chinese like a good soft iron that is easily worked, but they have been deluded with the commonest rubbish that is produced. At length John Chinaman has kicked, and having discovered a remedy he prefers good scrap to badly finished iron. In the economy of business it is impossible to injure another without injuring one's self, and those who have palmed off spurious iron on the unfortunate Chinese have now leisure to repent of their having closed what should have been a good market for good iron."

* * *

PARTIES HAVING CLUBS in hand will oblige us by forwarding them without delay, if the Indicator articles from the beginning are wanted.

A NOVELTY IN DRILLING MACHINES.

What may be termed a novelty in drilling machines is here illustrated. Its chief peculiarity is that there is not a gear about it, the motion being conveyed to the spindle by belts, from pulleys ample in capacity to drive drills from one-sixteenth to one inch diameter in all material. The machine is noiseless in operation; in itself a most desirable feature. The engraving explains its construction so clearly to all likely to be interested in it, that we do not think it necessary to point out details.

The dimensions and capacity of this tool are as follows:

It has power feed of three gradations, controlled by automatic stop motion; also sensitive (adjustable) lever-feed with depth gauge attachment. The drilling spindle is of improved construction, driven by patent round belting, and the driving cone has four changes, covering all ranges of speed.

This machine has a patent leveling device for drilling table, large base plate, eccentric belt tightener, patent balance spindle, with a vertical traverse of eight inches, and quick return motion, also improved oil reservoirs for automatically lubricating the spindle collars.

The machine will receive work 20 inches in height on table, and 30 inches on base; it admits 9 inches between center of spindle and face of rack, or will drill to the center of a 25 inch circle on base. The circular table revolves on a trunnion and has a vertical run of 18 inches on the column. It is furnished with countershaft, wrenches, and sockets for taper shank drills from $\frac{1}{4}$ to $\frac{7}{8}$ inch diameter; also patent coupled belt as shown. Drills, and adjustable chuck (for drills less than $\frac{1}{4}$ inch diameter) furnished when ordered, at extra cost, made in three sizes, with or without back-gears.

Address the Putnam Tool Company, S. W. Putnam's Sons, Fitchburg, Mass., for price lists.

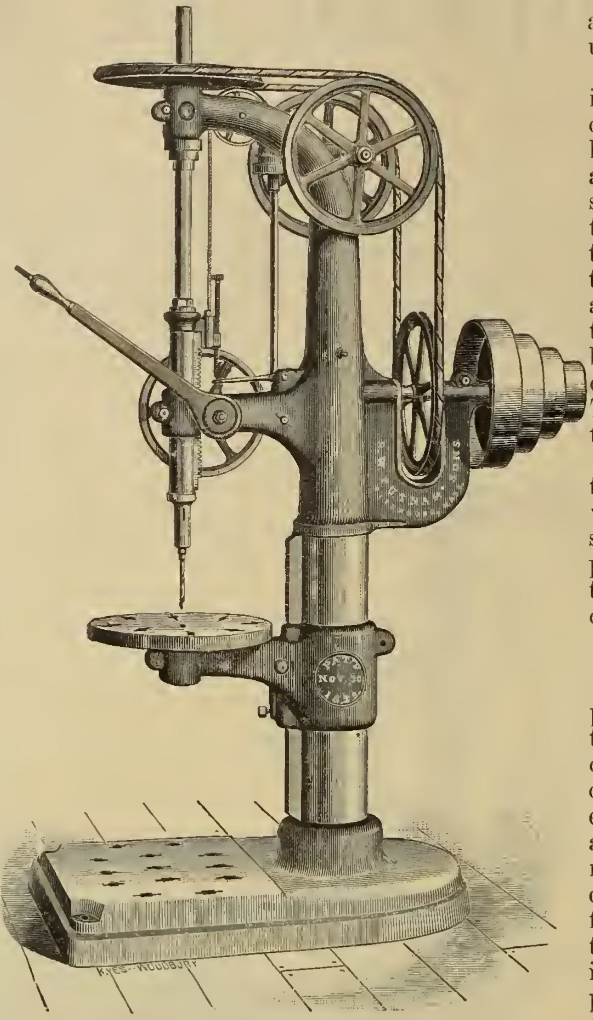
A TIMELY ARTICLE.

We are sure our readers will appreciate President Reid's timely article on laying an engine up for the winter, as much as we do. His experience covers thirty odd years, with a record for care and attention to his business, which has been learned by the exercise of these qualities. We note particularly in his article above, he says, that he leaves everything in order behind him, so that in the event of a stranger filling his place, through the chances of life, he will have no trouble.

This is admirable forethought, and shows that Mr. Reid has a thorough comprehension of the value of a reputation, and knows how to preserve it. Whoever comes after him will find his place swept and garnished ready to step in. Very many engineers will profit by Mr. Reid's instructions.

"Consistency thou art a jewel." A few months ago the editor of an Eastern trade paper set out to capture all the engineers in the United States and to that end engaged the services of some of the officers of associations to canvass among them. Not succeeding in his attempts to run the associations and have his candidate elected as President, he waxed wroth and demanded that his canvassers withdraw from all connection with engineers' associations on penalty of being dismissed from the paper. One of them, at least, was man enough to resent such interference with the liberty of the subject, and proposed to retain his own individuality, and he was therefore dismissed. Sometimes we hear of bulldozing in the Southern States, and in a few instances of employers demanding the votes of employees for this or that political candidate, but this is the first time we have heard of a man being discharged for the very reason that he was employed. "Conscience," says the poet, "makes cowards of us all," but he unfortunately omits to say what a want of consistency and manliness makes of those who abandon these virtues. It makes a man so little that the passing cur would scarcely lift a limb against him.

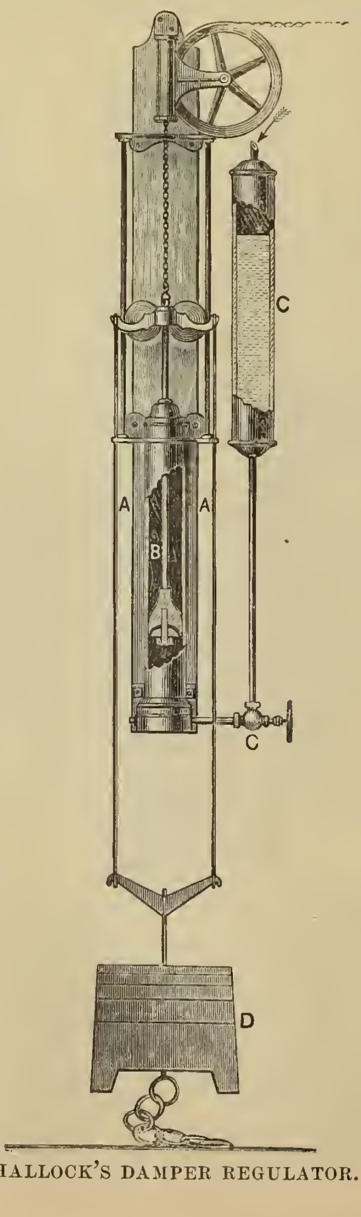
England has 200 bicycle makers, who turn out 50,000 machines a year.



A NOVEL DRILLING MACHINE.

HALLOCK'S DAMPER REGULATOR.

A new and positive device for regulating the dampers of steam boilers, and consequently the evaporation, is herewith illustrated. As will be seen, it is very simple in construction, and its details are conventional in design and character, so that they are easily understood as to their action and management by every one liable to use them.



HALLOCK'S DAMPER REGULATOR.

The apparatus consists of a cylinder, *A*, and its piston, *B*, to the rod of which the chain operating the damper is connected. This rod has also a cross head to the ends of which rods are attached carrying weights, *D*. On the right side is a water column, *C*, which connects with the boiler through a steam pipe entering at the top, and with the cylinder at the bottom through the pipe shown. This is the arrangement, and an engineer will see at once that the position of the damper depends upon the pressure in the boiler. As the pressure rises the piston also rises, closing the damper more or less as required. The pressure carried in the boiler is regulated by the amount of weights applied at *D*.

The advantages of these devices are obvious to all, especially in flour mills and other places where a regular speed is desirable. A catalogue showing the method of working, as also the parties using it, will be sent on application to the Hallock Damper Regulator Company, foot of Taylor Street, Brooklyn, N. Y.

One of the most remarkable uses to which paper has been put of late years is the manufacture of zylonite, a substance which, at the will of the manufacturer, may be made in imitation of horn, rubber, ivory, tortoise shell, amber and even glass. The uses to which zylonite are adaptable are almost infinite, but perhaps the most extraordinary is the manufacture of cathedral windows. The discovery was made about fifteen years ago, but it is only within the last two years that a company has been formed for its manufacture. The basis of zylonite is a plain white tissue paper made from cotton or cotton and linen rags. The paper is treated first to a bath of sulphuric and other acids, undergoing a chemical change. The acid is then carefully washed out and the paper treated with another preparation of alcohol and camphor, assuming an appearance very much like parchment. It is then capable of being worked up into plates of any thickness, rendered almost perfectly transparent, or given any of the brilliant colors that silk will take. It is much more flexible than either horn or ivory, and less brittle. Combs or other articles made of it in imitation of tortoise shell are said to be so perfect in appearance as to deceive the eye of the most practiced workman in that substance. The difference in the material can be detected only by tests.

ATTENTION! SECRETARIES OF SUBORDINATE ASSOCIATIONS.

During the first week in December I shall mail report books, and you will confer a favor if you will make up your report after the last meeting in December, and forward to me so I can give my report to the press as early in 1884 as possible.

Hereafter all applying for Charter, and all secretaries should make their drafts and money orders payable to Geo. M. Barker, Nashville, Tenn., but first send them to me so that I can credit them with the same. By so doing a needless expense will be saved.

Constitutions and Minutes sent upon application.

A. M. Davy, *Sec.*

The weight of an ax, says an experienced Eau Claire logger, is arbitrary, and dependent upon the purpose intended. If the object to be cut is small timber, which may be severed at half a dozen blows, an ax with a long, thin blade, and little bevel is chosen, and at every stroke the blade is buried to the helve. Another lumberman says if the purpose be to fell large trees or cut heavy timbers, an ax having a thick, heavy bevel is selected. The bevel, acting as a wedge, forces out the chip at the same stroke by which the incision is made.—*Northwestern Lumberman.*

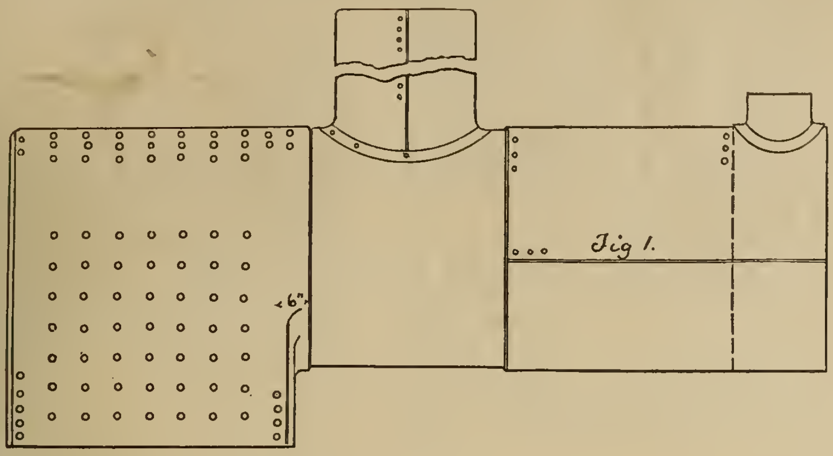
The people of this State do not indorse the opinion of the *Iron Age* that convict labor opposed to free labor is "purely imaginary" in its evils. At the last elections they voted unanimously against convict labor,

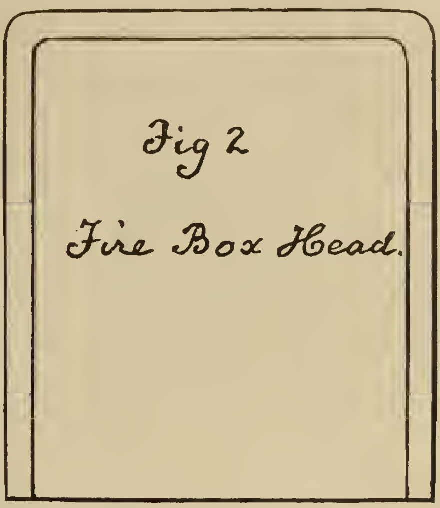
DRAWINGS FOR A LOCOMOTIVE BOILER.

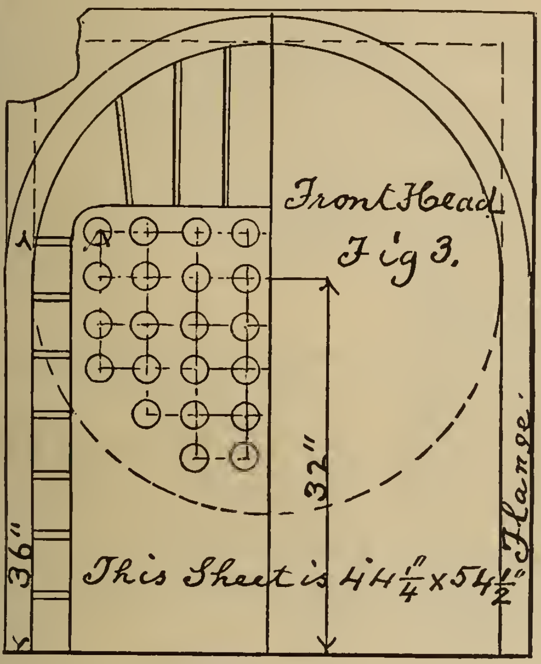
I send you a draft of a locomotive-shaped boiler and iron for it. The figured sizes are right. I have made it on a scale of ¾" to the foot, as near as I could come at it with a 2 foot rule, not having a scale-rule at hand. There are a good many who, by not knowing how to work economically on a boiler, lose work. The foreman boiler-maker may be a good workman and still not know how to give a close estimate. I have been over the country pretty much, in large and small shops, and I know there is a great difference in the way each works. There is a good deal of labor saved in punching all the holes in the straight sheet and in getting out iron with as little waste as possible.

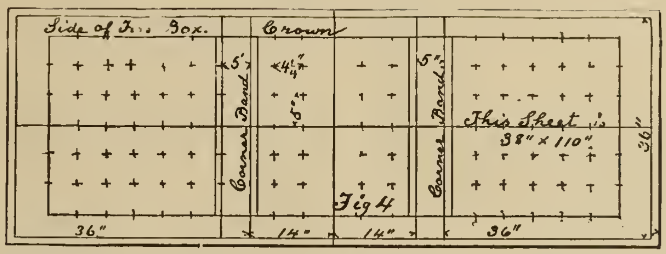
These sketches, as will be seen, show all single riveted seams, and the sheets explain themselves. The front head, when I am laying it out, I draw half of the fire-box on it and connection, or throat sheet, so I can see how my tubes and stay-bolts are going to come in. (See Fig. 2.)

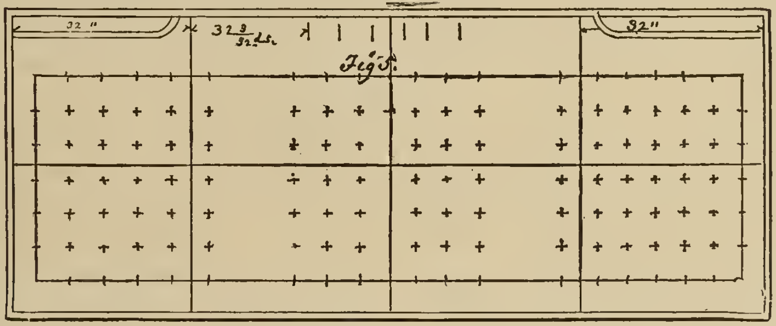
Figure 3 shows the fire-box head. I mark the corners from a 3" radius, as that will allow the roller to bend easy corners on the fire-box sheet. I lay out the stay-bolt holes for the sides 3" away from the line of rivet-holes, so they don't come in the way of the flange of the head. When there are 3" water-spaces the holes in the outside shell will have to be 6" from line of rivet-holes on the top, or crown. The holes will run, as the curve lengthens them out. These will go 4½, 5¼ and 6" between them one way, but still be 5" the other. (See Fig. 4). In laying out the dome holes, I draw a line in center of where I am going to put it and one on each side, half the diameter, or where the holes in the flange of the dome will come. (See Fig. 6.) Draw a segment of the boiler as wide as the dome holes will come and ¼ of the dome circle; that is if I am putting on a 24" dome where the holes will come, it will be 26", that is 1" from the outside of dome to center of holes (if there is no more than a 2" flange on dome), and space off into as many parts as I want them, then lay the square so it will touch the points and lay even on bottom line, then draw perpendiculars. I then take the dividers and span from 1 to 2, and afterwards lay it on the lines, *B* and *C*, and strike 1, 1, 2, 2, then back to the 40" circle, and space from 2 to 3, lay it on the lines, *B* and *C*. (See sketch 2,2, 3, 3.) After drawing the lines I set the dividers from *A* to *E*, and strike from horizontal line *A*, 2, 2, 2, 2 on each side.

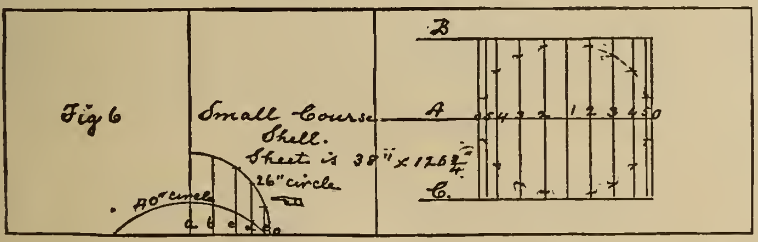


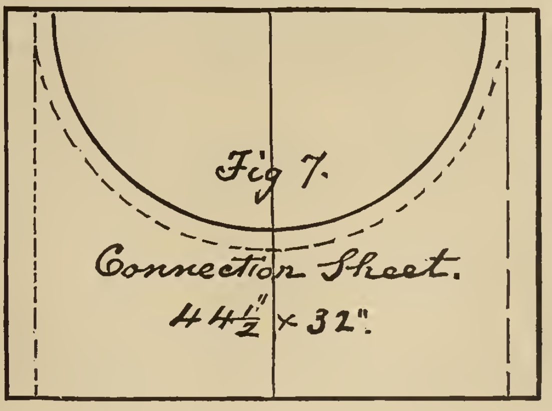


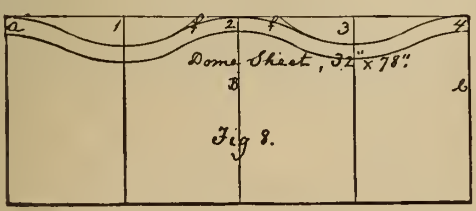


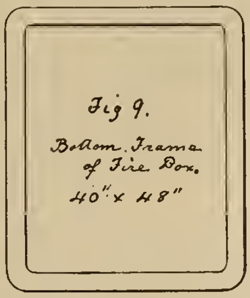


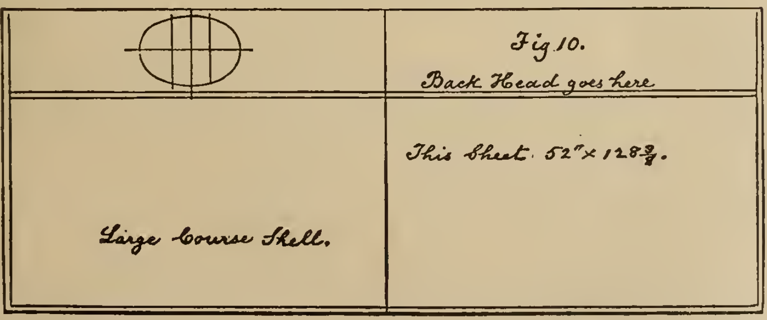


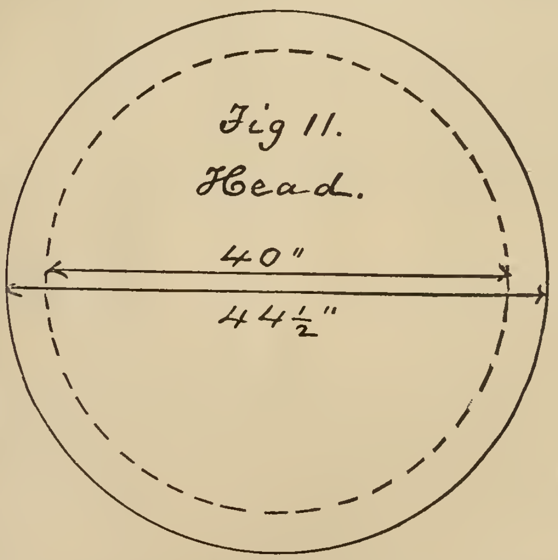












After striking all the points I draw the curves and that gives the line of holes. The holes in shell-sheet will be 36" in small course; in large course 37"; the head will be an inch back to allow for flange, and 6" to inside of fire-box head, or tube-sheet, making 78" the length of tubes and 15" for smoke-box.

The boiler will be 40" diameter, 11' 6" long over all; solid frames for door and bottom made of 2"×3" bar iron. The fire-box will be 42" long, 34" wide, and 39" high. There are forty-two 3" tubes.

BOILER-MAKER.
NEW YORK.

THE WESTINGHOUSE MACHINE CO. of Pittsburgh during the month of October shipped seventy-three engines representing nearly $50,000. Their new orders during the same month aggregated over 2,000 Horse Power. If it is true that activity in the engine business is a sure index of a general activity in manufactures, there is very little in the above to encourage a pessimistic view of the business prospect.

AS REGARDS decay, cypress wood is practically indestructible.

WOOD-WOOL IS NOW used for dressing wounds in surgery. It is very absorbent, as delicate as cotton, and very cheap; it will absorb twelve times its weight of water, being sponge-like in this particular.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

ENGINES OF THE NEW CRUISER "CHICAGO."

Editors MECHANICAL ENGINEER:

In your issue of Nov. 24th, you give an illustration of the engines of the new Cruiser "Chicago," which I think provokes severe criticism, for a worse design in some respects I never saw, your illustration only gives the side elevation, but I have seen in the "Proceedings of the Naval Institute," a plan view also.

In the first place, the cranks have no counter-balances, and to look at those enormous crank pins, counter-balancing would be of great advantage, especially as 80 revolutions are expected to be obtained; I say no good designer would have omitted counter-balances.

2d. The eccentrics are actually placed on the outside of the couplings, instead of upon the shaft itself, this may appear impossible, but I am sure I am not mistaken, for I have examined the illustrations carefully; they are, in size like enormous truck wheels. Think of the friction upon this outrageously increased surface, over what it should have been if properly placed!

3d. Please size the diameters of connecting-rods, or are they made hollow in the center ?

4th. Notice the bases of the supporting frames of the beam-pillow blocks, one of the feet is upon a column attached to a shaft pillow-block, subjected to but little change of temperature, therefore of a fixed height, while the other is upon the cylinder and steam chest casting, and is subjected to such changes of temperature as will increase the height from 3 16 to 1-4 inch. Either the bolts in the column must give way or the casting break. By this bad designing, the engines will probably be in several pieces by expansion, not provided for, before making a revolution.

5th. No good engineer would design working-beams "parabolic in form," these beams have too large ends, and are wanting in depth for the requisite strength at their middles, besides they are each made of two plates or sides, and have no provision to prevent the racking movement (when the engine is out of alignment), that occurs from one side having to sustain more engine power than the other; unless the designer relies upon keys in the center-pin there is nothing but the end pins to resist these strains, and if both of the above are used there is still a great lack of strength. Remember the center pin has double the engine power in pressure upon its journals at all times, and the beams need to be strong at their middle, or center of length.

6th. Your illustration leaves out the condenser, much to the advantage of the appearance of the design as a whole, for the engine, by the curious distribution of its parts extends entirely across the vessel, in a straggling disjointed manner. At all events compactness was not thought of. The air pumps are independent and may be very effective, but they are so placed as to carry out this straggling, I may say "long drawn out" design.

7th. The boilers are well known in our section of the country, how well they may work at sea, I am not competent to express an opinion about, except I might say they would have been more "removed from the element of danger and anxiety," had those back water-legs been left off entirely, with all their stay-bolts and flat surfaces, and more masonry employed instead of them; but fancy the brick layer being called in instead of the boiler-maker for repairs on this sample Cruiser!

Lastly: I think a beam engine preferable in many particulars to any horizontal engine, principally because the vertical cylinders and pistons have less frictional resistance, and are more easily taken apart for inspection and repair; this also applies to the other moving parts and connections, which, being in balance, contribute to a steady and uniform movement of the engine, an advantage, especially in high rotative speeds.

This design however outrages all those engineering principles, which contribute to make a successful working engine, and appears to me to be the work of a person who, if competent as a designing engineer, purposely sought to spoil it, or who is utterly ignorant of marine engineering, or in fact any other kind of engineering.

"DETROIT."

THE ENGINES OF THE NEW CRUISER. "CHICAGO."

Editors MECHANICAL ENGINEER:

I have always given credit to you heretofore for pursuing a fearless, independent course without regard to persons, places, or things, but if you know who designed the engines of the new Cruiser "Chicago," published in your last issue, and omitted to give his name intentionally I shall change my opinion. I think you have done yourself no credit in publishing such an engraving, and look upon it as the only blot in an otherwise splendid series of engravings of marine engines. I will, as a partial antidote to all this abuse, say that in an experience of many years in all parts of the habitable globe, and with all engineering papers, that I have never seen (and do not believe any one else has), such beautifully clear, distinct, and mechanically correct delineations of marine engines as you have given us.

Perhaps I should not blame you, for you did not design the "Chicago's" engines, but I want to fall foul of some one, for since I saw your paper I have made all in my vicinity unhappy by vigorous expressions.

Specific objections to these engines can scarcely be made in a letter, but let me note a few. Let me ask what material the frame is to be made of ? If it is vulcanized rubber I have nothing to say, other than that it would be a good material for the purpose; if it is cast iron I do not think it will answer. I also presume that there is a slip-joint in the after leg of the frame, near the crank shaft, which allows it to lift up and down occasionally, so as to compensate for the difference in temperature between it and the end which rests on the steam-chest. Possibly the steam-chest leg of the frame is made of asbestos, so that it will not get very warm! Also, what is the office of those immense things near the cranks? are they eccentrics, or what are they ? The valve motion I do not pretend to understand. It is fearfully devised, to the common mind. The leanness of the eccentric-rods and the fatness of the connecting-rods form a striking contrast with one another.

The engineer, it appears, has his station near the crank-pin, and conducts all his operations from that point, as I observe that the throttle and reversing gear are in this unusual position. Now if these defects are apparent from a mere picture of the engines, what might we not expect to find in the details of them? It seems to me that this must be a crude sketch of some one, not an experienced engineer, and to be regarded more as an engineering joke than anything else; it is a very poor one. I do not believe it can be seriously intended as a design

NEW YORK. HELIX.

CURIOSITIES FOUND IN ENGINE ROOMS.

Editors MECHANICAL ENGINEER:

I would like to call the attention of my brother engineers to an incident that I was witness of, in this city, which I think will interest them. They can see from it how our ranks are being filled, and how important it is for us to do all we can to help those worthy of help. and keep out such as I am about to speak of.

My business at the present time is such that it calls me among a great many engineers, and this is what I find in some places: The other day I met a man who was running an engine in one of our large factories that had just put in a second-hand engine. He found the cylinder cut very badly, and thinking that he could save the company some money, he went to work, and this is what he did. He got some pieces of grindstone large enough to hold in the hand, and had two men scour the cylinder till they got out the most of the scores. He then put in the piston and packed it with a hemp gasket to smooth up the cylinder, and then he intended to put in the rings, and it would be as good as it ever was. I told him that was a new trick to me, and I would like to be there when he put in the rings.

Now what do you think of such men in an engine-room, and what are we to do about it? There is one thing we can do, and that is to bring these facts before the public, and show manufacturers the loss they incur by employing such men. I think I can safely say that two thirds of our manufacturers are running their engines at a loss of from 25 to 30 per cent., and are willing to do so because they do not know any better. They have never paid over $10.00 or $12.00 per week, and would pay less if they could get a man to work for less; they say their expenses are so much that they must cut the pay down a little, and they have cut so often we cannot make a living, so, many go at anything that will pay them better.

Now I think if all who are advanced in the business, would try to help others, and get them to take some engineering paper, such as THE MECHANICAL ENGINEER, and get them interested in their work, they would soon look out for an advancement, and would help instead of holding us back, as they are now doing.

In another place I found a man that has been looking for a leak in a pipe for six months and cannot find it; he declares that he will have a new pipe put in if he has to pay for it himself. The leak is this; he is pumping cold water through a very hot room, and the pipe sweats, just the same as a pitcher with ice in it, in the summer-time ! He will have a nice time finding that leak.

In another place I found a man that takes old grain sacks, cuts them up and lays them up in eight strand square packing. A nice thing to pack a rod with, ain't it ? This man is running a 24×48 engine, does his own firing, puts in his own coal, takes out his ashes, comes in Sundays and laces belts, and does pipeing, and anything that they want of him; and this is the way I find things in general.

Now look at it ! I wish some one would tell me where these men got a license to take such a responsible position. There is a screw loose somewhere, and has been for a long time, and I think the sooner it is tightened the better it will be for everybody concerned. It is not right that such men should have anything to do with steam boilers, and boilers will never stop exploding where they are in charge of them. I know of two boilers that have not been washed in two years, or been looked into, for that length of time. No wonder boilers explode ! I wish manufacturers would look at this, in the same light, as they do when they buy fine horses. They will pay from $500 to $1.000 for a team but why don't they go and get a $40. or a $50. horse ? He will do just as well; he is a horse all the same ! They know it would be false economy; but that is the way they hire their engineer. They should get a good man and pay him for his work, and they will find that steam is a good deal cheaper motive power than they have had any idea of.

NEW YORK. CONSTANT READER,

REQUEST FROM PROFESSOR EGLESTON, OF COLUMBIA COLLEGE SCHOOL OF MINES, NEW YORK.

Editors MECHANICAL ENGINEER:

For some years past I have been making investigations on metals and alloys of all kinds, and have arrived at a point where I am very anxious to secure specimens to investigate the effect of compression. Will you be good enough to announce the fact and ask manufacturers of metals, and alloys of any kind, to send me specimens for that purpose?

The specimens which I wish for the investigation of compression, are:

First, three pieces two inches in diameter and three inches long.

Second, two pieces. each one inch in diameter and four inches long, for each examination.

Third, about three pounds of clean filings of the same kind of metal, or alloy, as the specimens sent.

I should like to make at least three examinations of each metal, which would make fifteen pieces in all; nine of the larger size, six of the smaller and nine pounds of filings.

These investigations on compression are made at very great cost, and I am making them for scientific purposes only, without remuneration of any kind, in the hope of discovering some facts which will be useful to manufacturers.

I shall be very glad, besides, to make comparative tests, other than compression, and also analyses of the metals and alloys at actual cost to me, making no charge for time or services.

The results I have already obtained are such as lead me to believe that the results of the investigations I am about to make will be of great interest to all persons using metals of any kind for construction.

A few very liberal gentlemen and firms have supplied me with the funds necessary for the investigations on compression, but I have no funds to make the comparative tests on tension, torsion, or transverse strain, and I therefore am willing to do them for their actual cost to me, and request your kind interest in making my purpose known to your readers, asking their assistance.

THOS. EGLESTON,
Prof. of Metallurgy Columbia College,
School of Mines, N. Y.

THE BIBLE IN STATIONARY ENGINEER'S ASSOCIATIONS.

Editors MECHANICAL ENGINEER:

I understand that there is some feeling regarding the Bible in our local Associations. Let me say that this matter was brought up in the late Convention at Chicago, by ex-president Cozens and Secretary Davy. Thinking it might prove an obstacle to some joining, I opposed the abolishment as strongly as possible. My reasons were that all members are believers in a Supreme Being, and if they are not, we do not want them in our Association. In the next place, all of us belong to some sect; some may be Prostestants and some Catholics. I was born and bred a Catholic and mean to die one. I know the rules of the Catholic Church and can say to my brethren of that creed, who belong to the Stationary Engineers Association, that there is nothing in the constitution that deprives them of their religious liberties in any manner whatever.

The Associations do not read the Bible at the sessions, nor does the Constitution say what Bible shall be used. The Bible in our Association is simply an emblem of religious faith; that we are believers in a Supreme being, and endeavor to do unto others as we would they should do unto us.

No one has more interest in the Engineers' Association than I have, and I think that all will agree with me in the opinion above expressed.

These Associations were organized to help engineers and their families, and also to advance them in a knowledge of their business, not for the purpose of furthering strikes and religious differences, or political discussions, and they never will be used for such purposes so long as the present board of direction holds office.

JOHN F. A. CULLINAN,
23 Exchange St., ROCHESTER, N. Y.

SETTING VALVES.

Editors MECHANICAL ENGINEER:

In your last issue, R. L. S. speaks of some mistakes in Roper's books. In Roper's Catechism, H.P. engines, page 220, in directions for setting valves, he says:

"Place the crank on the other center for the purpose of ascertaining if the lead is equal on each end. Should there be any difference, it must be divided equally between both ends, by *moving the eccentric backward or forward*, as the case may require."

Now my experience is that moving the eccentric only gives the *amount* of lead, and if it is not the same at both ends, it must be altered by changing the length of the rod.

I think if Mr. Roper would write fewer books, and have them right, they would be much more valuable to young engineers, if not so profitable to him.

COULTERVILLE, ILLINOIS, J. B. B.

[Our correspondent is correct all round.—EDS.]

PARAFFINE IN ENGINE OIL.

Editors MECHANICAL ENGINEER:

In your last issue *Steam Space Feeder*, of Canton, Ohio, asks the cause of impurities in his engine oil which resembles flakes of tallow. He does not say what kind of oil he uses, whether animal or mineral, but if it is the latter paraffine is the substance he notices. This will do no harm, except tending to stop up oil-holes. He also asks for a plan to condense steam at about atmospheric pressure, so that he can obtain the condensed water. This is a difficult thing to do without special contrivances which would cost more than the condensed water is worth. It could be done by an air surface condenser, but this rig would cost quite as much as a water condensing apparatus.

NEW YORK. J. MCCAULLEY.

BRAINS AND OTHER THINGS.

Editors MECHANICAL ENGINEER:

I notice in this issue a paragraph on the weight of the human brain, in which the Scotchman's is the heaviest I would like to ask, which is the most beneficial, quantity of brain regardless of mental activity, or mental activity regardless of quantity of brain? By this I mean a large brain of low vitality, or small brain of high vitality.

Your *Professor in the Machine Shop* articles deserve the highest praise for the writer; who he is I do not know, though I conclude he is evidently a far-seeing man, a student of nature, as well as a mechanic. The experience necessary to write such articles is not developed in an apprenticeship alone, it is the result of a well-balanced brain, and a temperament that is more a gift than an acquirement. "A bird is known by its notes, and a man by his conversation" is too true to need further comment.

CITY P. O., CHICAGO. JOHN ERWOOD.

* * *

TO THE OFFICERS AND MEMBERS OF STATIONARY ENGINEERS' ASSOCIATIONS, WORKING UNDER CHARTERS GRANTED BY THE NATIONAL OR STATE ASSOCIATION:

Your attention is called to Article 8, Section 1, of the Constitution of the National Association of Stationary Engineers of the United States of America, which reads as follows:

"*The President shall have power to deputize any member to organize Subordinate Associations, said member to be recommended by his Association.*"

Please attend to this matter as soon as possible, and send me the name and address of the member of your Association you may select for the office of Deputy, and I will issue a commission at once.

JAMES G. BECKERLEG,
Pres. National Association of Stationary Engineers of the United States. 862 W. Washington Street, Chicago, Ill.

MARKS ON BOILER PLATE.

Editors MECHANICAL ENGINEER:

Please answer the following and oblige an admirer of your paper: In books of reference on boilers I have noticed that the different kinds of plates used are designated by letters, such as C. H., etc. What I want to know is the different kinds of iron used in steam boilers, where used, and the meaning of the letters referred to.

Also, if you can tell me of some cheap and good book on boiler-making.

SOUTH BOSTON, MASS. WILLIAM WILSON.

["C." means charcoal, "C. H." charcoal hammered. Where they are used is more than we would like to say. The law compels every sheet to be stamped, but we may look a good while on some boilers and not find any. The Theoretical and Practical Boiler-maker, by Samuel Nichols, is one of the best and cheapest works on the subject we know of.—EDS.]

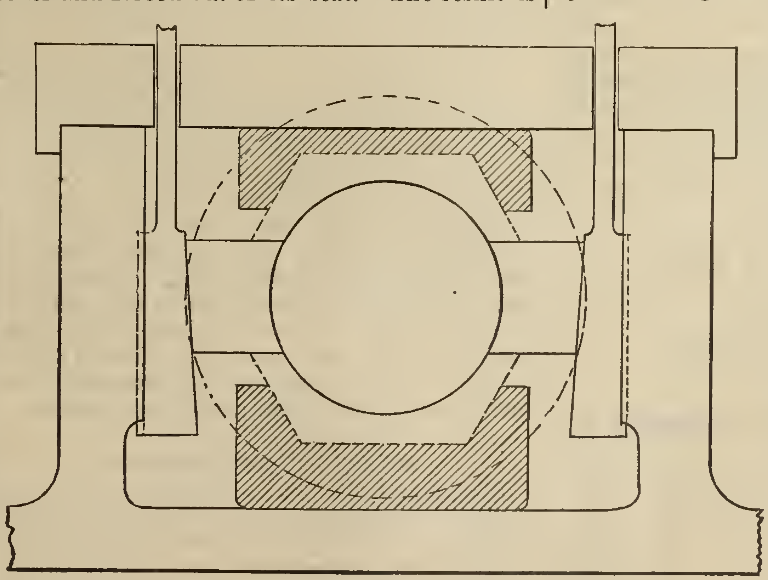
LAYING AN ENGINE UP FOR WINTER.

BY JAS. H. REID, CHIEF ENGINEER STEAMER NORTHWEST, PRESIDENT MARINE ENGINEERS' ASSOCIATION.

I will tell your readers how I lay up an engine and boiler for the winter. The first thing I do is to take out each gib and key, one by one, and examine them, and if found sound, oil them and put them back in their places. I then take all the oil cups, clean them out and store them away, stopping up the holes in the rods with wooden plugs, screwing them in tight. I then shut the stop cock or sea valves on the injection pipes, and let all the water out of them, being careful that there is none whatever left in. When I first commenced to sail, many years ago, we built a wooden box around them, and filled it with horse litter to keep them from freezing, and some engineers do that now; I never could see the use of it, as all water being out of the pipes there was nothing to freeze, and as for keeping the water from freezing, from the valves out-board that could not be done by covering the pipes and valves. As it always made a litter in the boat and helped to rot the timbers I discontinued the practice as soon as I had charge, and never have had any trouble with frozen pipes or valves if the latter are tight, and they are useless if not. I also let all the water out of the condenser channel and air pump, taking all the packing out of the same. I take all the packing out of the valves, stuffing boxes and piston rod, then blow the water out of the boiler, seeing that the steam is not more than six pounds. In my opinion a boiler is injured by blowing off with high steam when the boiler is cooling. I take up the cylinder cover and take out all the springs in the piston and wipe the same clean and dry, taking up the rings for that purpose and painting the same with white lead and tallow, mixing a little lard oil with it. I then put the rings back in their places, putting on the follower and screwing the bolts down on to it. I then raise up the upper steam and exhaust valves and paint them on their seats with white lead and tallow, and put them back on the seat. I also paint the valve stems and the piston rod. I then put down the cylinder cover and fasten it tight with the bolts to keep air out of the cylinder. I serve the lower valves the same as the upper ones, and paint the valve stems also. By doing this I have run three years without any repairs to the valves, and they are tight. I turn the valves partly round every day when running. It is six years since I had the piston or rings fitted up in the shop, and they are in as good order as when first made. I also let all water out of the force pumps and pipes, slacking up all plugs in the cocks and oiling them. I then have a man paint all the bright work with white lead, oil and tallow. I leave the engine all connected up, taking nothing apart, so that if a new engineer should come to run the engine he will find everything in its place. I clean the boilers thoroughly, putting on all the hand hole plates when done; having the flues, tubes and all parts swept clean of ashes and soot. I then take off the man hole plates, and go into the boiler and examine all braces, and if any are loose have them repaired. I also go through the furnaces and all parts of the boilers, taking a good boilermaker with me, and mark all places that want repairing, with chalk. When this is done I have the boiler painted with fish oil inside and out, furnaces, steam chimneys and all parts that can be reached. This is better and cheaper than paint, and it keeps the boiler from corroding, for, as soon as the boiler is heated up the oil burns and forms a hard crust.

MAIN BEARING FOR HORIZONTAL ENGINE.

The principal wear in horizontal engine main bearings comes upon the sides, and this is so well known that, generally, the boxes are in four parts, the chocks, or side brasses being adjustable by set-screws or keys, as shown in the diagram herewith. In all bearings which we have seen the bottom brass is fixed, or let in to the pillow-block itself, so that when the side brasses are set up the shaft is carried one way or the other and forced out of its seat. The result is that the bearing is soon worn irregularly, the brasses assuming all shapes according to the frequency with which they are adjusted; in time they get so bad that the engine pounds excessively and there is no way to stop it, because the brasses are worn in all directions.



We believe the plan illustrated above is new, and we think it is a remedy for the trouble mentioned, which is certainly not an imaginary one upon our part as all engineers know. By fitting the brasses into independent boxes sliding in the main pillow-block, the side brasses can be set up at any time without throwing the shaft out of the bottom brass, or to one side of it. With this plan all parts move together as one bearing, and will always wear true and round.

For large engines, particularly, this is desirable, and the extra cost of construction is very slight. The bottom brass and its box can be fitted up on the bench, and when the bearing on the inside of the bottom of the pillow-block is planed off, can be set in place without further fitting. This plan of fitting main bearings also permits very close adjustment and alignment of the main shaft in setting up, doing away with the necessity of fitting keys at the ends of the pillow-blocks to allow for slight errors one way or the other.

An objection which might be made is that it would be easy to throw a shaft out of line with this device, and that in the hands of a careless engineer much damage might be done. This is a valid objection. Careless engineers can do a great deal of mischief in all ways. No one can design an engine that cannot be destroyed, or injured by carelessness, and every valve-motion in existence is open to the same objection. Some cross-heads run so close that a man cannot screw up a nut on a gland without getting caught, but this only shows that the engineer must not use the wrench when the engine is in motion.

* * *

PROF. JOHN M. ORDWAY, of Boston, in a recent paper on "*Non-Conducting Materials for Steam Pipes*," read before the American Society of Mechanical Engineers, stated that, in the course of a long series of experiments, he had found the Fossil Meal Composition to be the most efficient of all plastic materials for the purpose. This testimony, from such a source, is of value to the trade.

WEIGHT ON DRIVERS.

It has long been believed that 12,000 pounds per driving wheel is the limit of the weight to which it should be subjected, and that anything more than this would result in crushing the face of the rail, or practically sinking into the rail. There are, however, several engines now running in this country with 17,000 and 18,000 pounds per driver, and no difference in the wear of the tire or rail is noticed, and in some cases it is claimed that these heavily weighted wheels shows less wear on the tires than some of the lighter weighted wheels. One case is on record of a shifting engine having 22,000 pounds on each driver, with nothing noticeable in the way of bad results. Many 18 x 24 inch cylinder moguls have from .50,000 to 55,000 pounds on the six drivers, but it appears that so far as the tires or rails are concerned, we could put 4 x 18,000 or 72,000 pounds on the four drivers of an 8-wheel engine, and the necessity of six drivers at once disappears, so far as the supposed injurious effect of exceeding 12,000 pounds per driver, is concerned. But it is not an easy matter to get the 72,000 pounds to put on the drivers of an 8-wheel engine unless a portion of the weight of the tender is utilized, and this is done on several roads. It is claimed by some master mechanics that this arrangement throws an excessive weight on the back pair of drivers In practice this objection is never raised, and the only change necessary that we have seen has been the adding of a leaf to the back springs, although in many cases this is not done. If any serious objections should arise to unequal distribution of weight, it would be a simple matter to transfer the *entire* weight on the drivers, to them through the equalizer, when an equality of weight on the wheels would necessarily result. In many consolidation engines we have seen two or more tons difference in weight on different pairs of drivers with no bad results.—*Nat. Car Builder.*

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STEAM-JACKETS.

A very great difference of opinion seems to exist among engineers concerning the efficiency of steam-jackets, and there are so many methods of applying them that it is conceivable some of them may be erroneous in principle, leading to loss instead of benefit.

That the steam doing work in a cylinder should be kept as nearly at the temperature due to its entering pressure as possible, all can understand; and that if it is so kept, the loss incurred by heating the walls of the cylinder at each stroke will be avoided. We believe it to be susceptible of proof, however, that in steam-jackets as generally applied, the loss is greater than it would be were there no jacket at all. This for the reason that the temperature existent in the jacket and the walls of the cylinder internally is not high enough to prevent condensation; and, secondly, that the jacket itself loses heat by radiation through want of protection. It would seem that any jacket which has, so to speak, dead-ends with no outlet for circulation other than the condenser, or a steam-trap in which the condensed water is caught, must of necessity be a loss, for there is no source to vivify [enliven] the steam in it, except the boiler itself, which may be more or less remote. Between the jacket and boiler there is more or less radiating surface, which has to be protected as efficiently as possible. No non-conductor or covering is perfect. All of them absorb surface heat, even if they do not permit it to actually pass through them, and reliance upon clothing to prevent radiation is not enough.

The office of the steam-jacket to a cylinder is that of a stove, and the heat supplied to warm the latter must be higher in temperature than the steam used in the cylinder. We take this to be so palpable that it needs no argument to sustain it. If the assumption is correct, then no steam-jacket which contains steam at boiler pressure, and the temperature due to it, can be other than unsatisfactory, for it is a refrigerator instead of a stove. Further: the heat supplied to the jacket must be taken from a source which is otherwise unavailable, or not used. This points to the use of superheated steam in jackets, which is one of the oldest and most obvious arrangements. Concerning it, however, Charles T. Porter, an eminent engineer of long experience, says that it is of no value, for it will (p. 41, *description of the Porter-Allen engine by Charles T. Porter*) instantly be cooled to the temperature at which it will condense; but he does not say what will cool it, whether the superheat is lost through radiation or by being absorbed by the cooler steam cylinder; in which latter case it is not a loss, but has served the purpose it was intended for.

It would seem that a steam-jacket filled with superheated steam *in circulation*, that is, taken from the boiler and returned to it again after passing through or around the jacket, would be an efficient system, the only question lying in the manner in which it was carried out. To our knowledge this has never been done, but it is possible that we are only suggesting what has been previously adopted by others. Obviously, the vitality of the jacket depends upon its temperature at all times exceding that of the steam entering the cylinder, and a superheated steam-jacket circulating around the steam-cylinder would seem to fill all the conditions required.

MARINE BEAM ENGINES.

Elsewhere we print two criticisms upon the engines of the new cruiser *Chicago* recently illustrated in this paper. These criticisms refer solely to the design and not to the system, which, as engineers in this country know very well, has been sufficiently tested to warrant its adoption in the *Chicago*. Marine beam engines are no novelty, but judging from the utterances of the *London Engineer* they are quite new. That paper, in a recent issue, condemns the beam engine for marine use from every aspect, but it seems to wholly ignore the fact that the American beam engine has been in use in every quarter of the globe for nearly a third of a century. It has crossed the ocean in steamships and steamboats, navigated the Danube and the China Seas, crossed the Pacific to Japan, rounded the Horn, and constantly goes up and down this coast in all sorts of weather at all seasons of the year, all this with perfect safety to itself and the vessel it is in.

Many years ago, when the side lever engine was the only form in general use, Commodore Vanderbilt fitted a steamship with a pair of beam engines, and went all over the world with them. When he reached England engineers there were unanimous in condemning them, and prophesied all sorts of things regarding them, none of which happened. The same hue and cry was raised abroad when the present vertical engine was introduced, for the English are nothing, if not conservative. They clung to the side lever engine and paddle wheel as the only true faith, and did not abandon it until the logic of dollars and cents compelled them to.

The *London Engineer* makes a specific point against beam engines for twin screws. But even from this aspect it is at fault, for beam engines have been applied to screws in several instances successfully, and are now running. There is a twin screw steamer with beam engines, designed by Frank Stevens, now in daily use in the Pennsylvania R. R. line. There is another pair in the *Metropolitan*, a coasting steamer running on Long Island Sound, and still another in the *Louisiana* of the Cromwell Line. This vessel is one of the fastest, if not *the* fastest vessel out of this port, and her performance leaves little to be desired. So far as the type of engine goes there is none at all events. It is too late to decry the beam engine for marine use; its merits are too well known, but as regards those in the *Chicago* we think our contemporary's strictures merited, for everything seems to have been done to throw discredit upon the type.

DEAD-CENTER LATHES.

There may be reasons which do not occur to us at present why dead-center lathes are not desirable for general work, but they would seem specially adapted for a great variety of uses. Not the least virtue appertaining to them is, that the spindle itself, as a possible chance of disturbance, and source of expense in construction, is taken out of consideration. In dead-center lathes there is no live spindle, the work itself revolving between two fixed points. This should give greater rigidity of the work for one thing, and almost absolute rectitude in surfaces, provided the fixed points the work turns on are *fac-similes* of each other, for another. Of course, dead-center lathes can be used only for straight turning; chucking or facing on them, where the work has to be held in a chuck, being out of the question. Back-gears could be introduced on the dead-center lathe without difficulty if greater power than the simple cone gives is needed.

It seems to us that dead-center lathes, particularly for small work, offer many advantages.

CORROSION OF STEAM BOILERS.

The causes which tend to produce corrosion of boilers are in some instances obscure, and beyond the bare fact that exposure to dampness and a circulation of air corrodes iron, but little is known. Boilers have been destroyed most rapidly under the use, so to speak, of intelligent attendants and under conditions that did not differ from those found everywhere.

We have said but little is known as to the causes of rapid corrosion, and this applies in so far as it relates to every-day use. Certain waters in some localties are manifestly unfit for use in boilers, because they are known to be strongly acid or alkaline. Corrosion would be expected from them, but it is difficult to see how waters that present no peculiarities in taste or appearance can injure iron. Nevertheless they do, and their dangerous character can only be discovered by analysis.

Making steam in a boiler is, in fact, a process of distillation. The vapor (steam) which arises is pure and harmless, but the constituents of the water from which it is made are condensed and concentrated. This may be the cause of many cases of rapid corrosion which have seemed unaccountable. All water contains more or less mineral matter in solution, which, unless the boiler is frequently blown out, is present in very much greater quantity than is generally supposed Surface blowing will not remove it, for being denser it is heavier, and settles at the bottom and does its work unsuspected. Where there is an effect there is certainly a cause, and in many cases a remedy, but not in all.

Investigations of scientific men have revealed that mineral salts, that is the condensed deposits of the minerals held in solution, acted more or less rapidly upon iron plates; those which corroded iron most rapidly were the chlorides of ammonia, barium, calcium (lime), magnesia, potash and salt. These were stimulated in their action if the water was full of air and carbonic acid. Chloride of magnesia is said to be the worst and most active agent in corrosion. These substances exist in most waters, and, as we have shown, may be the source of injury by lack of attention to blowing out frequently from the bottom. It is not easy to say, in all cases, what remedy should be adopted, and we cannot suggest any general course to be followed, other than frequent inspection and such preventitives as experience seems to suggest.

CLOTHING STEAM SURFACES.

We have frequently urged upon our friends to consider the necessity of using some form of non-conductor for their steam surfaces, for we have felt that it is in too many instances thought to be a matter of slight importance. That this is an incorrect view is well shown in some recent experiments of Dr. John M. Ordway, of Boston. This gentleman, who is a trained observer of ability, has made a series of trials with all the pipe coverings in the market, and finds that the value of a good one is incontestable. A naked two-inch pipe, carrying sixty pounds of steam, says the experimenter, may condense 181 grammes per foot per hour, while a simple cheap covering—not the best kind—may reduce this to 46½ grammes. The total saving is estimated, in commercial terms, as equal to 2·96 pounds of steam per working day of ten hours, in a pipe 100 feet long; and in 300 working days to save coal, enough to vaporize 88,000 pounds of water. Reduced to commercial terms, this would amount to five tons per year on one hundred feet of 2″ steam pipe. It would be very much more in proportion in larger pipes.

It would seem from this that no proprietor of steam works should need coaxing to have all the steam surfaces exposed covered.

INCORRECT STATEMENT FROM THE SCIENTIFIC AMERICAN.

We find in the *Scientific American*, for Nov. 10th the following:

> "(59) A. H. writes: If a train of cars traveling east at the velocity of a cannon ball should have on board a loaded cannon, the mouth of which is pointed west, about how far would the ball in the cannon travel west if the cannon be discharged? A. The ball would fall to the ground at the point of firing under the conditions you mention."

Then, if a locomotive attains the same speed in feet per minute as the piston travels feet per minute, the steam has no effect on the piston! Is this so? It is not. The piston is a cannon ball and the steam is the powder, and the effect on the piston is precisely the same as if the cylinder was stationary. So it is with the cannon under the circumstances mentioned above.

Read the second law of motion:

> "*A given force always produces the same effect, whether the body on which it acts is in motion or at rest; whether it is acted on by that force alone, or by others at the same time.*"

This earth revolves at the rate of 25,000 miles in twenty-four hours from west to east. According to the senile "*Scientific*," any force acting from east to west would be inert, provided it attained the same velocity as the surface of the earth.

A cannon ball moving at the rate of 1,500 feet per second—which is about its speed—travels 1,052 miles per hour, exactly the velocity of the surface of the globe through space; according to the *Scientific American*, if fired from east to west, the shot falls to the ground. The argument of the *Scientific American* considers that, as the cannon is carried on the cars, at the rate the ball travels when it leaves the gun, it must run away from the ball, so to speak. It omits to consider the fact that if the gun is traveling so is the ball; and it therefore acts when fired precisely as any other cannon fired on the surface of the earth would. Action and reaction are equal.

HERE IT IS AGAIN.

Even a paper so well informed and so well edited generally, as *Bradstreets*, joins the ranks of believers in mysterious boiler explosions. In a recent issue it says:

> "A German professor of eminence propounds the theory, which has been satisfactorily tested abroad by a body of engineering experts, that the prime cause of explosions in many hitherto unexplained disasters has been the insufficiency of air both in the water in the boiler and in the vapor above the water line, thus occasioning a sudden and powerful expansion of both, sufficient to rend the plates. The tendency of heat is to drive the air out of water, and, with the steam generated within the boiler deprived of its due modicum of air, the result is an explosion. That a host of explosions occur at the period of 'firing up,' after the furnace has been banked or suffered to get low for a considerable time, is a fact tending to confirm the correctness of the theory. The remedy is manifestly in the supply of fresh water, and also a drawing off of a portion of the air-exhausted water in case of a boiler that has been left inactive for a period with the fires still in."

The ejaculation which is the caption of our article is caused by meeting this old, old notion, put forth as newly discovered. For certainly thirty-five years, which is as far back as our knowledge extends, the view above quoted have been put forward, but we do not observe any remarkable dimunition in the number of accidents, by reason of the discovery. The reason that this fallacy should be retired forever is that it has been disproved over and over again as a cause of disaster. Any one who looks for carelessness and mismanagement in boiler explosions will find it, if there is enough left of the boiler to locate it.

Observe the incoherency of the statement above quoted "a prime cause of explosions is the insufficiency of air in the water and in the steam, *thus* occasioning a powerful expansion, etc." How much air steam at working temperatures of 60 or 70 lbs. should contain is not stated, or what is an insufficiency of it, and our mention is only made to show how even the most intelligent minds will fly slap dash at technical matters and settle them off-hand.

PUBLIC ACKNOWLEDGMENT.

We desire to publicly return thanks for important services rendered, to A. M. Davy, Esq., Secretary National Association Stationary Engineers, N. W. Williames, Esq., President Keystone Council No. 1, Philadelphia N. A. S. E., William Ponsonby, Esq., Chicago No. 1, N. A. S. E., Jas. H. Reid, Esq., President Marine Engineer's Association, Detroit, Mich. These gentlemen have made The Mechanical Engineer's interest a paramount consideration, and have most materially added to its dissemination. We should be also wanting in consideration, did we not acknowledge, without naming individuals, the various attentions we have received from large engine builders in Rhode Island, Connecticut and Massachusetts, and from foremen of railway repair shops in all parts, for personal efforts to increasing our circulation.

A GOOD CRITERION.

A very intelligent mechanic attending machinery at the American Institute Fair in this city says that he has been astonished to see the number of people wanting engines and machinery. He sold seven engines while there and doubtless other builders have also made sales. There is a universal intention among visitors, he says, to enlarge their engine power, and the preference is for automatic engines. Our informant judges that the cry of dull times is more alarming than real.

We have also an opportunity of judging of the tone through the country. The Mechanical Engineer circulates all over, and renewals from old subscribers have come this year earlier than ever before, while the new names have been astonishing in numbers. We do not want any better tell-tale than this, for it is very certain that when men expect to be out of work for the winter, or in the immediate future, they do not spend any money.

WHAT ONE MAN CAN DO.

What one man can effect when he throws his influence in favor of a paper and induces another subscriber to join him, is shown by the fact that if all would do it any given subscription list would be doubled. Such a gain as that is a very great one, and not to be hoped for under ordinary circumstances. All publishers are in a great measure dependent upon the good will of their subscribers, for through them do permanent additions to their lists come. A reader generally knows some other of similar tastes, and if he uses his influence for a paper can generally obtain a trial of it. Those who feel that our aims are worthy of encouragement and wish to further them to the extent of their power, can greatly aid us by sending in new names with a yearly subscription.

* * *

The promptness and decision with which Americans act is well shown in the adoption of the new time standards throughout the country. It was scarcely known a month ago, now every watch is set to it.

THE PROFESSOR IN THE MACHINE SHOP.

Number XLIV.

Engineers and machinists are a curious set of men in some respects, and like no other class that I know of in other trades. I have alluded before, I think, in these papers somewhere to one characteristic they possess, and that is their tremendous energy in argument. When two machinists or engineers come together, or clash in views on some topic it is like the onset of two game chickens, metaphorically, and sometimes it seems as though it was a Chinese battle, where each one tries to make all the noise he can. Their convictions and views are shouted at the top of the voice as though the other fellow was on a mountain a quarter of a mile off. This is merely a trade characteristic, but I cannot see why it should belong particularly to engineers and machinists, as it does. I have heard blacksmiths and boilermakers discussing trade points in tones of thunder. I can see why that should be, for they live so constantly where they have to raise their voices to be heard, that it is natural they should be high pitched.

Now, all this leads up to a matter which has occupied a portion of the press at intervals, and which they seem to keep in stock, so to speak, for handy use, and that is, the decadence of American mechanics. I wish the voice of the trade could be heard on this subject in the same proportion that it is heard in private argument, I think some papers would change their tune.

How these editorial writers found out that American mechanics are decaying is more than I can tell. So far as I have observed, the work done by them is better every year. The fits are better; the finish is better; the number of useless parts, or superfluous details is less and less, and the general efficiency is enhanced. Now, to be told that we are getting worse yearly, in the face of facts to the contrary, is what I call bearing false witness. The trouble is that none of the papers who start this cry know anything about the matter personally. They do not know a job when they see it for one thing, and for another, they do not know whether it was done by an American or some other mechanic. A little wider vision would enable these editorial critics to judge better. If they had had more experience among the mechanics of the country, they would know that the work turned out by them was never better than at the present time. Who does all the good work that is done in this country if American mechanics do not? I haven't heard of any especially large importations from the old country lately, and when I go into large shops in other parts of the country I do not observe any expert "foreign workmen" recently arrived who are teaching American mechanics. Last week I read in The Mechanical Engineer an extract from an English paper which said in effect, that no good workmen left the old country, for they were so much better off there that they could not make anything by the change. This is not complimentary to foreign mechanics here now, and between the statements of the home papers and the foreign papers, I hardly know what to think. This is the kind of thing I kick at! I cut it out of a Western paper:

> "This special or technical education is difficult to obtain in shops. The apprenticeship system is dead, and the learners of trades are buffeted about in shops to pick up a knowledge of their trade from fellow-workmen who are not under obligation to help them, but who, on the contrary, look upon them as soon-to-be-rivals, to be discouraged as much as possible."

Let the reader mark that this is from a technical paper, which certainly ought to be better informed. I don't know how it may be in other trades than our own, but what is said above as to apprentices kicking around a shop, "buffeted about," is ridiculous. No apprentice is buffeted in any way in this country. A man would have a lively time who undertook it, but I am given to understand that it is by no means uncommon in the old country. Perhaps the writer means buffeting in the sense of discouraging, but if he does he is equally wrong, for American apprentices do not allow themselves to be discouraged. That is not what they come to the shop for; neither do American proprietors of machine works permit any interference with them.

So far as I can see, all this talk about decaying American mechanics is only to get a chance to whack trades unions, and as for me personally, editors can pitch into them as much as they please. Many years ago when I was at work at the vise I used to be solicited to join such associations, but I never did, and never had any trouble with them, or the members of them in any way. I used to be told that I couldn't stay in the shop unless I joined, but I stayed all the same, and got all the wages I was worth. What others got I never cared. I was working for myself, not them, for I knew perfectly well if I got out of a job they never would get me another; as for supporting me when out of work, I would as soon go on the street and hold out my hat. I would just as lief beg from the general public as from my fellow-workmen, and I think a little sooner, for they cannot afford help while the public can. I am given to understand that this is a free country, and from living in it upwards of fifty years I think the statement probable at least. Being free I cannot see what trades unions have to do with the alleged decadence of American mechanics. The pretence that trades unions control anything as an institution has been several times put to the test on a very serious scale, notably in the strike of the telegraph operators, and the long strike of the iron workers last year. Certainly they do not control machine firms or engineering shops. If, therefore, it is necessary to put down trades unions—and I, by no means feel that it is, so long as they do not interfere with the liberty of individuals—let it be done upon the demerits of them, pure and simple, not upon the pretence that they cause American mechanics to deteriorate, for they do not. The silent testimony of every industrial fair is proof enough of this statement.

THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER 4.

BY WILLIAM BARNET LE VAN.

HOW TO ASCERTAIN THE HORSE-POWER OF A DIAGRAM.

A horse power being 33,000 pounds raised one foot high per minute, to ascertain what an engine is exerting, all we need is to find out how many pounds weight it will raise in a minute, and through how many feet. The following card we will take as an example:

This diagram has registered on it all the lines and pressures heretofore mentioned.

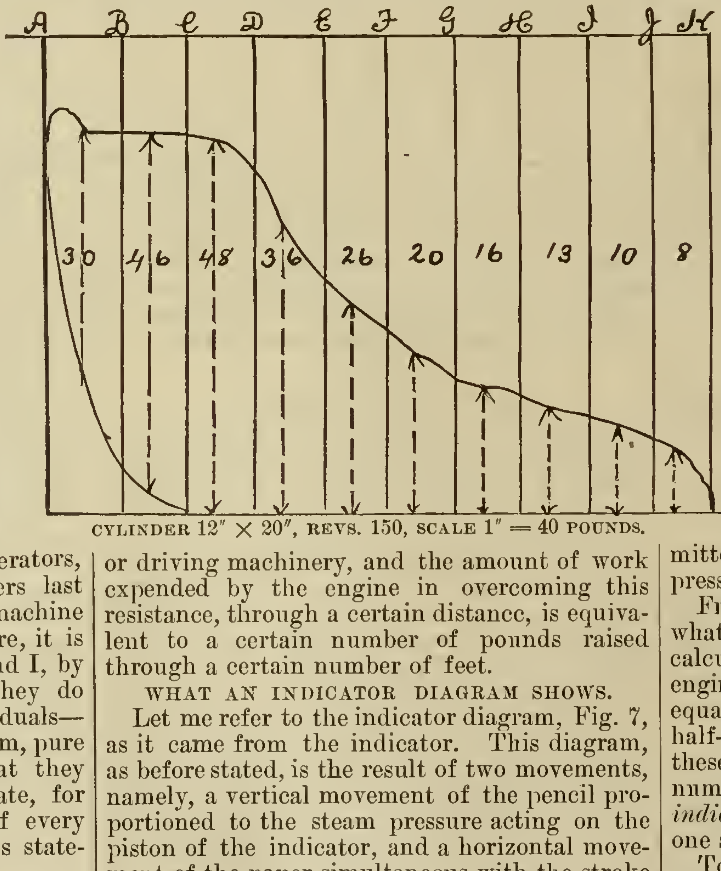
The connection between this curved figure and the power exerted by the engine is not apparent at first sight; and before showing how to obtain it, it is necessary for the reader to look back to the begining of this article to see what is the true measure of power exerted.

Without a clear and definite conception of what constitutes mechanical work, or, in other words, what is the measure of work done, it is impossible to form any idea, either of what is meant by economical use of steam, or of the connection between the indicator diagram and the indicated horse-power.

The simplest example of an expenditure of power, and also the most common, is that of a weight raised from the ground. If one pound has been raised one foot high, just half the work has been required which would be required to raise two pounds one foot high. This is so simple a conception as not to require further explanation. A little consideration will show that, generally speaking, the work required to lift any weight to any height, may be said to be equal to a certain number of pounds raised one foot high, or, as it is generally stated for the sake of shortness, the work expended is equal to a certain number of foot-pounds. One pound raised one foot is one foot-pound.

It is a well known law in mechanics, that when work is done, or power expended, some resistance has been overcome through some distance. What is really done in raising a weight is to overcome the attraction of the earth, or gravity. If we had overcome any other resistance than gravity, compressing a spring, for instance, we might say that the expenditure of work was equal to that required to lift a certain number of pounds through a certain height. We make gravity a general standard of resistance, and whenever any resistance is overcome, we may refer it to this standard. One pound raised one foot high, may be taken as our standard unit of work done.

An engine at work overcomes some resistance, either propelling itself, a vessel, pulling a train, or driving machinery, and the amount of work expended by the engine in overcoming this resistance, through a certain distance, is equivalent to a certain number of pounds raised through a certain number of feet.



CYLINDER 12" × 20", REVS. 150, SCALE 1" = 40 POUNDS.

WHAT AN INDICATOR DIAGRAM SHOWS.

Let me refer to the indicator diagram, Fig. 7, as it came from the indicator. This diagram, as before stated, is the result of two movements, namely, a vertical movement of the pencil proportioned to the steam pressure acting on the piston of the indicator, and a horizontal movement of the paper simultaneous with the stroke of the engine-piston. It consequently represents, in its length, the stroke of the engine on a reduced scale, and by its height, at any given point, the pressure on the engine-piston at a corresponding point in the stroke. The pressure shown is measured by a scale marked to correspond with the indicator spring used. The most common scales are 20, 30, 40 and 60 pounds per inch—that is, an inch of vertical height on the diagram represents 20, 30, 40 and 60 pounds of steam per square inch on the piston, according to the scale of the spring used. These scales are sent with every instrument.

The length of the diagram measured horizontally, represents the space passed through by the piston in feet, and is known when we are given the length of the engine crank.

As the pressure is given by the indicator-scale in pounds, the area of the figure represents the work in foot-pounds done by the steam on *one* side of the piston, in one complete stroke, or a revolution of the crank.

The diagram, Fig. 7, is divided into ten equal spaces. The distance from *A* to *B* is one-tenth of the whole length of the indicator-card, and during the time the drum moved horizontally from *A* to *B*, the piston of the engine traveled one-tenth of its stroke; while the drum traveled from *B* to *C*, the piston of the engine moved another one-tenth of its stroke, and when the engine had traveled its whole stroke, the drum would have traveled from *A* to *K*, and similarly on the return stroke. It is not a matter of any importance what the length, *A K*, is when compared with the stroke of the engine, so for convenience, *A K* is usually made about four inches, excepting in engines running at high speeds the length is reduced as much as possible, compatible with accuracy. This is to avoid errors caused by shock and jar of changing direction of motion of the paper-drum of the indicator. All that we care about is, that when the engine-piston has moved through a portion of its stroke, the drum shall have moved with it in reduced proportions, and that the motions of both correspond at all points throughout the stroke. Then we have only to look at the indicator-card to see what pressure of steam there was in the cylinder at any part of the stroke. In this particular case a $\frac{1}{24}$th spring was in the indicator, which means that for every one pound pressure on the square inch of the indicator-piston, the pencil of the indicator will rise $\frac{1}{24}$th of an inch.

If we have 48 pounds cylinder pressure, the pencil will rise two inches as soon as the steam is admitted at line *A*; then as the engine and card move, the pencil (still held up by the steam) moves to *B*, then to *C*. Between this point and *D*, the steam is cut off, then the steam pressure falls as the piston moves on, and the pressure can no longer compress the spring the full height, the pencil falls to *F*, then to *G*, and so on to *K*, where the steam is exhausted into the air, and the spring being no longer compressed, the pencil falls to the line called the atmospheric line, a line of no pressure, which will be referred to hereafter.

At the bottom of line, *K*, the piston begins the return stroke, and up to *C*, the steam continues to exhaust into the air. At about this point the slide-valve closes, and what is left in the cylinder is compressed until nearly the top of line, *A*, is reached, when the slide-valve again opens, and steam is admitted for the next stroke, and the spring compressed as before, to the top of line, *A*.

From the curved figure, thus formed, we find what power the engine was developing. To calculate this area approximately, it is usual for engineers to measure the pressure at ten places, equally distant from each other, leaving two half-spaces at the ends (see dotted lines, Fig. 7), these pressurss added and divided by ten—the number of spaces—will give the *mean effective indicated pressure* acting on the piston during one stroke.

To find the foot-pounds raised per minute, we multiply the mean pressure by twice the stroke in feet, by the revolutions per minute, and by the area of the piston in square inches.

IN THE ROUND HOUSE.—No. XV.

BY L. O. DANSE.

BREAKDOWNS.

There are some engines (particularly new ones and very old ones) that seem to feel called upon to disintegrate. At any rate they are constantly breaking down, to the disgust and inconvenience of all who have anything to do with them. In many cases the runner is more or less to blame for the ultimate crash, but not in all.

Side-rods seem to have an unpleasant fashion of breaking. This is, to some extent, due to the peculiar nature of the motion which they have, pushing and pulling, and also rising and falling constantly, the momentum of the rod being resisted by the change in the direction of its motion. When one does break it usually takes the running board, and frequently part of the cab with it. Sometimes a piece of the rod hanging at one end to the crank pin whirls around, striking the ground and raising the engine clear of the rails, only to let it drop back a moment later with a shock that breaks the frame as though it were a match.

The only thing to do, when you break a parallel rod, is to stop and take off the pieces and the corresponding rod on the other side.

The A. V. R. R. had a great deal of trouble for a while with its P——— engine drivers. The wheel-centers would crack in the most unaccountable manner without any apparent cause. Of course the trouble originated in the foundry. When a driver shows a very serious crack it had best be disconnected. If it is not a main wheel, this will only require the removal of the parallel rods; but if it be a main wheel the parallel rods must be left on, and the main rod on the broken side removed. Then the crosshead is moved to one end of the guides and fastened there by means of blocks of wood. The valve-stem is disconnected from the rocker, and the valve prevented from moving by screwing up one of the bolts on the stuffing-box so that the gland binds on the stem. Of course a slight crack will not necessitate any disconnecting, but it must be frequently and carefully inspected.

Wheels often part company with the engine, the axle breaking square off outside of the box. In this event, drive blocks in the pedestal, to hold the box in the proper position, and if the wheel be a main driver disconnect the entire side; if it be any other, remove the parallel rods on both sides. In all cases where a parallel rod is removed, the corresponding one on the other side must also be removed, as, if left, it may start the wheels in the wrong direction and occasion more trouble. On locomotives having more than two pairs of coupled wheels, only those sections of the parallel rod need be removed which connect with the damaged pair. A cracked tire requires the same treatment as a cracked wheel.

When any part of the machinery gets out of order it usually betrays itself by the rattle, pound or squeak produced; and the careful runner always investigates any unusual sounds that may make themselves heard about his engine. Many a time has an accident and delay been avoided by a timely short stop to repair some insignificant injury to the mechanism, which, if not repaired in time, might have led to a very serious breakdown. The sound of the exhaust, as a criterion of the condition of the valve gear, has already been alluded to.

When a valve, yoke, stem, or rocker is injured, disconnect the stem and jam up the gland as previously directed, unless the valve is so injured as to allow steam to pass out through the exhaust port, in which case a block of wood must be fastened over the port in such a way as to close it. Should the chest be broken, the steam inlets must be similarly closed. In case of a broken arch-pipe, a piece of board may be bolted over the opening of the T-pipe after the broken pipe is removed.

When a crack in a cylinder head, or piston occurs the entire side must be disconnected, as for a broken main wheel, except that the parallel rods are to be retained. Should the front head of one cylinder and the back head of the other be cracked, substitute the sound front head for the cracked one and disconnect the side having the cracked back head, leaving on the parallel rods.

When a link hanger or lifter breaks, it necessitates putting blocks of wood in the link to hold it up. The blocks must be tied with twine, or wire, to prevent their being worked out. It would not be a good plan for the engineer to forget himself and reverse his engine while one link was blocked up, as it would doubtless cause a much more serious accident. The engine can, however, be reversed by stopping and substituting a longer block so as to hold the link in full back gear. This same cure is equally efficient for a broken reach rod.

A broken spring or spring-saddle necessitates blocking the corresponding box into the center of the pedestal by inserting wooden wedges above and below it. A broken spring-hanger will require blocking one end of the equalizer in addition to the box, unless a chain can be substituted for it.

When a tube collapses, a plug must be driven in each end of it. If plugs have not been provided for this purpose, a stick may be pared, into a cone at one end to fit the tube, and then almost cut off, so that after it has been driven, it can readily be broken off. It may be advisable to pump the boiler full of cold water to reduce the rush of s eam.

Whatever goes wrong the principal thing for the runner to do is to keep cool, for if he gets excited, he will probably be twice as long getting the damage repaired, as he would be if he kept cool: and never forget to send out the flagman when you stop on the main line, and call him in before starting again.

(*Concluded.*)

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.—No. X.

By J. P. Mullin.

TWO WAYS OF MOULDING CYLINDERS.

At Fig. 66 we have shown a 14 x 24 cylinder with piston-valve and the valve-chest cast on. The drawing shows the plan, side and end sections of the cylinder casting, and another part represents the plan and side elevation of the pattern.

When the cylinder is to be cast horizontally, as shown at Fig. 70, the pattern should be parted through the center of the body of the cylinder and valve-chest at *A*, and also through the upper part of the stand at *B*. (See end section, Fig. 66.) When it is to be moulded vertically, as shown at Fig. 72, the pattern may be parted across the end at dotted line, *C*, and the center belt and steam inlet. In fact all the bosses, etc., must be loose.

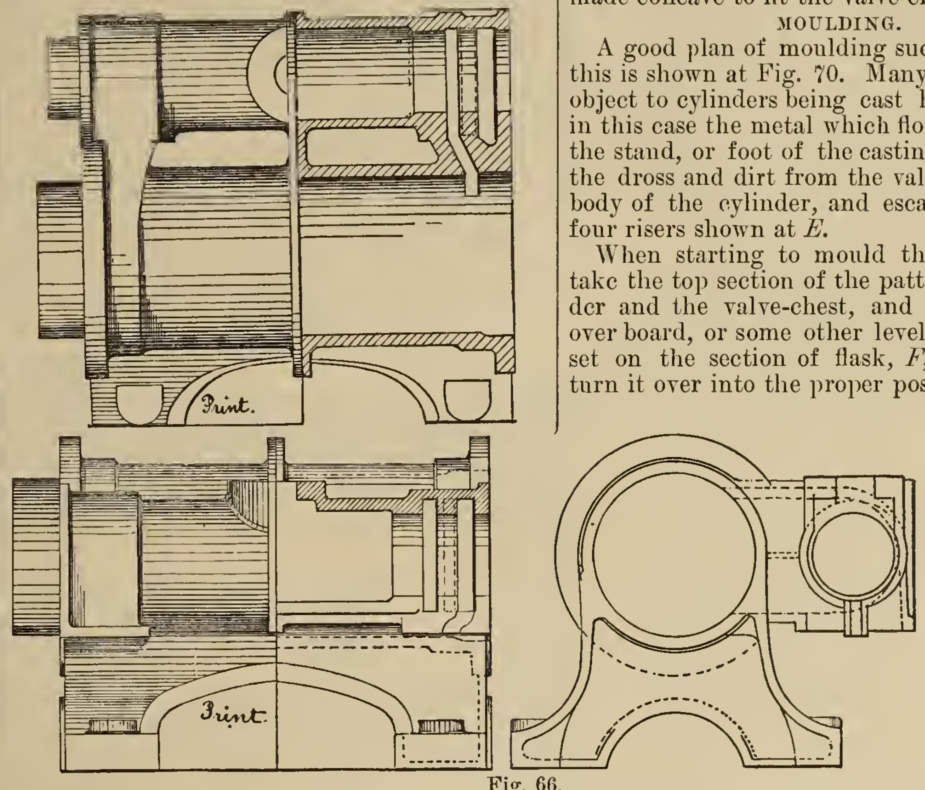
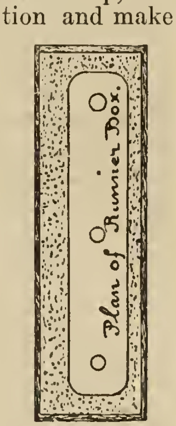


Fig. 66.



A plan and section of the valve-chest core-box is shown at Fig. 67. It is a half box, and it will be seen by the drawing that the body, port and exhaust-cores are all made in one. The pieces of wood which form the bottoms, divisions and side of the port and exhaust-cores, should be loose and an easy fit, so that they will come out of the body of the box with the core. They can then be easily drawn in sections without breaking the port or exhaust-cores.

Fig. 68 is a side and end section of the stand core-box. It is made just the shape of the inside of the casting required, and all the brackets and pieces, *D*, which form the feet or bearing surfaces of the cylinders, are loose and drawn from the core separately.

A plan and section of the steam-inlet core-box is shown at Fig. 69; it requires very little explanation. It is an open box, and the top made concave to fit the valve-chest body core.

MOULDING.

A good plan of moulding such a cylinder as this is shown at Fig. 70. Many engine builders object to cylinders being cast horizontally, but in this case the metal which flows up and forms the stand, or foot of the casting, carries off all the dross and dirt from the valve-chest and the body of the cylinder, and escapes through the four risers shown at *E*.

When starting to mould this cylinder, first take the top section of the pattern of the cylinder and the valve-chest, and set it on a turn-over board, or some other level surface. Then set on the section of flask, *F*, ram it up, and turn it over into the proper position and make the parting at *G*, and then set on the bottom section of the pattern of the valve-chest and the body of the cylinder.

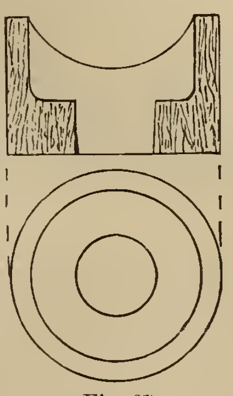


Fig. 67.

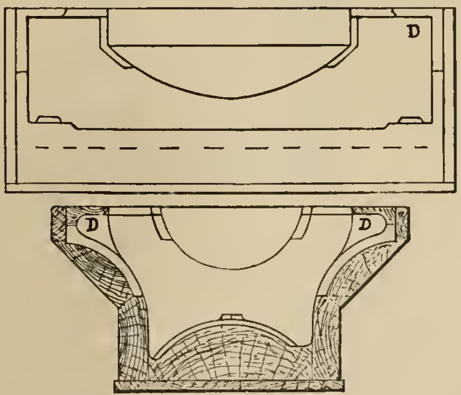


Fig. 68.

The section of flask, *H*, may then be put in place and rammed up to *J*, where the parting is made. The section of the pattern which forms the feet of the cylinder must now be put in place, and the flask, *K*, set on and rammed up level with the top of the pattern and the parting made at *L*. The cope-flask may now be put on and rammed up.

The mould is then opened and the different sections of the pattern drawn from the sand. When this has been done we may finish the mould, set the cores, close the mould, make risers and runner-box, and we are ready to cast, as shown in the figure.

The method of casting the same cylinder vertically is shown at Fig. 71. In this case the end section of the pattern is first set in the lower section of the flask shown in the figure; the flask filled in and rammed up around the prints, level with the lower edge of the flanges, and the parting made at *M*. The part of the flask, *N*, is then set in place and moulded up to *P*, where the parting is made. The main part of the pattern may then be put in position, and the flask, *R*, set on and moulded up level with the top of the flange, and the parting made at *S*. We can then put on the cope and ram it up. When this has been done we are ready to open the mould and draw all the different sections of the pattern, finish the mould and close it down.

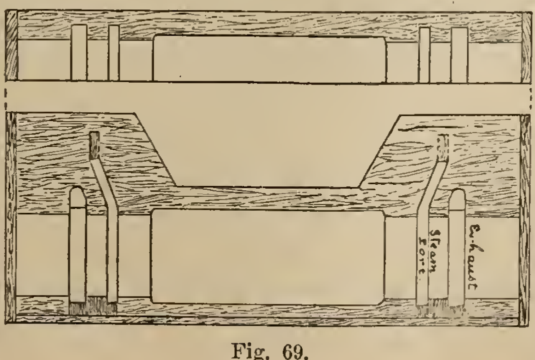


Fig. 69.

When setting the cores, as shown in the figure, a space of about ½″ should be left between the port-core and the cylinder body-core. This allows the dirt, which would have a tendency to lodge under the sides of the ports, to pass between the cores and be carried off by the risers, *T.*

(Concluded.)

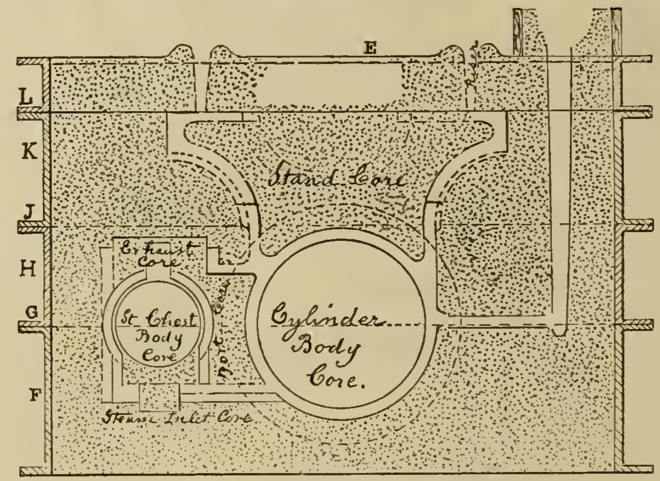


Fig. 70.

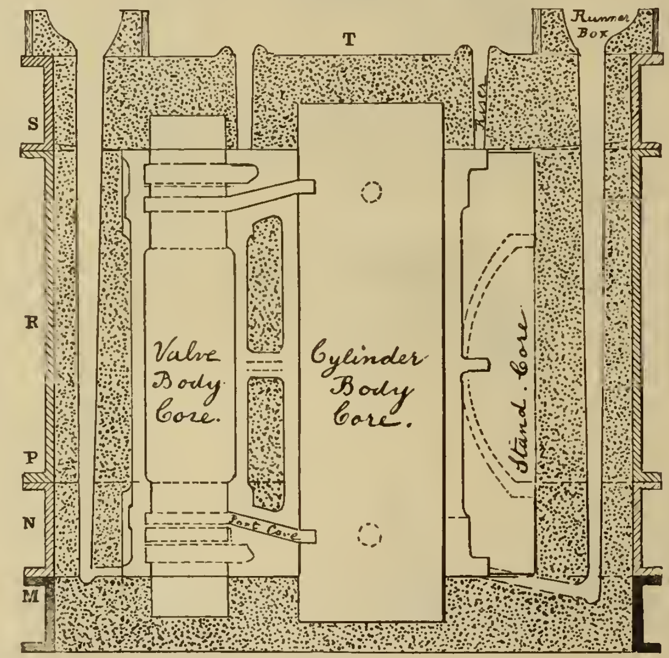


Fig. 71.

THE NEW TIME STANDARD.

On Sunday last, November 18, the new time standard adopted by the railroads of the United States went into effect, and its evident advantages for general public use are so obvious that the system agreed upon by the railroads has been accepted generally by the community wherever it has been understood.

COMMON CLOCK TIME.

The hearty encouragement given it since the railroad convention at Chicago promulgated the scheme leaves little doubt that the uniform standard will come into vogue through the force of its own excellence. But, whatever reluctance to adopt it may exist in some localities through an unwise conservatism or from a spirit of jealousy, the innovation is destined to prevail wherever the great railroads lines make their way. These great arteries of business are so dominant in the local concerns of States, and their clocks are now so generally the criterion, that "railroad time" (which after next Sunday will be the new kind) will be the clock time for nine-tenths of the population outside the great cities.

DETAILS OF THE PLAN.

The country is indebted to two citizens of New York for the original suggestions leading up to this important innovation in our practical and social economy—an innovation which is likely, as a convenience in public business, to take rank with the American invention of the decimal system of currency. The confusion of time standards in a nation with so broad a domain as ours, had been the source of unceasing annoyance and trouble. The remedy occurred to Professor Cleveland Abbe, of the Signal Bureau at Washington, a graduate of the College of the City of New York, and his plans were elaborated by Dr. F. A. P. Barnard, of Columbia College, who, as delegate to the International Congress at Liverpool last year, laid the foundation for the eventual extension of the system to Europe and the East. Professor Abbe proposed his plan as early as the year 1878 at a meeting of the American Meteorological Society. To understand it, let us go back to our school days and recall the answer we were accustomed to vociferate when the teacher asked, "What is the shape of the earth?"

"ROUND, LIKE AN ORANGE."

Now, let us take this fruit, and, stripping it of its rind, imagine that nature has divided the sphere into twenty-four sections, instead of the eight or ten which we find it made up of. If these sections are of equal width they will represent to us the twenty-four sections into which the surface of the earth is supposed to be divided to secure the basis of the system of standard time—the standard in each section being an even hour prevailing as the time all over the area of the section. In the circuit of the orange—or the earth—the twenty-four sections will thus occupy successively each and all of the twenty-four hours of the day. Suppose next that midway between the seams of the sections of the orange, we draw with ink twenty-four lines—from pole to pole—and conceive that one of these black lines coincide with the longitude of Greenwich. Then the twenty-four black lines, which in the revolution of the earth are just an hour apart in coming vertically beneath the sun, represent the twenty-four arbitrary meridians, each of which starting at Greenwich, is to give the time to the country half way on each side of it, or, in the case of the orange, to the space between the seams. What to call these spaces puzzles the experts. It would be in conformity with geographical nomenclature to speak of them as belts or zones, but these terms imply parallel boundaries like the zones of temperature, whereas as the meridians converge from the Equator to the poles, inclosing on each side of the Equator a series of convex triangles. Possibly, as the railroads have given the initiative in the practical use of the new standard, they will be designated as time divisions or sections, although this nomenclature might again conflict with the terms used for the different portions of a long line of railway, especially that of "divisions," in which it is quite customary to subordinate the operation of a protracted extent of railway. The expression "sections" will probably be adopted as nearest the definition of what is meant.

THE FIVE "SECTIONS."

An inspection of the atlas of the Western Hemisphere shows that all the land composing the continent of North America is contained substantially between the 50th and 130th degrees of west longitude. Professor Abbe started with the meridian of 60 degrees west of Greenwich—or the four-hour meridian—and proposed that it should give the time to Newfoundland, Nova Scotia, New Brunswick and all the maritime provinces of Canada. His next meridian, the one 75 degrees west of and five hours later than Greenwich, was to dominate New England and the Middle States and Quebec and Ontario in Canada. The third was the meridian of 90 degrees, the six-hour meridian, being the longitude of New Orleans, and was to fix the time for the Mississippi Valley. The fourth, that of Denver and Pike's Peak—namely, 105 degrees, seven hours later than Greenwich—was to govern the time of the Rocky Mountain section, and the fifth that of Santa Barbara, California—120 degrees—the eight-hour meridian, was to be the standard for the Pacific slope. To these he gave respectively the designations—Eastern time, Atlantic time, Valley time, Mountain time and Pacific time. It is only fair to another scientist to say that at about the same time that Professor Abbe brought forward this plan one almost precisely similar was proposed to the Canadian Institute at Toronto by Chancellor Sandford Fleming, of the Queen's University, who, during his previous career as chief engineer of the Canadian Pacific Railway—an east and west line—had his attention directed to the necessity of uniform time schedules.

Attention was directed anew to Professor Abbe's methods by the objections raised against others, all of which would break up except for places contiguous to the selected one or two meridians, the long established association between the hours of the day and the fixed habits of life as, say, to meals and the general routine of daily duties, and would tend to confuse and derange business except among professional people, savans, navigators and scientific men, who could keep mental record of the difference between local and standard time.

IDENTICAL MINUTES AND SECONDS.

The curious and valuable feature of his plan was this, however: No standard clock would be more than half an hour slower or faster than the local time anywhere, even at the half-way lines between the time meridians—the seams of the orange—and while the hour hands would differ by intervals of unity from section to section, the minute and second hands would point identically to the same figures on every clock over the whole face of the earth. For instance, when it was fifteen minutes and fifteen seconds past twelve o'clock at Greenwich it would be exactly fifteen and a quarter minutes past some hour of the clock on every other time-piece all over the globe. This scheme received at once the emphatic approval of a number of scientific associations. Dr. Barnard, in commending it to the attention of the International Congress at Liverpool last year, cited as an argument in its advocacy the fact that the report in its favor to the body last named was drawn up by no less an authority than the distinguished astronomer Professor Otto Struve director of the renowned Russian Imperial Observatory at Pulkova, for which an American firm recently manufactured one of the largest telescopic lenses ever constructed.

The practical value of the plan was seen at once by the railway companies, and its adoption by them gives it a vigorous start. The objections raised in Boston have been overcome by arguments showing that in the usual clock time in any place is not, in fact, an exact record of the sun's daily journey—the difference at certain seasons of the year being fully as much as the "slowing" which Boston's clocks will be subjected to on and after Sunday next. There is a difference of opinion in Washington as to the legal right of the Executive to order a change of the clocks there to the new meridian time, but Congress is likely to obviate any difficulty of this kind by giving its sanction to the alteration.

In New York city the clocks will be put back just three minutes and fifty-eight and a half seconds. In Philadelphia clock-time will be about a minute fast. Among the places where the clocks will be exactly right by the new standard are Ottawa, Canada; Potsdam, Cooperstown and Herkimer in New York, and Vineland in New Jersey.—*N. Y. Herald.*

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THE IRON for the new Government lighthouse at Astoria is on the ground, and the foundations are now building. The lighthouse will be erected at the extreme end of Hallett's Point. It is to be built entirely of iron, and will be 250 feet high, surmounted by a large dome. The light will be furnished by electricity, through a powerful engine in the building, and there will be six electric lights, having altogether 20,000 candle power. An elevator run by steam will take passengers to the top of the lighthouse. The light will be seen from Sandy Hook and up Long Island Sound beyond New Rochelle. It will render the passage of Hell Gate as easy by night as by day. It will not be ready for use before next spring.—*N. Y. Sun.*

◆

SIEMENS, THE WELL-KNOWN scientist, engineer and electrician, died Nov. 20th, of rupture of the heart. He was 63 years of age.

SOME DETAILS OF A NEW ENGLISH EXPRESS LOCOMOTIVE.

The boiler contains a great deal of heating surface in proportion to its weight and its size. The tubes being small, numerous and closely set, it would not be possible to work such a boiler satisfactorily unless certain precautions were taken to supply it with very clean and pure feed-water. It is well-known that if water is heated it throws down lime salts, and the use of hot feed-water economizes fuel and spares the boiler many strains due to the forcing in of cold water. Mr. Stroudley has for several years heated his feed-water by carrying a portion of the exhaust steam back into the tender. This system also allows the exhaust of the Westinghouse pump to be utilized, as this is turned into the bottom of the tank through a check valve; it also softens the blast and permits the waste cock from the steam chest to discharge into the water instead of blowing all over the station—a very serious matter in crowded London stations in the winter. To use hot water, however, a pump must be employed. It has three inlet and three outlet valves, and an air chamber placed quite close over the outlet valves. Such pumps give less trouble and cost less to maintain than injectors. In the suction pipe two small snifting valves are fitted; these take in air at every stroke, and so soften the working of the pumps, and keep the air vessels supplied. When the water, however, gets very low in the tender and very hot, these valves do not work; and a small cock is provided on the Westinghouse main pipe, which allows a little air to escape into the pump, keeping it perfectly quiet, as when the water is colder. By using this system, in preference to injectors, the boiler is also kept cleaner, and of course makes steam better. The large goods engines on the Brighton Railway ran 300,000 miles before the tubes were taken out, and they were then quite clean. A point worth notice is that the tubes are all bent upwards by an amount equal to their own diameter, namely, 1½ in. This permits expansion and contraction to take place without starting the tube ends in the plates, the tubes hogging up or straightening themselves as the case may be. This bending is done very quickly and accurately across a horse by the boiler makers. The tubes so bent never leak or give trouble in any way.

The crown of the fire-box is supported by solid roof stays; these are forged, and the water spaces cut out, the bosses being afterwards rounded in a drilling machine and tapped. This admits of the stay being reduced in thickness and kept well above the crown plate, the space being actually 2 in. These stays lap well over the ends of the vertical plates on which they rest, and are provided at the back ends with bosses into which copper stays are tapped in the same manner as in the other parts of the fire-box. There are no longitudinal stays. The stays are attached to the crown of the outer shell by heavy angle bars which are carried well down into the water space and thinned off towards the ends, to prevent local action by the deflection of the crown. The holes are made $\frac{5}{16}$ in. oval to permit the fire-box to rise when the steam is being got up. It is now more than twenty-five years since Mr. Stroudley first adopted this practice. Roof stays have been generally made flat on the underside, and a ferrule put between the stay and the crown of the box; but as this is not in metallic contact with the stay bolt, the latter becomes heated and the head burns off and gives trouble. This does not take place when the stay bolt is screwed into the roof stay close down to the plate, as the cooling surface of the stay is so great as to protect the stay bolt.

Engines fitted with pumps alone will get into trouble if they are compelled to stop for any time with a heavy fire on, no means existing of getting water into the boiler. To obviate this difficulty Mr. Stroudly puts an auxiliary feed-pump under the air cylinder of the Westinghouse engine, and he provides a valve by which air is permitted to circulate in the air pump instead of being forced into the receiver. The Westinghouse engine being then put in motion will feed the boiler with water at a sufficient rate to avoid all risk while the locomotive is standing. The auxiliary pump is capable of throwing about one-half as much water as one of the normal feed-pumps. The back pressure is in nearly all cases very small for a locomotive, and it may be mentioned here that the engines on the London and Brighton Railway do not throw sparks, and the smoke-box temperature is so low that a piece of waste tied to the exhaust pipe by one end will remain unconsumed for a considerable period.* This experiment has actually been tried. The result is due, no doubt, to the large calorimeter of the tubes, and to the peculiar method adopted for working the fire, which is really more a gas furnace than anything else.

As to the consumption of fuel and water we give the following particulars:—On Monday, the 8th October, the Gladstone left Brighton at 8.45 a.m. with twenty-five coaches; distance run, 50 miles, 49 chains; time, one hour and nine minutes; gross weight of train, including engine and tender, 350 tons; water used, 1400 gallons. The engine returned to Brighton on the same day with fourteen coaches. Started to time, but arrived seven minutes late being stopped ten minutes by signal; running time, one hour and seven minutes; gross weight of train, 225 tons; water used, 1250 gallons. Average load for day's work, 19·5 vehicles; miles run, 101 18c.; vehicle miles, 1973 71c.; coal consumed. 28 cwt.; consumption per train mile, 30·98 lb.; per vehicle mile, 1·58 lb. If 10 lb. per train mile be allowed for engine, the consumption per vehicle mile would be 1·08 lb. Water used, 2650 gallons; pounds of water to pounds of coal, 8·45; average temperature of feed-water, 152·5; average boiler pressure, 132·5 lb.: weather, fine. No allowance is made here for coal consumed while standing under steam and shunting. In considering the evaporation, allowance must be made for the water returned to the tender in the shape of steam. If the performance of this engine be compared with that of the compound locomotive of Mr. Webb, it will be found that the advantage claimed for the latter does not come out very prominently.—*London Engineer.*

THE REASON WHY.

An English Consul at Rio Grande, del Sud., in the San Francisco *Bulletin*, refers to the progress that is being made with the construction of the railway from Rio Grande to Bage, which is being carried on by a French company, and in this connection he says:

"In alluding to this railway I may mention a circumstance which seems worthy of the attention of English mechanical engineers, viz., that the company are importing the locomotives required from the United States, and a vessel arrived recently from Philadelphia with six. It might be natural to suppose that the company, being French, would give a preference to the manufacturers of such articles in France. The favorable reputation also which Belgium has acquired might, reasonably enough, have induced the company to satisfy their requirements in that country. But, excluding the special reasons which might have favored France or Belgium, I should certainly have thought that Great Britain offers advantages for the supply of locomotives which can not be approached by the United States, I mean, of course, in regard to cost, for I do not in the least insinuate that the company have not been well served as far as quality is concerned. They must, however, know their own business best, and have good grounds for the course they have adopted. My object in drawing attention to the matter is that our own manufacturers may be induced to inquire and ascertain for themselves how it comes that, in regard to articles for which they have hitherto stood pre-eminent, the preference is now frequently given to other countries."

Well, there are several reasons, the chief being that American locomotives do more work and are easier on repairs than others.

LIGHTNING RAN along the wire into an Indiana telegraph office. The operator thought that a phenomenal man was at work on a hasty message. "Don't send so fast," he protested.

CORRODED WIRE CABLES.

Our suspension bridge, that link between the sister cities which is traveled by hundreds of thousands of people weekly, has been in a state of commotion, owing to the repairs being made upon it. It has been twenty-four years since the bridge was built, and in all that time the moorings of the cables have not been repaired to any extent. Colonel Roebling thought it would be well to examine the wires and see what condition they were in, for the bridge was in danger of being ruined by the sagging, and even by the breaking of the cables. The large cables, which are seven and one-quarter inches in diameter, were surrounded at the moorings on each end by masonry which was concreted closely around the wires. Before the cables were surrounded they were covered with a preparation of boiled tar. Tar was once supposed to be an admirable protector of iron, but this belief was exploded long ago, and the result in the present case illustrates how injurious it is. The tar gradually, through atmospheric influences, changed into tar water, and this water was rapidly ruining the wire. The water contained chloride; carbonate and other salts of ammonia, which ate the iron. Some pieces of wire were dotted with little holes like small-pox pits, where the rust had gnawed away the material, and when the wires were uncovered and a strain put upon them they snapped like straws. Although each of the eighth of an inch wires should stand a strain of 1,200 pounds they broke at 200. Whenever a defective piece was found it was cut out and a new piece spliced in. The splicing was a delicate and a difficult piece of work. It is easy enough to join the ends together, but it is not so easy to get just the right strain on the new piece. There must be no slack wires in the cable, of course, so each splice is put in with a grip machine, and the amount of strain is kept uniform by delicate tests. In one large cable 175 wires had to be spliced, in another thirty-one, in another seventy-one, five in another, and thirty-one in another, and three are not yet examined. It is very tedious work scraping each wire, as only a few men can work at a time. There are 600 of these wires in the big cables and 200 in the small ones, so that the amount of work can readily be seen. After the wires are scraped they are covered with a coating of linseed oil, which is allowed to dry, and a thorough application of white lead is given. Then the wires are drawn together by bands of small wire seven inches apart, and the wrapping goes on. The wrapping consists of wire one-sixteenth of an inch thick, and it takes 300 feet of this wire to a foot of cable. A coat of ordinary white lead and coloring finishes the work. One mistake made in building the bridge was in putting the masonry around the cables at the moorings so that they could not be examined. The masonry has been all removed, and a bricked tunnel built which is water tight, and is provided with iron water shedders and covered by iron plates, which can be lifted if necessary to repaint or repair the cables in future. Where the cables pass through the wood-work, holes have been made so that all parts of the big wire can be reached at any time. Collingwood says that it takes ten per cent. yearly of the cost of a large bridge to keep it in good condition.—*Pittsburgh Telegraph.*

DANGERS INCIDENT TO THE USE OF POOR OILS.

The injuries resulting from the use of poor lubricants will not always be perceptible at once, but they are produced gradually and persistently. The bearings of the machinery are telltales of the quality of the lubricant used; they appear covered with gummy and dirty-looking incrustations, the result of decomposed and accumulated impurities, and the saturated timber and floors in the vicinity of the bearings indicate the waste and danger.

Most of the cheap black lubricators are made from the residuum, of petroleum stills, which, at the best, have been steamed and settled, thereby assuming a less tarry color and separating some of its gritty components, but much of the latter, mostly in the form of charred products remain. The residuum is thinned out to consistency for lubricating purposes, and as it is of very low gravity, permits the use thereto of the cheapest kind of natural oils with all their lighter and inflammable products, and frequently even the coarser kinds of benzine alone are used. These mixtures are brought to a gravity of 28 to 29 deg. B., in imitation of the once celebrated natural 28 deg. West Virginia oils, and are largely sold under that name. Frequently these oils are mixed in so coarse a manner that, when at rest in the packages, the heavy residuum will separate underneath the lighter fluid oil, and the danger arising from the using of such oils is apparent.

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* [English waste must be in the nature of asbestos.]

In cold weather, and when first poured on the bearings, these oils have an apparent good body, but in warm weather and in warm places they soon thin out, and in flour mills, where it is distributed over hundred of bearings, it spreads minutely over the adjoining wood-work and floors. It evaporates rapidly, and its inflammable vapors, mingled with the close atmosphere highly saturated with floating flour dust, form explosive combinations which a single spark, produced by the accidental getting into the mill of even the smallest piece of iron, will explode. In saw mills, where pillow blocks, the surrounding wood-work, the floors and saw-dust are saturated with such oil, and where, on hot days and when the sun shines on them, the rising vapor can be seen, a flying spark from the rapidly revolving saws is all that is needed to set the whole place on fire.

Why, then, do managers of large mills and other establishments persist in running their machinery with poor and dangerous oils?

They seem to forget that lubrication is as important a factor in the control and economy of motion and power as they need hands to attend to it, as they need light to see at their work, and as they need fuel to produce the power and motion with which to do it, but inattention to these facts and false economy induces them to pursue a faulty policy.

They claim it to be of no use to purchase better oils, as the hands pour it on recklessly any way, but acknowledge thereby poor management and want of control over their men. It is no wonder the men pour it on. They have to do so in order to keep the bearings cool, and while the oil runs out below as fast as they pour it on above; with oil capable of doing its work with regularity and efficiency they would not do so, as lubricating means also exertion, requires attention and causes labor.—*American Miller.*

GAUGE-COCKS AND WATER-GAUGES.

The *water-gauge* is one of the most important fixtures pertaining to a steam boiler, and upon its indications the safety of the boiler in a great measure depends. Therefore it behooves the engineer and steam-user to look sharply to its condition at all times, and see that it is in proper order, and that its indications show the true level of water in the boiler.

Probably the most reliable of all the different forms of apparatus that have been devised for showing the height of water in steam boilers is the ordinary gauge-cock, properly located and kept clean. The glass gauge is a valuable adjunct in the hands of a careful man, but as ordinarily constructed is very apt to become stopped up, unless the water is more than ordinarily pure, and then, if too much reliance is placed upon it, its indications are not only useless, but absolutely dangerous. Many accidents that have occurred have undoubtedly been due to the passages to the glass having become filled up with sediment, so that the water-level indicated by the glass was not that of the water in the boiler. When a glass water-gauge is used, more especially when it is placed with the gauge-cocks on a column, or "combination," as it is usually called, it should be thoroughly blown out at least three times every day. Merely opening the drip-cock at the bottom of the glass connection for a few seconds is not enough. Remember that there are *two* passages to the glass, *both* of which must be kept clean to give the glass any value as a water-gauge. When the glass is to be blown out, close the stop-valve at its upper end, and blow out the water passage at lower end, then close the stop-valve at lower end, and blow out the steam connections. When you have blown out the glass sufficiently, don't forget to open *both valves* and leave them open.

With a gauge-cock it is different. The very act of "trying" them assists in keeping them clean. The best way to connect them to a boiler is to run each one separately into the boiler straight through the front head. No bends in the pipe should be admitted. If the pipes are straight they may be easily cleaned by running a wire through them, even when steam is on the boiler. The connections should be of good size, not less than $\frac{3}{4}$-inch pipe being used.

When the cocks are placed on a column, or combination, the pipes connecting this with the boiler should never be less than $1\frac{1}{4}$ inches in diameter. They are usually made one-half or three-fourths of an inch. Where bends occur in these pipes, tees or crosses should be used instead of elbows. Then, by simply removing the plugs from the tees, the pipes may be easily cleaned out without disconnecting them from the boiler. A half-inch pipe should be run from lower end of water column into the ashpit. This pipe should be provided with a valve, by opening which the apparatus may be blown out once or twice daily.

When gauge-cocks become worn so that they begin to leak, it is very poor policy to continue them in use. They should be at once repaired or new ones substituted. When it becomes impossible for an engineer or fireman to close a cock after "trying" the water, he is very apt to try it only when he is obliged to, and very naturally too. The possible risk thus incurred of letting the water get low in the boiler is one that no steam user can afford to take.—*The Locomotive.*

BOOK NOTICES.

MONCKTON'S PRACTICAL GEOMETRY, being a series of lessons beginning with the simplest problems, and in the course embracing all of geometry likely to be required for the use of every class of mechanics, or that is needed for instruction of mechanical schools. Illustrated by forty-two full-page plates, by James H. Monckton, instructor for many years of the Mechanical Class in the General Society of Mechanics' and Tradesmens' Free Drawing School of the City of New York. Published by William T. Comstock, 6 Astor Place, New York. Price, $1.

Our first impression on taking up this work was that, while ostensibly addressed to mechanics, it was actually written for professors, or students who have had opportunities, but in this we were agreeably mistaken, for upon more careful examination we find that it is just such a work as should be in the hands of every mechanic, be he where he may. Particularly is it desirable for boiler-makers who lay out work, for through its teachings they will find the solution and reason of many rule of thumb plans which are followed from tradition. Beginning with the very simplest definitions of signs, angles, sections, parts of circles, quadrants, etc., etc., the author in plain language gives rules for the construction and solution of simple problems which will be found of great service to practical men. Accompanying the work is an introduction treating of the use of drawing instruments needed in developing the problems, and this part will be found valuable to students in mechanical drawing. No one can spend a dollar to better advantage than in the purchase of this work.

* * *

THE PATENTS for all cable railways have been purchased by a company located in this city called the National Cable Railway Company.

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which, with one exception, make a reduction in their rates in connection with us. All complaints of irregularity in receiving other papers must be made directly to the publishers of them, not to us.

	Publication Price per Year.	With The Mechanical Engineer.
Railroad Gazette	$4.20	$5.25
Scientific American	3.20	4.40
North-Western Miller	2.00	3.30
American Miller	1.00	2.50
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THE MECHANICAL ENGINEER FOR 1884.

In return for the many favors accorded us in the past by the trades we represent, we put forth renewed energy to merit a continuance of the good will shown. To this end we announce the following serials, which will appear in all of 1884.

HOW I SERVED MY APPRENTICESHIP.

This will run through many issues, and is an account of an actual service by a mechanical engineer now in charge of work. It deals with such matters as will be of interest to all in similar positions—not merely beginners, but others who have not had the fullest opportunities for informing themselves. The opening chapter takes a common wheel–press, such as is in use in every locomotive shop of any size, explains its principles and construction, the action and how to calculate its power. The problems are all in simple arithmetic and quite within the reach of mechanics. The style is easy and in narrative, so that, aside from its intrinsic worth, it is very entertaining.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks, of the University of Pennsylvania, will, in a series of papers, touch upon various points in the construction of steam engines, rendering the principles involved in their action clear to all. These papers will be as useful to designers and constructors as to working engineers, for the author will not follow others and expound text books already published, but reason from his own deductions and observation.

BOILER MANAGEMENT.

Under this head, Mr. A. H. Goff, a practical engineer of St. Louis, Mo., will give his experience with boilers of various kinds, as to the care and course to be pursued to insure the best results. The author will consider the subject from a practical standpoint, so that persons in similar situations can apply the instruction conveyed if it seems good to them.

A SERIES BY H. L. STELLWAGEN, ESQ.

These papers cannot be announced definitely as to the title, but we have made an engagement with the author, who is an engineer of ability, to give our readers the benefit of his experience, and from his previous contributions we know that the writer will both interest and instruct us.

In addition to these positive announcements, we shall have many other short papers through the year, which will be of permanent value. The Indicator Series, now publishing, will be continued well into 1884. and all who wish to know what their engines are doing as well as inform themselves upon the use of an instrument indispensable in every engine-room, should not fail to renew for 1884.

Locomotive work will have special attention in construction and management on the road. The success which has attended the efforts of the publishers during the past year is evidence to them that their enterprise will be supported, and the very considerable outlay involved in the serial papers announced above—all of which are paid for—is some evidence of an intention to deserve the reputation for practical value to workers in its line The Mechanical Engineer has won.

Club Rates of
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(Payable invariably in advance.)

One copy free to the party who organizes a club of ten or more names.

Egbert P. Watson & Son, 150 Nassau St., N. Y.

THE INDICATOR SERIES.

Many friends have written us that they are getting up clubs for The Mechanical Engineer, to commence from the Indicator Series. We have to advise these friends that we have at the present writing but a few hundred copies—by count 300—of the last issue on hand, notwithstanding that we printed a large extra edition from the beginning. Those who wish to have the series intact should not delay one moment. Three or four more clubs, like some we have received, would make 300 copies look sick!

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Maufg. Co., 95 & 97 Liberty Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
W. Barnet Le Van, 3607 Baring Street, Phila,, Pa.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. John Becker, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering. Send for catalogue before purchasing. F. Keppy, Publisher, Bridgeport, Conn.

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New York: Weekes & Melville, Printers, 25 Beekman St.

THE MECHANICAL ENGINEER.

New Series. Vol. VI.—No. 13.
Enlarged 1883.

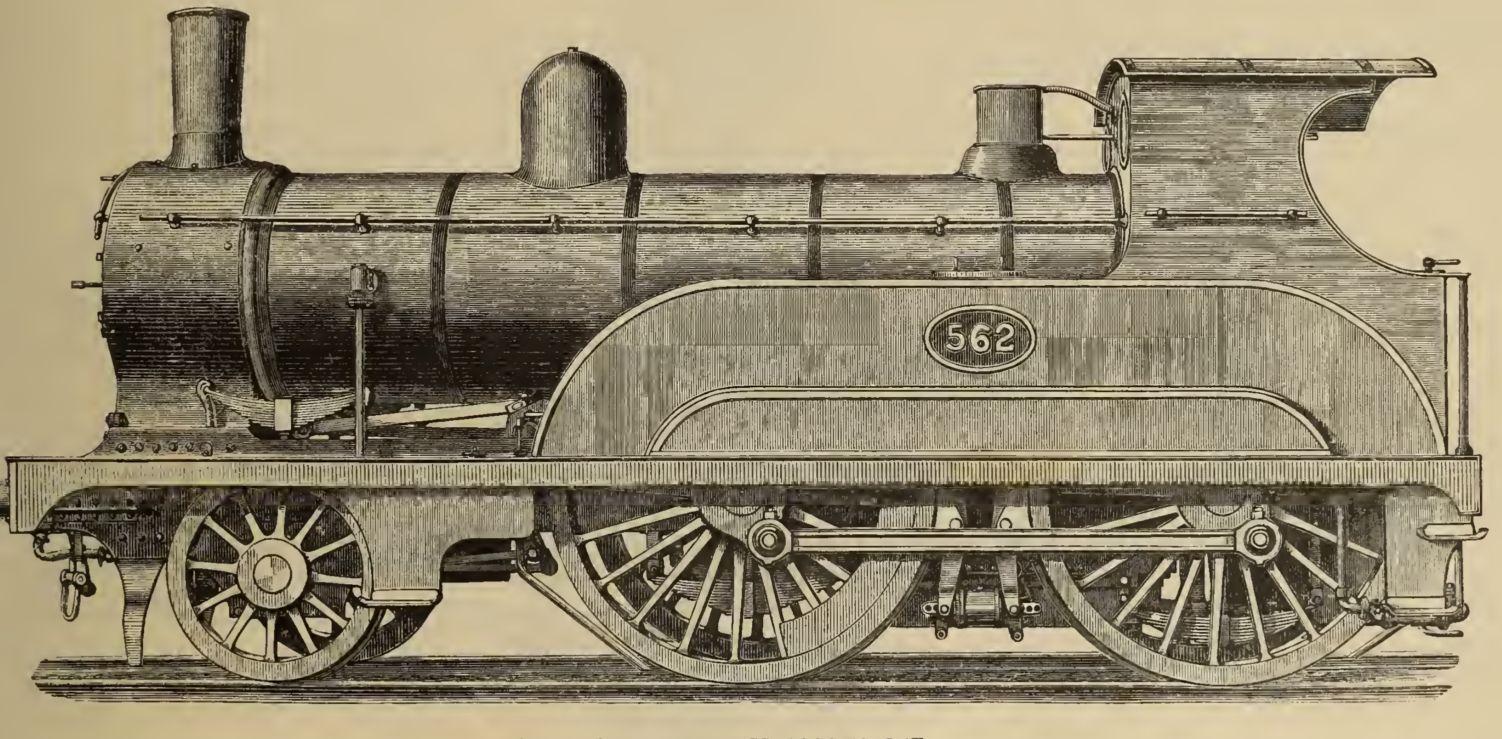
New York, December 22, 1883.

Single Copies 8 Cents.
$2.00 per Annum.

AN ENGLISH EXPRESS LOCOMOTIVE.

The engraving represents a new English express locomotive, and to our American readers it presents many peculiarities, especially externally. The cab will strike American engineers as somewhat contracted in space, and the short and tapered smokestack looks more like a temporary contrivance than a permanent fixture. The boiler is perfectly straight from end to end, while the dome, with its hemi-spherical top and exterior unrelieved by any ornament looks naked, affording no point for the eye to dwell upon with satisfaction. This is the locomotive reduced to its severest outlines, and these being not beautiful in themselves, leave something to be desired. Our comments are made in no captious mood, but to American eyes the English locomotive looks uncouth and ungainly.

The weight of this engine is not given, but its principal dimensions are as follows: Extreme length of engine, without tender, 26′ 3″; cylinders, 18″×24″; drivers, 7′; main axle bearing 7½″×9″, figures on drawing say six feet over all for length of fire-box; scale shows 7′; wheel-centers, 8′ 9″; boiler 50″ shell, with 201 tubes 1¾″ outside diameter, 11′ 9½″ long; exhaust nozzles, 4″. The Joy valve motion is used. This engine is used for rapid express trains, and the designer, Mr. Stroudley, has a high reputation in England as a locomotive engineer. Americans cannot but wish they could see one of these engines attached to, say two sleepers, two mail and baggage cars, and two ordinary coaches, and run on a time schedule of 50 miles per hour over an American railway, burning our soft coal.



AN ENGLISH EXPRESS LOCOMOTIVE.

◆

THE LATEST PERPETUAL MOTION.

"The public has heard so much about attempts to discover perpetual motion that it is looked upon as a chimera. It is no wonder, then, that the "perpetual motion" advertised around a tent in the Toronto fair failed to attract visitors. Yet the "perpetual motion" exhibited is really a good idea; whether of much actual utility or not, it may yet be too early to say. The inventor is Mr. Forster, of Guelph, Ont. Like many of the greatest discoveries, this is a very simple one. The motive power is simply air, contracted and expanded by the natural variations of temperature. A large cylinder of sheet iron is connected by a tube with a small cylinder with sides of oiled silk so as to swell or stretch like the side of a pair of bellows. The double air chamber is hermetically sealed. To the upper part of the smaller chamber are attached chains running over pulleys, and winding up a spring which furnishes the power for work. Whether the air expands or contracts the winding continues. It is claimed that a daily range of 10 degrees will furnish enough power to keep a pendulum going. A greater range will allow of power being retained for use in steady weather."

[We do not know where the above originated, but our comment is, that this invention is not a perpetual motion machine, even if it runs constantly, for it is acted on by an external force. A turbine under Niagara would be as much of a perpetual motion.—Eds.]

◆

THE CANNON-BALL QUESTION.

We have received one letter of dissent from our position on the cannon-ball question, from a gentleman in Iowa, whose letter we do not print. We must advise our friend that the force of gun-powder is independent of the velocity at which the cannon moves, or may move at the time of firing. Let him suppose himself the projectile, and the cannon in which he was, moved 1,000 miles an hour. Does he think he would drop harmlessly at the mouth of the gun, or would he go whirling through space ?

◆

A correspondent of the *London Engineer* says: "The hydraulic rivetter is never used in the best locomotive boilers in England, nor, indeed, in any first-class boiler works, but it is the mainstay of slop boiler makers, and an examination of most machine rivetted boilers will show that the edges of the plates are bulged out, while cracks are not uncommon."

◆

Mr. W. B. Le Van (whose address is 3,607 Baring street, Philadelphia) says, in regard to his articles in The Mechanical Engineer on the indicator:

"I receive letters, every day or so, wanting to know if I publish a book on the Indicator. In answer I have said that correspondents will find in your paper all that I have written on this subject."

◆

Friends are particularly requested not to send postage stamps for fractional sums. We have large quantities on hand and cannot sell them except at a discount.

Brethren of the throttle-valve will perhaps be glad to know that the gentle sex has invaded the engine room, and the surroundings of one young lady are thus mentioned in a Western paper:

> "A model 60-horse power nickel plated engine has been recently constructed at the machine shops of Messrs. Duvall & Co., Zanesville, Ohio, to be used in running their works, which are the oldest in the city. The engine is said to be a marvel of beauty, and the room in which it has recently been set is fitted up with massive black walnut furniture, large mirrors, and other adornments, including gold fish and flowers; presenting more the appearance of an elegantly furnished parlor than anything else This engine room has plate glass windows on three sides the entire height of the compartment, commanding an extensive view that exposes it to every one coming into the city by rail. The engine is in charge of Miss Sarah Bogue, niece of the senior proprietor of the works, a beautiful, accomplished, and talented young lady, sufficiently acquainted with the science of mechanism to discharge the duties of an engineer efficiently."

We think it is Mr. A. Getchell, a boiler inspector, who says:

> "The literature of boiler explosions is by no means scanty, and varies anywhere from sound practical experience to the most visionary idealism; but those who have had most to do with steam boilers, and whose business it is to trace results to causes, are singularly unanimous in the opinion that almost without exception boiler explosions may be traced directly back to the causes—overpressure and neglect."

Yes, sir; these are the causes.

◆

A gentleman in Brussels claims to have contrived a perpetual clock. It was started in the latter city about one year ago, and up to a recent date is said to have been running perfectly. An up draught is obtained in a tube or shaft by exposing it to the sun. This draught turns a fan, which winds up the weight of the clock until it reaches the top, when it actuates a brake that stops the fan, but leaves it free to start again after the weight has gone down a little, and thus the power is stored for keeping the clock in motion.—*Never-dying item.*

A big fan might wind a very small clock by such means, for the pressure obtained as above would be almost imperceptible. Is it worth while setting up "a tube" to save winding a little clock? *Answer.*—No, sir.

◆

The engine room of the Yonkers, N. Y., water-works, in charge of Mr. C. C. Daniels, is beautiful with flowers of all sorts in bloom. The engine-room is in other respects one of the handsomest in the State.

CYLINDER BORING MACHINE.

BY THE CRAWFORD IRON WORKS.

An indispensable machine in all shops where steam engines are made in large quantities is here illustrated. It is easily understood as to its general design and operation from the engraving and appended description. A long and heavy boring-bar is carried in two bearings, mounted on a bed; this bar is in two parts, and is shown separated in the engraving. This separation is for convenience of putting in the cylinder, and is a valuable feature. When set the cylinder is held in place by the chains seen hanging from the bed in the foreground; the chains being connected with heavy straps and bolts so that the work is held firmly in its place. There are also four heavy screws working in two cross-bars sliding in the bottom of the bed to adjust the cylinder properly before boring. The flanges are faced at the same time the boring is done, and this operation is performed by two sleeves seventeen inches long sliding on the bar, and having a tool carried in ways, the feed being given by a star on the end worked by the usual device. The boring bar is fed by the gearing shown at the extreme left, driving the screw attached to the bar.

These machines are very strongly made, and are furnished in three sizes, for cylinders from 7″ to 30″ diameter. They bore and face at the same time, and it is stated that five cylinders, 9″ × 20″, can be bored and faced perfectly in ten hours.

Made by the Crawford Iron Works, Meadville, Pa., who will send price lists to those desiring them.

THE ELECTRIC LOCOMOTIVE depends upon the work of a stationary engine driving a dynamo for its power. Does it not seem plain that the same steam engine would do more work, and do it cheaper, attached directly to the train? It would most certainly, and this is why we fail to see the utility of electric locomotives.

HOW TO WRITE FOR THE PRESS.

It would be a great favor to editors and printers if those who write for the press would observe the following rules:

Write with black ink, on white paper, wide-ruled.

Make the pages small—one-fourth that of a foolscap sheet.

Leave the second page of each leaf blank.

Give to the written page an ample margin all round.

Number the pages in the order of their succession.

Write in plain, bold hand, with less respect to beauty.

Use no abbreviations which are not to be put in print.

Punctuate the manuscript as it would be spoken.

For italics, underscore one line; for small capitals, two; capitals, three.

Never interline without the caret to show its place.

Take special care with every letter in proper names.

Review every word to be sure that none is illegible.

Put directions to the printer at the head of the first page.

Never write a private letter to the editor on the printer's copy, but always on a separate sheet.—*Obscure Genius.*

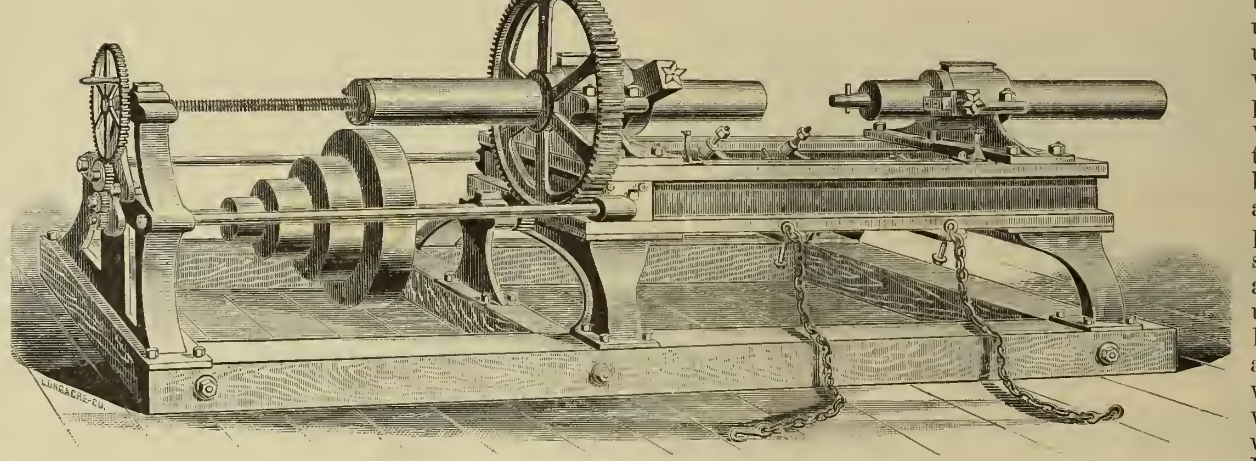
PARTIES KNOWING of a small dry dock to be had low for cash, will confer a favor by noting the advertisement on fourth page of cover.

"AGAINST THE SUN."

If a man stands facing the sun at sunrise or any other time, and whirls around to the right he is moving with the sun. If he whirls to the left he is moving against the sun. An augur runs with the sun when boring perpendicularly. By keeping these simple facts in mind, any one can determine a with or against the sun movement for themselves. Mechanics living south of the equator have to reverse the above rule. If they want a machine to run with the sun, and order it from the northern half of the hemisphere, they must order a machine against the sun, because with the sun down there, means against the sun up here. Upright shafts also run either with or against the sun. A horizontal shaft running parallel with the axis of the earth, also runs with or against the sun; as, for instance, if it were geared to the earth's axis with a pair of spur wheels it would run with the sun; if driven by an open belt from the earth's axis it would run against the sun. However, to apply a with or against the sun movement to a horizontal shaft is rather confusing, and rarely indulged in by practical men.—*Modern Miller.*

The expression above noted is obsolete, but in old countries some still use it. A much better statement is to say that a machine runs either right or left handed.—EDS.

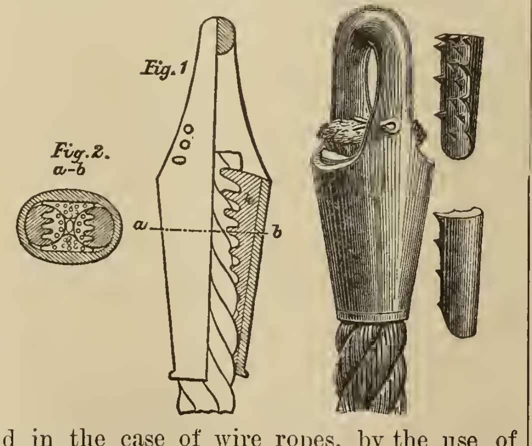
NEW HAVEN ASSOCIATION of Stationary Engineers, No. 2, write us by their librarian, Mr. L. M. Foster, that they have recently received a donation of $25 for books, and also that they have been promised lectures this winter by scientific gentlemen of Yale College, on matters relating to their business. This will be of great service, and we hope to be favored with reports for the benefit of other engineers. There are 73 members now in the New Haven Association, and it is increasing rapidly in influence and numbers.


LONGACRE-CO.

CYLINDER BORIMG MACHINE.

NEW ROPE ATTACHMENTS.

The accompanying engravings illustrate a new appliance for coupling hemp or wire ropes, and for connecting them to hooks or eyes. Up to the present this has been accomplished by splicing, riveting, screwing, knotting, and the like, and in the case of wire ropes, by the use of conical thimbles, into which the end of the rope has been inserted, and fixed by wedges driven into its center, or by metal run round it in a molten state. The new attachment consists of a conical shell, or thimble, provided with a hook or loop, and a pair of toothed wedges which nip the rope between them, increasing their grip according to the tension put upon the rope. These wedges are provided with teeth on the inside which indent the body of the rope, obtaining a greater frictional hold upon it than they do of the thimble, consequently if any slipping take place the wedges advance with the rope to a smaller part of the thimble and obtain a firmer grasp. The wedges are coned more sharply than the thimble, and the length and thickness of the teeth decrease towards the lower end, so that the bite upon the rope where it leaves the thimble is almost nothing, and is steadily increased to its upper end.



To fix the attachment in place, the end of the rope is pushed into the thimble from the lower part; then on each side of the thimble a wedge is inserted from the top end and driven in by a few blows with a hammer, after which the further tightening ensues in a self-acting manner as soon as the load is put on the rope. The wedges are kept from rising by a split pin.—*Engineering.*

FRIENDS ARE PARTICULARLY REQUESTED not to send postage stamps for fractional sums. We have large quantities on hand and cannot sell them except at a discount.

BROTHER R. DOTY, Secretary of Mutual Aid Marine Engineers' Association, in renewing his subscription with some others added, says:

> "I had forgotten it had run out, and was only reminded of it by the fact of not receiving the paper, as you very properly stopped it."

We did Brother Doty, we did. It is a way we have of trying to give equal measure to all. It is unjust to those who do pay to send papers to others without consideration, and it is unbusiness like for another. Our paper-maker sells us so much paper for a given price, and unless it is paid for he will not sell us any more. Neither will our printer work for us unless we pay his bills. We are in the same category. We receive many postal cards running: "Send us THE MECHANICAL ENGINEER for a few months," but we can't seem to remember that it was ever sent.

A VALUABLE SUGGESTION.

Miers Coryell, Esq., an American constructing engineer of wide experience in all parts of of the world, suggests to us that the use of a steel ribbon for street railways would obviate many of the difficulties found with cables, being much more easily managed as to gripping, releasing, carrying itself, renewal, repair, and first cost. The suggestion is a valuable one, and is presented to those who may wish to avail themselves of it.

ATCHISON, KANSAS, engineers organized Nov. 12, under the title of Atchison Association of Stationary Engineers, No. 1, of Kansas, with the following officers: President, B. G. Cheney; Vice-President, George Fishwick; Secretary, T. C. Logan; Treasurer, Oscar Verdan; Conductor, John Stanard; Doorkeeper, James Gilkinson; Past President, Richard Hard. The prospects of the association are very good; they go in, with true Western independence, to win without outside help.

DRILLING SQUARE HOLES used to be considered one of the impossibilities of the workshop, but some one with more ingenuity than sense contrived to do it. Turning square posts, however, is an accomplished fact, and machines for doing such work are in daily use. Square baluster posts, table legs, etc., etc., are now produced moulded or plain in large quantities.

No matter how long a pipe may be, if there is no leakage, water would flow along the pipe until the level of its surface was the same at both ends. But the rate of flow would diminish with the length and diameter of the pipe. Thus we can transmit power through a perfectly tight pipe however small, and however long; but when we come to consider the gross power that can be transmitted through a given pipe, with a given percentage of loss, the question is different. Given the size and strength of the pipe, the gross amount of power, and the percentage of loss, and the limits are fixed. Thus, says Professor Reynolds, taking a 12in. pipe capable of standing 1400 lbs. on the square inch, the loss in transmitting 1000-horse power would be about 5 per cent. per mile. at first increasing—as the preasure fell to 700 lbs.—to 10 per cent. We should thus have lost half the power in about seven miles. We cannot say that seven miles is the absolute limit, for with a 24in. pipe, which would cost four times as much per mile, we could transmit the same power thirty times as far with the same loss. The cost of laying a 12in. pipe for seven miles, however, would probably be as much as even 1000-horse power would stand; while a 24in. pipe for 200 miles would be out of all proportion. Then there e consideration of leakage, which although very small for short lengths, is larger for greater lengths.—*London Engineer.*

* * *

The property of the Troy, N. Y. Steam-Heating Company, constituting the plant of the works, radiators and about five miles of pipe, was sold at auction for $15,000, subject to about $3,000. The steam-heating works have been an extensive "white elephant," having cost, it is said, $225,000. Mr. Russel will take charge of and run the works at the expiration of the lease on May 1, 1884. The works will be run this winter. It is believed that for next season's operations a new company will be organized.—*Water Gas Journal.*

* * *

"Many a valuable suggestion is lost by failure or neglect to clip from a paper when it is fresh to hand, and sometimes by neglecting to paste the item away when it is clipped. I have seen a good many valuable technical or special books made up entirely of newspaper clippings."—*Age of Steel.*

So have we, though as to the value there might be a difference of opinion. Mr Joshua Rose in his work on mechanical drawing cooly appropriated three of the best illustrations in it from The Mechanical Engineer without a word of acknowledgment.

* * *

A contemporary says: "One of the most prolific causes of trouble in mill, factory, machine shop or other establishments where belts are used, is the careless cutting of belts ends when taking up slack. Unless cut off perfectly square, the belt never runs true, and when this occurs it is only one time in a thousand that the real cause is known and the proper remedy applied. Cut your belt ends square, "Yes, ends of belts should be cut square, but it is of more importance that they should be *laced* square. Oftener than otherwise the ends do not touch by a quarter of an inch; if the lace holes are not true the belt runs crooked.—Eds.

* * *

A novel application of photography has been introduced at Woolwich, and some very successful plates have been taken showing defects in the bores of guns sent back for examination after trials. The electric light, powerful lenses, and mirrors are employed for this purpose, and minute flaws in the metal undetected by the usual gutta-percha impressions, have been rendered clear to the eye by these photographs; they are likely to prove of essential service.

* * *

An inventive genius has discovered a new plan for oiling cylinders. He wants to make piston-rods hollow, so that they will act as oil pipes, and he has sufficient faith in his plan to expend patent-office fees upon it.—*Am. Machinist.*

Hollow piston rods are no novelty. Thorneycroft uses them as well as other torpedo boat makers.

A firm who make a specialty of the erection of shafting, state that their experience teaches that the loss of power due to improper conditions in the line shafting amounts to 50 per cent. of the engine power employed, and that the defects most commonly found are as follows: Shafting too light for the duty, crooked shafting, hangers too far apart, hanger bearings too short, pulleys too heavy and not properly balanced, hangers which are not adjustable and not self-adjusting, and sometimes filled with spurious Babbitt-metal, and improper proportion between two pulleys connected by the same belt.—*Am. Miller.*

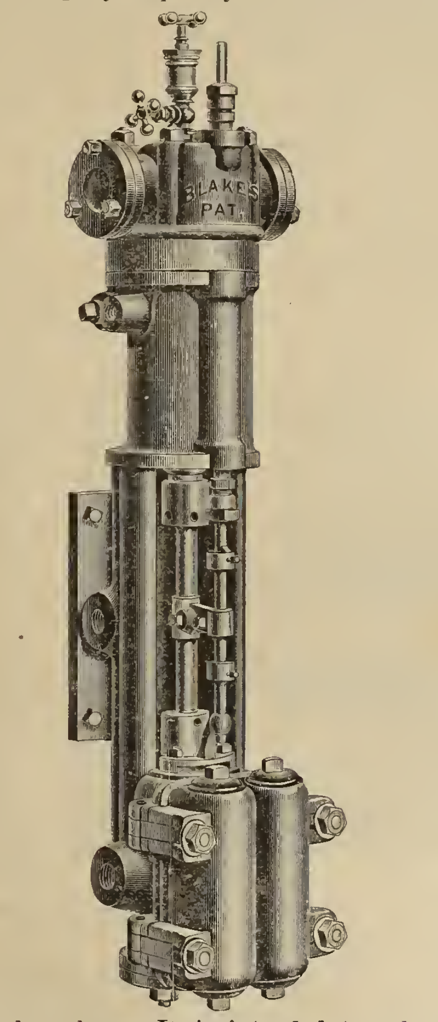
Yes, and stickemfast oil too.

* * *

INDEPENDENT FEED PUMP FOR LOCOMOTIVES AND STEAM LAUNCHES.

THE GEO. F. BLAKE M'F'G CO., NEW YORK AND BOSTON.

Our engraving represents a new and useful pump lately introduced by the Blake Steam Pump Company, expressly for locomotives and steam launches. It is intended to take the place of an injector for this purpose, and has many advantages over that instrument. It is absolutely certain to work under extremes of pressure and temperature, and requires no attention when in operation. It is usually bolted to the boiler in locomotives, and its position is similar to that of the air pump of the Westinghouse brake; it is also a favorite with naval engineers, and is adopted in the government launches to the exclusion of all others.



In construction it will be seen that the steam-chest and valve set horizontally on top of the steam cylinder, which offers every facility for examination, as well as the correct working of the valve; also that the feed and suction-valves on the pump-end are readily got at by unscrewing the swing bolts on the chamber. These valves work vertically and are consequently in position to seat properly at the highest speed the pump is run. An air-chamber is formed in the body of the bed-plate or main casting, which is hollow for that purpose. The water-valve seats and piston are of composition, and the latter is packed with fibrous material adjustable to any pressure

This pump can be run from the slowest motion to three hundred feet piston speed per minute, if needed, and always starts at the moment steam is let on; there is no dead center. It is widely used on locomotives in lieu of the injector, and is well adapted to any situation where space is limited and where steady and reliable feed is wanted regularly or intermittently. Circulars and price lists furnished by The Geo. F. Blake Mfg. Company, New York and Boston.

* * *

The *London Engineer*, Nov. 16th, says:

> "The American *Mechanical Engineer* makes a special note of our quoting from it and acknowledging the *American Engineer.* But the first named takes a note from us on a method of getting at the speed a train is running, and does not even credit it to a contemporary of a similar or any other name. American fair play does not always appear on the surface, but the *Mechanical Engineer* does not often make this mistake."

Our contemporary is quite justified in its remarks; the property it alludes to was found in our possession and without credit. It struck us at the time that it was an old acquaintance in a new guise, not especially the production of our contemporary. We are sensitive in the matter of credits and will not wittingly trespass. Our columns are the best evidence of sincerity we can offer.

* * *

We find in *The Mechanical World* a notice of an American book. It says:

> "The style is thoroughly American, displaying that peculiar curtness of expression so noticeable amongst American technical writers, but it is clear and distinct."

"And a good thing, too," to use an English expression. Life is too short to be spent wallowing in words. Better be curt than verbose.

* * *

Some English firms now build lathes with very long beds, say 24 to 30 feet, and put four complete lathes on them, entirely distinct as regards fittings and belongings. This saves shop room to some extent, but it offers a premium to tool stealers, which would not be slowly taken advantage of in some parts of this country. A man would have to carry his tools in his pocket if he wanted to keep them; particularly if just ground.

* * *

Regarding the sorghum sugar industry in Kansas, M. Day, Jr., writes to the Buffalo *Express* that two refineries have reported unqualified success this season. One is managed by Professor M. E. Scoville, and the other by Professor Swenson, late agricultural chemist in the State University, Wis. The two companies cultivate 3,000 acres of cane, and the yield will be from sixty to seventy-five gallons of syrup. Both sugar and syrup are entirely free from the sorghum flavor.

* * *

Solid connections, as they may be called, of the valve-stem to the rocker-arm are viewed with disfavor by many. They are charged with a share of the irregular wear of the valve-faces by inducing a prying motion, with the stuffing-box as a fulcrum. It is asserted that with the old fashioned knuckle-joint on the valve-stem, valve-faces kept in order a much longer time. What do our friends say about this?

* * *

A friend in Pittsburgh writes asking us to publish Mr. William Meredith's views on valves and valve motions, etc., as delivered at a recent lecture in Cincinnati. We, perhaps, should do so if we had them, but as Bro. Meredith long ago ceased his communications to this journal we are unable to reach him.

* * *

Dr. Wedding says that when melted cast-iron is allowed to chill, the first crystals which form are nearly pure iron. He suggests that, by repeatedly crystallizing the iron, a metal of high character may be obtained from poor pig-iron. This would work very well but for one thing, which is that poor iron will not chill.

* * *

Into the American fur trade enter the skins of monkeys, cats, rats and skunks. From the last-named animal comes much of the fur that is politely described by the dealers as Australian mink, and as there are about 350,000 skunks used annually, we naturally have a great deal of mink.

* * *

Jacob Seib, near Erie, Pa banked his savings in the parlor stove; his wife made a fire and burned up $10,000.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

REPAIRING BREAK DOWNS; AN ENGINEERS' EXPERIENCES.

Editors MECHANICAL ENGINEER.

I have been reading your valuable paper for a year or more, and must say that I have gained considerable knowledge from it; especially from the correspondents' department.

As you say if engineers would only give their experiences oftener it would make the paper still more interesting. Nearly all could tell something that others might be benefitted by. It may seem of little value to themselves, but would be very useful to others.

Now, I don't think I am any better than plenty of others, nor do I want you to think so, but I have been at the business twenty years, on river and ocean steamers with a variety of engines; up to this time I have never been towed into port, or asked for assistance. I don't mean to brag on this for I may have plenty of mishaps yet.

I remember on one occasion, I was running a single engine, when the main valve stem broke in the stuffing-box. I was at loss to know what to do. I sat down and thought the matter over quietly; for there was no use getting excited, which naturally upsets everything besides getting everybody wild about you. After planning out what I wanted, I went to work and disconnected the stem, filed the ends straight across, drilled end tapped a ⅜ hole in each, and then cut a stud and screwed them both together. It made a very good job. Every boat should be supplied with taps and dies, drills and ratchets in different sizes; from, say ¼ up to 1 inch diameter.

We often hear of cylinder heads being knocked out from the breaking of follower-bolts. Now during my experience, I never had the latter break under steam, but I have broken several putting them in. I always make sure that they don't touch the bottom. Then I take a 24 inch wrench (for an ordinary size bolt) and screw them down solid. I don't want any help on the wrench. If I find the bolt gives at the finishing, then I try to break it. I find that is about the best time to have them break. If the bolt after straining is left in the piston, expansion takes effect on it, and away goes the bolt and the cylinder-head with it; oftentimes follower and piston also.

There are a number of men running old style double engines. If the valves slip on the stem or the eccentric shifts, both engines come to a stop; now, to tell which is at fault! There are some beginners who would be obliged to open both steam chests before finding the cause of the trouble. I saw an instance of this kind a little over a year ago, that induces me to mention this; but the party was not a beginner. He was trying to lift a piece of machinery when the engines stopped, and being a crack man out of one of the big New York shops, putting up machinery and bossing the job, I hardly looked for such an exhibition. He had some six or eight men waiting on him to get things in place. My boat was lying within sight near enough to see all that was going on. One thing I noticed he made plenty of noise. You might have heard him a long way off. I thought I would "edge around" a little and see what was going on. The man began to slack the friction-band, then the journals one after another; he said "the thing had been lying in the rain and got rusted; had the same trouble with others." With all this assistance the engine would not work. I suggested that he should examine the valves, but he hooted at me, saying the eccentrics were keyed on, and "our valves don't slip, besides if I break the joints, I have nothing to renew with," so I made myself known to him, and told him that I could accommodate him with all the gum wanted. Finally he said, "this beats all I ever saw." Then he asked me if I could see anything wrong with the "d——d thing," I said "yes, and if there is nothing broken we can fix it very easily; the right hand engine is at full stroke so that can't be wrong; the left is at half stroke, if it was all right it would pull the other off the center. So we took the bonnet off and found the valve adrift. It had been secured with clamps and they had slipped; this often occurs with double engines.

I am troubled with grease in my boiler. I wish some one would tell me how to avoid it. I am using soda and lime and the "Anchor compound," but they do not act as well as I would like. It still leaves some on the tubes. The engine is a compound, surface condensing, with a Scotch boiler, built by Harlan & Hollingsworth, Wilmington, Delaware. Everything works first-class I am a member of No. 32, M. E. A., Baltimore.

MARION BELL,
OLD POINT, VA. *Chief Engineer, Sr. Pilot.*

[A remedy for grease in boilers is found in suspending zinc plates in the steam space. These are ingots about 14″ long, 8″ wide and about 2″ thick. They are attached directly to rods hanging from the shell, and require no attention except for renewal as they waste away. The action is as stated by some writers on the subject, that the zinc in wasting away through the influence of the steam upon it, combines with the grease to form a soapy compound or sludge, which is easily removed by washing out. Zinc is not suited to all waters and all types of boilers, and it should be carefully watched where applied, to see what is going on. We shall be glad to hear from Mr. Bell again.—EDS.]

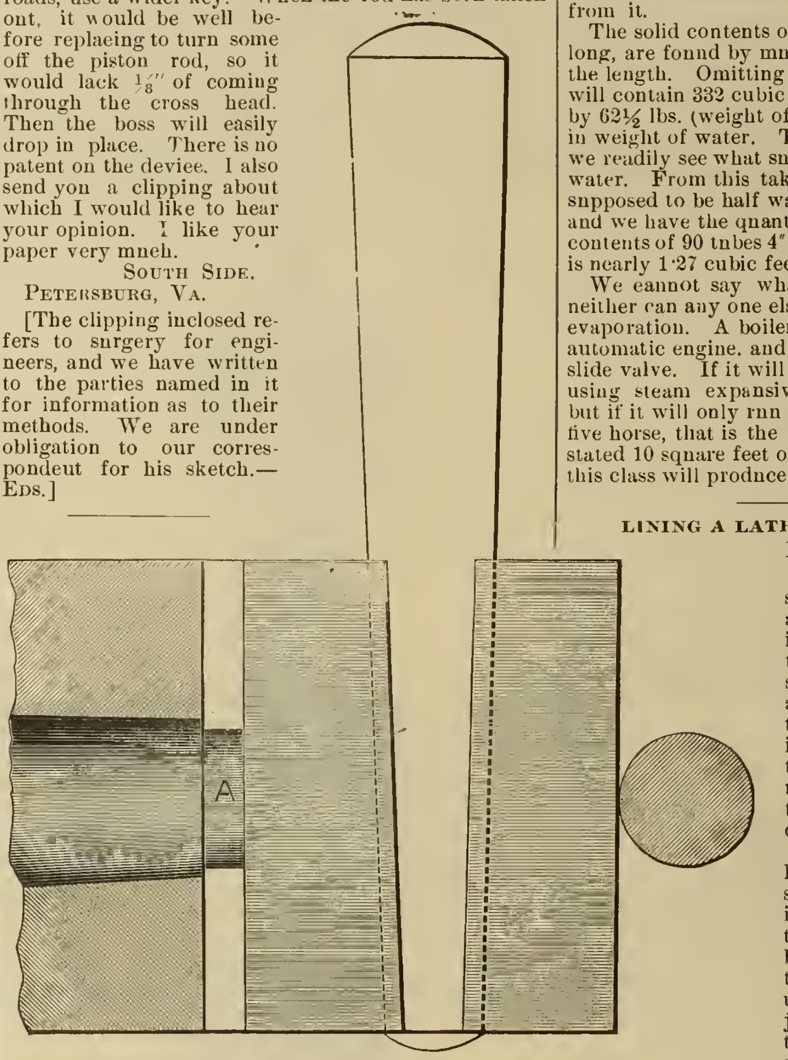
DEVICE FOR REMOVING PISTON RODS.

Editors MECHANICAL ENGINEER:

I inclose a drawing of a device for removing piston rods from cross heads of locomotives. It is the same that has been used in the South Side shops. N. and W. R. R, in this city, for some years past; it is simple and very effective. A few strokes of a hand hammer on the key is sufficient to start the most stubborn rod. It should be made of steel, in two pieces, with a half key-way in each piece, so when the parts are together (as in cut) they form a taper key-way. The boss, *A*, is about half an inch long, which is quite enough to start the rod. The device is nearly as wide as the strap on the rod, so as to get a good bearing. The other proportions are made according to the distance from wrist-pin to cross head. When ready for use set the device, as in cut. The boss should be about ¼″ smaller than end of piston rod. Should there be different makes of cross heads, as there are on some roads, use a wider key. When the rod has been taken out, it would be well before replacing to turn some off the piston rod, so it would lack ⅛″ of coming through the cross head. Then the boss will easily drop in place. There is no patent on the device. I also send you a clipping about which I would like to hear your opinion. I like your paper very much.

SOUTH SIDE.
PETERSBURG, VA.

[The clipping inclosed refers to surgery for engineers, and we have written to the parties named in it for information as to their methods. We are under obligation to our correspondent for his sketch.—EDS.]



BURSTING PRESSURE OF BOILERS; WEIGHTS ON SAFETY-VALVES.

Editors MECHANICAL ENGINEER:

Being a subscriber, and seeing the encouragement you gave "Apprentice" in a late issue, I concluded to ask you a couple of questions. I am a young man with not a great deal of experience, working as an engineer here, and anxious to learn from any source I can. The questions are as follows:

What is the most practical method of finding the safe working pressure of steam boilers?

What is the most reliable method of getting the effective weight of ball on a lever of a safety-valve?

I have asked these questions of practical engineers of unlimited experience, and their methods seem to me to be all chance-work, not one of them relying on calculation, I mean with regard to the first question As to the lever the only way they get it is by a scale. Now your paper being a medium for practical men, I am in hopes I shall get a clear explanation through it of these questions. I understand decimals thoroughly, and have Roper's and others rules, but they do not seem clear to me.

SOUTH ST. LOUIS, MISSOURI. INFORMATION.

[Multiply the strength of the iron (which ought to be found stamped on it), say 50,000 pounds, by twice the thickness of the plate in inches or fractions of an inch, and divide the sum by the diameter of the boiler in inches, this gives the bursting pressure of a *solid* cylinder; not rivetted.

Example. A boiler shell is ⅜″ thick by 7′ diameter; what pressure will tear it asunder? ⅜×2 = ·75′×50,000 ÷ 84″ = 446·45 pounds With a factor of safety eight times less than its ultimate strength, such a boiler should carry 55 pounds per square inch.

To find the pressure on a boiler with any given weight on the end of lever. Multiply the weight of the ball in pounds by the length of the lever in inches, divide this product by the area of the valve in inches, and again by the distance from center of valve to center of fulcrum; the last quotient is the pressure at which the valve will rise. For example, we have a 50 pound weight on the end of a lever 50″ long. The valve is 4″ diameter (equal to 12·56″ area), and from center of valve to fulcrum is 6″, at what pressure will the steam blow off? By the above rule, 50×50 ÷ 12·56 ÷ 6″ = 33 pounds.—EDS.

SOME DETAILS OF A BOILER.

Editors MECHANICAL ENGINEER,

Please give the heating surface of the following boiler. It is a return tubular, 5′ 6″ diameter, 14′ long, with 90, 4″ tubes. Also, how much water it will hold and its power at 80 lbs. pressure.

PETERSBURG, VA. J. S,

[The heating surface of the above boiler is in the under side of shell, 242 square feet; in the tubes 1968 square feet. This reckons the whole interior of the tube as efficient. In the end of tubes there are, considering the center of tubes on center line of head, 575 square inches, which divided by 144 will give the square feet. This heating surface is found by taking half the area of head and subtracting the tube area from it.

The solid contents of a cylinder, 66″ diameter by 14′ long, are found by multiplying the area of the end by the length. Omitting thickness of iron such a cylinder will contain 332 cubic feet of water, which multiplied by 62½ lbs. (weight of one cubic foot) will give pounds in weight of water. There being 8 pounds in a gallon, we readily see what such a cylinder will contain full of water. From this take one-half, for the cylinder is supposed to be half water space and half steam-room, and we have the quantity it will contain less the solid contents of 90 tubes 4″ outside diameter, 14′ long; which is nearly 1·27 cubic feet in each tube.

We cannot say what the horse power would be; neither can any one else. That depends wholly on the evaporation. A boiler may be fifty horse power for an automatic engine. and only twenty five for a common slide valve. If it will supply the fifty horse automatic using steam expansively, it is of fifty horse-power; but if it will only run a common slide valve of twenty-five horse, that is the limit of its capacity. Roughly stated 10 square feet of heating surface in a boiler of this class will produce one horse power.—Eds.]

LINING A LATHE THAT BORES TAPER.

Editors MECHANICAL ENGINEER:

This job may not be new to some of your readers, but there are others that have never seen it done. To do it, first bring the two centers together in line sideways, shifting the tail stock, as usual, for the purpose. Now take two pine sticks, one fifteen inches long; the other about three feet, and both one inch or more square, or a little larger than the hole in the live spindle.

Fit one end of each to the hole, squaring the other end; cut smooth with a sharp knife; chalk it and put it in the live spindle, the short stick first, now run the belt on the fastest speed, and see that the stick runs true. Bring up the tail-stock so that it is just clear of the stick, having the center and spindle run out about two inches and tightened up. Now screw down the tail stock, and with a sharp pointed pencil, using the center for a rest, make a circle, as small as possible, on the end of the stick.

Stop the lathe, bring one of the squares on top, and mark the position of the center on top and on the side next to you. Push back the tail stock, take out the stick, and put in the other one and proceed as before. The difference between the two sticks will show the way the spindle must go—either up or down. Should the marks on the long one show low to the center, the front box must go up. Should both show low both boxes must go up. A little study will show just how to do it after the above test. Should either show out sideways the remedy is to dress off the box to bring it right, and line it with something that will tighten it in place again.

Use a good quality of writing or card paper for packing under the boxes.

NEW YORK WM. H. BUTLER.

HEATING FEED WATER FOR LOCOMOTIVES, ETC.

Editors MECHANICAL ENGINEER:

In reading "*Some Details of a new English Express Locomotive,*" in last issue, it says Mr. Stroudley heats the feed water by carrying back a part of the exhaust steam into the tank. I am reminded of a device used on the Old Colony R. R., which the engineers call the blow-back. When first applied all the escape steam from the safety-valve went into the bottom of the tank, and when the water was low it sometimes got very hot and blistered the paint on the tender, but now a valve is placed just outside of the window, in front of the cab, and by turning the lever the blow-off steam can be turned into the tank, or through the muffler.

Perhaps you will say that no good fireman will let the boiler blow off enough to keep the feed water hot, but they do in this section of the country, for the mill in which I work is situated near the foot of a steep grade, and a majority of the locomotives which run through here are blowing off; I suppose it is so elsewhere. I think the Old Colony idea is better than any plan wherein the exhaust is used, for in this country the exhaust is cramped enough already by the small nozzles which are used to create draft. In England where (I have read) the draft is furnished by a steam-blast, and large exhaust tips are used, the back pressure is very small, and it would be different from here. If a locomotive does not steam well here, one of the first remedies would be a smaller exhaust tip and an increase of back pressure.

I saw an indicator diagram, some time since, taken from a locomotive, and I don't know exactly what the back pressure was, but it would have made your eyes hang out to have seen it. If I could have got a diagram I would have sent it to you, but they quickly put them out of sight While visiting the Institute Fair, at Boston, last month, I saw a fan-blower which was run by a small steam jet (or jets), for I believe the inventor used two gas burner tips for the jets, and got a very strong blast with a very small expenditure of steam; the exhaust steam mingled with the air-blast and so, was not altogether wasted. There were no belts used at all. Now, why would not something like this work on a locomotive to make a draft, and then there could be a free exhaust and no back pressure?

If the blast was not run into the smoke-stack, perhaps, it could be run into an air-tight ash pan, and blow some of the exhaust steam from the engine, through the fire, thereby getting the moisture necessary for a gas-burning furnace, for the Jarvis furnace is a success, and *they* say the fuel should contain 40 per cent. moisture to burn the gases. Doubtless a great deal of unconsumed gas is wasted in locomotive boilers, and any device to remedy it would be a great saving.

WESTBORO, MASS. BLOWER.

[Our correspondent's suggestions are not new.—EDS.]

SARCASM FROM MR. ALFRED BEACH OF THE "SCIENTIFIC AMERICAN."

Editors MECHANICAL ENGINEER:

You are doing a world of benefit to the public, and securing credit to yourself, by exposing such atrocious blunders as the *Scientific American* lately made concerning the cannon ball fired from a railway train.

The comparisons you make (Dec. 8) with the piston of the steam engine, and the rotation of the earth, are very lucid and settle the question.

But there is one point about which myself and companions differ; it has created discussion in our shop, and we should be glad to have your views.

It is this: suppose a train of cars to be moving with the velocity of a cannon ball, the cannon capable of throwing the ball three miles If the gun is fired from the rear of the train, how far back of the spot where the firing took place, will the ball go? Some of us say that, according to your recent article, the ball ought to go back three miles; but others insist you do not mean that it will travel quite so far.

Please give your idea of the approximate distance. We do not expect you to make a minute calculation if you find it to be less than three miles.

BRIDGEPORT, CONN., Dec. 4, 1883.

A CONSTANT READER,

[Our correspondent violates a rule which he enforces himself, we believe, by omitting to sign his name. The messenger who brought it, however, advises us that it came from Mr. Beach. We should have preferred a more effective argument than sarcasm, which does not seem to meet the case wholly. We have nothing to add to our article, except that we have been compelled to expose a good many of our contemporary's blunders. Notably in the case of the Fontaine locomotive, which it declared to be the greatest improvement of the day. Mr. Beach should not write, or cause to be written, anonymous letters.—EDS.]

THE HASKELL-LYMAN GUN.

Editors MECHANICAL ENGINEER:

I saw in your issue dated Nov. 24th, an article on the multicharge gun, in which you say that Mr. Haskell claims the invention, and there is no mention of Mr. Lyman in connection with it. I never saw any account of the gun except in your paper, that did not call it the Lyman-Haskell Multicharge gun, and I have always understood that Mr. Lyman was the original inventor, and Mr. Haskell improved on it and put it in practical shape. If I am wrong, I am ready for correction.

84 ALBION ST., BOSTON. GEORGE H. SLOANE.

[So far as the principle is concerned the multicharge gun, (Lyman used to call it the "Accelerator Gun") is the same as it was several years ago. We are not prepared to say that no improvements have been made upon it.—EDS.]

PERSONAL ATTACKS THE LAST DITCH OF THE VANQUISHED.

Editors MECHANICAL ENGINEER:

I was somewhat amused at the two articles I inclose presumably aimed at you. I am not personally acquainted with the managers of the paper they appeared in, but it would seem to follow that the editor of a mechanical paper ought to know something about compression. However the case may stand as to its merits, I hope you will note and take benefit by the novel adjectives used by the ambitious writer of the article. Also the nouns. I recommend the comparative "suddener" as an adjective, and the "so-so-ly-so" as an adverb.

Yours in the interests of the forgotten Lindley Murray,

HARTFORD, CONN. L. B. C.

[The friend who writes the above is himself an editor, and he understands (as we do) that personal attacks are the last ditch of the vanquished.—EDS.]

A BAD "GIVE AWAY."

Editors MECHANICAL ENGINEER:

Doctor Robert Grimshaw, in a paper published by him, "lets the cat out of the bag," and by his own admission has given himself away.

He admits "introducing a 'catch' demonstration" into his article, which I (*Mechanic*) stated should never have been published in the *Franklin Institute Journal.*

He also attacks Mr. John W. Nystrom as the author of the article he complains of, when, in fact, he might just as well attack the Pope of Rome. I doubt very much if Mr. Nystrom ever saw the article referred to.

He also complains that the editor of THE MECHANICAL ENGINEER should not "introduce personalities (such as the placing of an honorary title in quotations) in a purely technical discussion."

Now as to this latter, I admit that when an honorary title has been earned it would be improper to place it in quotations, but when it is merely obtained without authority, I fail to see a violation of "any rule of journalistic or personal decency."

MECHANIC.

ATTENTION FRIENDS OF ENGINEERS' ASSOCIATIONS.

Editors MECHANICAL ENGINEER:

The Chicago Association of Stationary Engineers, No. 1, have appointed a Committee on Ways and Means to organize a library. I wish to say through your paper that we shall be thankful to all friends, manufacturers and others, who will respond either with engineering pamphlets or large photographs of machines. Send all such to J. G. Beckerleg, 862 Washington St., Chicago, Ill.

WILLIAM PONSONBY, *Cor. Sec.*

CHICAGO, ILL.

MAN WITH A LEVEL HEAD TALKS ABOUT FUSIBLE PLUGS.

The importance of frequently cleaning and renewing the alloy metal of fusible plugs cannot be too strongly insisted upon, especially where the alloy is exposed to the direct action of the fire. Even in those of the best type, such as Hiller's or Kenyon's, where the alloy is protected from the direct oxidizing or other action of the fire by a flange, the makers recommend renewal of the alloy at frequent intervals of, say, every nine or twelve months. The transmission of the heat through the alloy for a length of time seems to have the effect of rendering it more crystalline in structure, and of very considerably raising its point of fusion, and hence the necessity of having it frequently replaced by fresh fusible alloy. Whatever the type of plug, however, which may be in use, I think the renewal of the metal or refilling should always be done by the makers, and should not be entrusted to workmen, who have no real knowledge of what is required, and who are almost sure to bungle in some manner in the manipulation of what they do not thoroughly understand.

The same remark may be made respecting low-water and other apparatus of a special character. I have known many low-water safety valves made in imitation of well-known types, the patents of which have expired, which could never be made to work satisfactorily, and where much time and money would have been saved if they had been constructed by the original makers. Another important point in connection with the care of fusible plugs is keeping them perfectly clean on both the water and fire side. A thin layer of scale less than $\frac{1}{16}''$ in thickness has been known to effectually resist a pressure of 80 pounds per square inch after the inner cone of a double cone plug has been melted out, from which the necessity of keeping them well sealed on the water side will be seen. Plugs are also frequently rendered inoperative from the accumulation of deposit on the fire side, and I know instances where leakage from the plug has taken place, and the lower cavity exposed to the fire has been allowed to get filled up solid with a tough incrustation, and the plug has been thus rendered perfectly useless.

Accidents from shortness of water are far more common than is generally supposed. They do not often lead to disastrous explosion, and loss of life from this cause is probably far less than from other causes of explosions. They are, however, by far the most numerous class of accidents to steam boilers, and no boiler should be without some provision or safeguard against such a contingency arising. Some boilers are so constructed as to preclude the application of either a low-water safety valve or fusible plug. For such boilers, and for those which are fired externally, I should advise the attachment of a good low-water alarm. Whatever fittings or safeguards, however, be adopted, the great point I would insist upon is that no fitting will take care of itself, or will remain effective in the event of contingencies occurring, unless kept clean and well looked after, and that with all the precautions which can be adopted it will be still necessary to have about boilers careful and intelligent men, who can be relied upon to do their work faithfully and conscientiously. I do not share the opinion of those who hold that any one who can lift a a shovel or open a valve is competent to take charge of a steam boiler, and in my opinion the sooner this notion is dispelled, and men only appointed to the charge of steam boilers who have undergone some kind of training or instruction, and who are endowed with at least a fair amount of intelligence, the better it will be for everybody concerned.—*The Mechanical World.*

THE BABCOCK & WILCOX COMPANY report the following sales during the four weeks ending November 24th:

New York Steam Company, New York, 1,250 H. P.; Ponemah Mills, Taftville, Conn., 200 H. P.; Maitland, Phelps & Co., New York (for export), 104 H. P.; Arbuckle & Co., Brooklyn, N. Y., 208 H. P.; Nathan R. Yewdall, Philadelphia, Pa., 104 H. P.; McCracken, Stark & Co., Philadelphia, Pa., 35 H. P.; Dager & Cox., Bridgeport, Pa., 104 H. P.; Edison Electric Illuminating Company, Tiffin, O., 92 H. P.; Edison Electric Illuminating Company, Mt. Carmel, Pa., 51 H. P.; Edison Electric Illuminating Company, Newburgh, N. Y., 146 H. P.; Edison Electric Illuminating Company, Hazleton, Pa., 92 H. P.; Edison Electric Illuminating Company, Bellefonte, Pa., 82 H. P.; Wm. Lea & Sons, Wilmington, Del., 125 H. P.; McCullough Iron Company, Northeast, Md., 104 H. P.; W. W. Taylor, Havre de Grace, Md., 20 H. P.; Westinghouse Air Brake Company, Pittsburgh, Pa., 92 H. P.; Lucy Furnaces, Pittsburgh, Pa., 832 H. P.; Pittsburgh Steel Casting Company, Pittsburgh, Pa., 416 H. P.; Black & Germer, Erie, Pa., 92 H. P.; making a total of 4,149 H. P.

The New York Steam Company, which is at the head of the above list, has now ordered 8,999 H. P. of these boilers. The various Edison Companies, including those in the United States, London, Paris, and Milan (Italy) have ordered 3,356 H. P. The business of the New York Steam Company is to convert the heating power of coal into steam and distribute the same to its customers; the business of the Electric Illuminating Companies is to first convert the heating power of coal into steam and then use the mechanical energy of this steam to make light. With both of these businesses the largest item in their whole expenditure is the cost of fuel. It is therefore very necessary for them to select the boiler which will economize fuel to the utmost extent. No greater commendation can be given the Babcock & Wilcox boiler in regard to its economy of fuel than its selection by these important companies.

THE DE LA VERGNE REFRIGERATING MACHINE COMPANY, of New York city, should be credited with by far the handsomest "gift book" of a technical character published this year. The one which we find on our table is beautifully bound in pebbled morocco, with title and inscription—"To the Editor of the THE MECHANICAL ENGINEER"—in gilt. The contents embrace a very clear account of the refrigerating processes in vogue at the present day, embellished with special details and photographs of the De La Vergne machine. It is valuable as a work of reference in its line, but will not be sent to all who may apply. Doubtless those who can show cause will receive a copy gratuitously.

WM. MUNZER, 515 First avenue, N. Y., has five large engines and nine small ones on the floor in different stages of completion. He points all comers to them as an answer to queries about his business.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, when possible.

INTERESTING TESTIMONY IN FAVOR OF AMERICAN LOCOMOTIVES.

Our readers will not fail, we hope, to consider carefully the article on another page entitled "*American Locomotives described by an English Engineer.*" The testimony of the gentleman sent to the Chicago Exposition of Railway Appliances, by the *London Engineer*, from which paper we take the account quoted, is all in our favor as regards the comparative efficiency of English and American locomotives, save in one respect, that is the consumption of coal per mile. On this point we are certainly far behind English locomotives upon the face of the comparison. Just how one can be made between the varying loads, the differences in the roads themselves in England and in this country, and the methods of management, we cannot see. Possibly if an English locomotive was run upon our tracks with the same loads our engines draw easily, the rate per mile would be vastly increased. The writer of the article we quote says distinctly in the case of the route between Providence and New London that an English engine could not begin to make the time with the load. This latter, it will be seen by referring to the article, is rather under the average of similar trains in this country. Drawing-room cars weigh in some cases more than 30 tons, and no allowance whatever is made for passengers, baggage, mails, etc., which would be, at a low estimate, 50 tons more. Also, the performance quoted, although good, is not in itself exceptional or extraordinary. We forbear mentioning instances, because we have no details of engines for comparison. The article alluded to is fair and unbiassed, and well repays perusal.

We shall feel under great obligation to the various superintendents of motive power whom we reach throughout the country if they will favor us with their views upon the subject. No names will be given, or localities either, if for any reason it is desirable to suppress them. We want facts.

ONE CAUSE OF RUNAWAY LOCOMOTIVES.

Undoubtedly one cause of runaway locomotives is the practice of leaving the lever when the engine is on the track, in full gear; "in the corner" as it is facetiously called by some. Another cause is too sensitive throttles, and the final and immediate one is opening the latter by fair means or foul when no one is in the cab to take charge.

When the link is in full gear ahead the engine is all ready to start, and it only needs a bump, with some engines, to give them steam at once. There is no especial need for the links to be left in full gear, but if one looks at locomotives on the side-track, or main track for that matter, he will, in a majority of cases, find them as stated. Even in mid-gear an engine will start itself with some link motions for the valve is open slightly, but it would run so slow that it could be over-hauled very soon; much sooner, at any rate, than when in full gear.

What we would like to suggest is that in all cases the lever should be left in full gear for backing; then, if bumped or accidentally started from any cause, it would not go far. It would, at any rate, move in the direction where it would be stopped before gaining headway. Runaway locomotive accidents are far more common than people in general are aware of, and so long as engines are left in condition to invite such casualties they will continue to occur.

INTERESTING TO THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

From President Allen, of The Hartford Boiler Insurance Co., we have a pleasant private letter which we are not at liberty to publish, although we regret the prohibition as it contains many warm expressions of good will and vital interest in the National Association of Stationary Engineers and their avowed plans. President Allen hopes that the Association will stick to its constitution and not be led off upon any outside issues. Many prominent manufacturers hesitate to countenance the Association from the fear that, ultimately, this will be the case, and that the National Association will be captured by trades unions. President Allen also says that he looks upon the Association as a splendid scheme for the social, moral and intellectual improvement of the craft, and that he has the highest hopes of their future usefulness, provided they adhere closely to their constitution. As to new boiler insurance companies President Allen says he has no feeling whatever; the field is wide enough for all, but that he would regret to see one formed within the Association, as he feels sure that it would alienate many warm friends.

This is the gist of a long letter, and it is quite what we expected from the gentleman, but we may say for the National Association that no Boiler Insurance Company has been formed as yet. At the last convention held in Chicago, the project was merely mooted in secret session and the propriety of it discussed. This action was made a handle of by those who are trying to destroy the National Association and with the hope of arraying it against the Hartford Boiler Insurance Company. Of course all such schemes will fail.

We know, as President Allen says, that some manufacturers have the feeling he speaks of. It is natural enough and we confess to having, at the outset, a lurking fear of the same character; but having the fullest confidence in the present direction and conductors, we are quite certain our friend's fears are groundless. The National Association of Stationary Engineers are debarred by their constitution for one thing, and by the feeling of members, from ever being the foe of manufacturers.

DOUBLE-HEADED LATHES.

A difficulty with lathes of this character, which has been overlooked by some, is the interference caused by work of different kinds carried on at the same time. For example, one end of the lathe is employed in facing off a cylinder-head, taking a heavy roughing cut, while the other end is taking a very light finishing cut on some particular job. In such cases the heavy cut sets up a jar and tremor through the bed, which is communicated to the end upon which light work is done, with the result of throwing it out of use for the time being. The effect of a heavy constant cut on a lathe is well known, but when the same is not constant but intermittent, as it is with some kinds of work, a double-headed lathe is turned into a single one, so far as fine work is concerned. With a heavy cut on a single lathe even the very tool-board will dance sometimes. We notice in an English paper a multiple lathe—so-called, which consists of a very long bed with four separate and distinct lathes mounted on it. Motion is communicated to the face-plates of these several lathes by one cone-pulley at the end geared into a countershaft on the back of the lathe. On this countershaft are pinions opposite each face-plate, which is also geared to mesh into the pinion; thus one belt drives the whole four lathes. This seems to us an exceedingly short-sighted device from some aspects. If one man is to attend the whole four machines, and do one kind of work constantly, such as turning short shafts, then it may be useful, but in case more than one kind of work is done, the lathe which is taking the heaviest cut affects all the others through the countershaft. The complications and personal controversies which would arise in such cases are easily foreseen.

Many-headed lathes may be useful in some localities where floor room has to be considered, and they are cheaper than four distinct separate lathes, but for the universal work of lathes generally they are not economical.

LIGHTING THE INTERIORS OF BOILERS AT WORK.

Electricity has been applied abroad to lighting the interiors of steam boilers at work, so that the actual operation under given conditions can be seen. It is easy to understand that this will prove, in careful hands, a very great addition to our knowledge of what is taking place in boilers of certain types. Experiments made by competent parties would tend directly to economy of fuel, in that it could be seen by the ebullition and direction of currents whether the distribution of heat was uniform or whether it was irregular. The result of firing could be seen, as also the effect of opening the doors at certain periods; in short, the application of the electric light to boilers at work promises great results; but what action will be taken in this country regarding it remains to be seen.

CLUBBING RATES WITH OTHER PAPERS.

Parties in Maine write us, asking separate rates for THE MECHANICAL ENGINEER and the *American Machinist*, saying that some men in their shop want one paper and some want the the other, but do not want both. As there may be persons in other localities who have similar views, this matter can be arranged as follows:

Send the price named in the list, $3.50, for both papers; let those who want THE MECHANICAL ENGINEER take it when it comes, and those who want the *Machinist* ditto. In that way individuals can get the latter paper for $2.00 per year, in connection with our own, for, to have the club rate evenly divided, each person should bear half the difference in club rate and publisher's rate. This rate is only made to new subscribers and does not apply to old ones.

EDITORIAL CHANGE.

We are advised on good authority that a change has taken place in the editorial management of *Cotton, Wool, and Iron*, and that Thomas Pray, Jr., has retired. His successor is not named.

NUMBER FOURTEEN.

We present our readers this year with an extra issue—Number XIV.—in which will be found a complete index for the current year. This involves a considerable extra outlay to us, but being desirous of giving good measure for value received, we have concluded to do it. It will make bound volumes a little larger, but this is not especially injurious, we believe.

SEASONABLE LITERATURE.

At this season the publisher everywhere casts a retrospective eye over the year, and asks himself whether he has done well or ill by his constituents. Sometimes he feels that he might have done much better, and determines that another year he will gird up his loins (brace up) better. Then the next mail brings him the letters appended, and he feels that there is more charity abroad in the world than mankind get credit for:

> "Your paper is the *best* of its kind in print; it is a very great help to young engineers, and also is good to brighten up the ideas of old engineers. I have read it for some time and it has given me great help. Please have the paper well covered by the wrap, so that it will not be injured in the mail, *as I wish to have it bound.*"

Seldom do we find so much solid sense in so small a compass.

Another friend writing from Chicago, embellishes a postal card with these sentiments:

> "THE MECHANICAL ENGINEER is the great educator of engineers! The mechanics' friend! I wish a great success to THE MECHANICAL ENGINEER."

Another says:

> "For real benefit all engineers should read THE MECHANICAL ENGINEER. I have had some experience in the course of twenty-five years, but am not ashamed to say that I have derived from the paper more solid instruction that has put dollars in my pocket, than from all the others combined."

With one more we forbear:

> "During the last year THE MECHANICAL ENGINEER has certainly most wonderfully improved in its handling of mechanical subjects. I am surprised at the number of topics treated in it; also the manner of treatment. The most unlettered can grasp subjects which in other papers are muddled up so that it is doubtful whether the writer understood what he was talking about himself. For one I am not ashamed to say that I regard your paper as a very marked success, though for a time I had serious doubts. Excuse my plain speech."

We do. We like plain speaking better than complex speech. This last smacks of insincerity, and we heartily thank all those who have contributed to make our success, whether subscribers, personal friends, contemporaries in all parts of the country, and that other class who have said a good word for us without more active exertion. "A word in season how good it is."

NO CAUSE FOR ANXIETY.

Some friends in the National Association of Stationary Engineers have called our attention to a scurrilous article published some time since in an Eastern trade-paper, reflecting upon certain members whom it calls by name, and making charges which are wholly unwarranted by the facts. We have not read the article in question, nor have we seen the paper containing it; our knowledge of it is confined to what our friends say. Their expressions are that they think the cause may be injured by the article.

They fear that persons intending to join might be deterred from so doing through the representations made. We think there is no cause for alarm. The animus of the editor is apparent, but it will fail, for the simple reason that the attack is unprincipled. Mere abuse is not argument, and whoever employs it shows at once his mental capacity and the poverty of his cause. When men fight they strike from the shoulder; they do not pelt an adversary with mud. Not very many weeks ago this same paper was fulsome in its adulation of the Society and its proffers of assistance. It went so far as to engage the services of two of its officers to canvass for it, expecting thereby to have the whole conduct of affairs in its hands; but not meeting with a very cordial reception from engineers, who very soon detected its objects, and having its candidate for president defeated at the last convention, it finds the grapes very sour indeed. Its consistency may be imagined when it is known that immediately after the convention it discharged one of its canvassers because he was an officer of the association and would not withdraw from it at the editor's bidding, who a few days later, repenting of his rashness, tried to hire him over again.

From these childish exhibitions of spite and want of principle our friends will see that they have nothing to gain by noticing the paper above alluded to. It can print what pleases itself and its readers, and if matter of that class is agreeable to them there is nothing to be said. No one is the gainer by responding to personal attacks. Tramps in the highway may shower all kinds of abuse on us, but no one thinks of responding. So there are newspaper tramps who having nothing to lose, hope to gain something by the notice of respectable papers.

The trouble lies in the fact that the paper in question is outside, and knows it. If its candidate had been elected all would have been well, but being defeated it adopts the tactics of the cuttle-fish or polecat, discharges a shower of ink, or a strong stench, as the only means of covering its retreat.

Let it go. The National Association of Stationary Engineers and the officers whom it attacks are beyond any harm it can do. They are too well known, and the results of their conduct of the Society are sufficiently apparent without any defense or explanation. Least of all should they reply to personal abuse from such a source.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLV.

I am glad to see that you have begun a series of articles on the Indicator, for a knowledge of it, how to apply it and read its revelations, is of the utmost importance to every one who has charge of an engine. An indicator should be as much a part of the tools of an engine-room as a screw-wrench. It is even more indispensable than this humble servant, for a man can makeshift without a screw-wrench and not lose a cent, but he can't do this with an indicator. I know many fancy they can, and try it on; the end of such men is ludicrous to behold. Generally unto them come enterprising outsiders who offer to buy the fuel for the establishment and run it for a period of years, if the proprietor will give them a percentage on what they save.

Let me digress a moment and ask if any one has ever seen anything more pigheaded than the average steam user? I never did, and sometimes I get out of all patience with them. It is a curious fact that by no method of ordinary argument can you make the average steam user believe that in trying to save him money you are not rigging some trap on him. Just so soon as you tell him it's no use to oil bearings with a squirt can, he is up in arms at once. "Oh, yes," he says; "I know. You want me to put on some darned nickel-plated thing that goes by clock work and talks. You want to fill me full of metronomes (?) and autographic machines (!) that will save more than I use every year. My friend," he says in a ludicrously solemn way, and with an air of forbearance for my want of common sense, "if I was to buy everything that comes along, you couldn't get into the engine room. What with patent dampers, heaters, lubricators, packing, new kinds of whim-whams of all sorts, life is made a burthen. I don't buy any of 'em, and I don't see as we are starving to death for want of 'em."

"No," say I, when I get a chance to put in a word edgeways. "You don't see the want of these improvements because you are determined not to. In a line of trade you know nothing about you pretend to give opinions, and you are so stubborn that you will not listen to those who have been through the same experience, but have repented and found a better way. I don't know anything about making shoes, but suppose I go into your factory where I see machines of all kinds and say: 'What's all this!—heeling machines, pegging machines, sewing machines, polishing machines—away with 'em; pitch 'em out of the window; they are no good. I made shoes thirty years ago without all these things and can again, and so can any one else who wants to.' Suppose I was to say all this, what would you think of me? You would think I was a lunatic, and I wouldn't blame you. But this course is exactly the one you pursue to-day. You know all about shoemaking, but you know nothing about steam engineering, but you decide any given case off-hand. What's the difference between a fool chattering about shoemaking, or one chattering about engineering, when neither of them know what they are talking about? What is the reason that a man can take advice for his benefit on every earthly subject except steam engineering? If he wants a house he goes to a carpenter and asks his opinion; if he wants it painted he don't tell the painter what to do; the painter tells him. If he wants a horse he goes to somebody who knows more about horses than he does, but just so soon as he wants anything in the steam line he settles the whole thing himself."

If the reader thinks this is exaggerated, let him go and interview the boiler makers, the engine builders, engine supply men and machinists and hear their testimony. It will make him laugh, some of it, and some of it will make him ashamed.

Now let me get back to where I started from—the indicator—for the influence it has upon profits is a very beneficial one. One of the heaviest items is fuel, and unchecked in its consumption it may reach any amount. Practically there is no check to this useless waste except through the indicator. True, a man can see that a valve leaks, or a piston blows, without an indicator, but these parts may have been faulty for weeks before he found it out, and in that time lots of money may have gone through the exhaust pipe. Many steam users have found this out, but there are a good many engineers who have not, and it is to them I speak. There is still a class of men extant who cannot learn anything except it is driven into them by dynamite. You would have to drill a hole in their skulls with a $\frac{7}{8}''$ drill, and put the idea in bodily, written out on paper, before their brains could absorb it; and then some of them would not have the idea unless you paid them 50 cents more a day for taking it in. They would sink all the personal benefit they got by wider information, and look only at the few cents advance. There are too many of this class, and they consider the indicator a mortal foe. They are afraid that it will, in some way, betray them and give them away. They resent the indicator as an idle toy, and boastfully assert they can beat it in economy every day. By what? Why, guessing. They simply bet on a result they cannot possibly know anything about. When a man undertakes to tell me that he can set valves by looking in the steam chest when the engine is cold, and have them perform properly every time, he tells me an untruth. I have set valves of all kinds for a good many years—say thirty off and on—and I know that no valve can be set properly without the aid of an indicator, but I suppose it is useless to talk. I used to think the same as our friend, whom I have alluded to above, but having an idea that it was just possible others beside myself knew something about an engine, I looked into their book and listened to what they had to say, the result was I learned something.

The indicator is the best friend an engineer ever had, and like all other friends it will serve him well if it gets kind treatment. If I thought I was not getting so much money as I ought to, I would take up the study of the indicator and find out all that I could about it. Then I would ask the boss to buy one. If he wouldn't, I would find some friend in the trade who had one, and would put it on my engine for me. When I found out what I could do by it, and that there was a chance to save money, I would go to the boss and say I wanted more money, but that he need not pay me any direct addition to my wages now. Just give me a percentage—so much on what fuel I saved within six months, over what we used now, and there would be a change at once. Suppose the boss said he wouldn't give anything, and didn't want to save money; or that if he did want to save it, that I was bound to do it anyway, with or without an indicator, what then? Just this: the engineer has lost nothing. He has gained something; he has found out that by the use of an indicator, he can detect great leaks and losses; he has discovered that by the aid of this little instrument, as a detective, he can rise higher, if he knows how to use his opportunities. If he does not, but just sits down and takes things as they come, that settles it so far as he is concerned. The indicator has done its work; it can do no more. It cannot make a man ambitious and energetic; it only makes him more intelligent as an engineer.

I well remember the first indicator I ever saw many years ago. Compared to the splendid instruments of to-day it was about as good as a small plunger-pump, but for all that it did its work, after a fashion; and showed us where to look for defects. When engineers come to receive this fact—that the indicator is one of the most certain aids to better positions—they will be more anxious to learn. It will not be long before, in the best posts, it will be made an indispensable requirement—the use of the indicator—and employers will look for its application and learn to read diagrams themselves.

Therefore, I repeat, that I am glad the editors have issued this series; they cannot fail to be of great service. I read them all carefully, and have no doubt but that I shall get many new points before they close.

THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER 5.

BY WILLIAM BARNET LE VAN.

To find the horse-power we divide the foot pounds by 33,000, this quotient is the indicated horse-power of the engine, or

$$\frac{\text{Area of cyl.} \times \text{mean pres.} \times \text{Revs.} \times \text{Stroke} \times 2}{33{,}000.}$$

Where there are numbers of cards all taken from the same engine to be calculated, a further simplification is made. Instead of multiplying the area of the piston by 2, and by the stroke, and dividing by 33,000 each time for each card, we may find what this sum, which is invariable for each particular engine, is, and multiply it by the mean pressure and the revolutions. This quantity is called the constant for the engine. This constant is the number of horse-power which would be exerted by 1 pound of mean pressure. It is found by multiplying together the area of the piston in square inches and the feet traveled by it per minute, and dividing the product by 33,000.

Then to find the horse-power we multiply the constant by the mean pressure.

In illustration of the rules given in previous issue, we will compute the horse-power exerted in the following diagram, taken from the cylinder of a Corliss engine. The diameter of piston was six inches, the length of stroke sixteen inches, and the revolutions per minute 108; diameter of piston rod one and one-half inches. What is the horse-power of this engine by the indicator?

Cylinder, 6 inches; stroke, 16 inches; revolutions, 108; boiler pressure, 70 pounds. To find the mean effective pressure on the piston proceed as follows:

Divide the card into ten equal parts and measure the length of each ordinate by the scale corresponding to the spring of the indicator, (which in this case was 30 pounds for each inch in height). The sum of the length of the ten ordinates amounts to 344 pounds, which divided by the number of ordinates (ten in this case) gives an average mean effective pressure of 34·4 pounds.

A horse-power is a conventional term, and expresses a rate of mechanical work, measured in foot-pounds for some unit of time, as one second, or one minute; 550 pounds raised one foot high in one second, or 33,000 pounds in one minute is commonly understood to mean a horse-power.

To calculate the indicated horse-power, multiply the area of the piston in square inches by twice the length of the length of stroke in feet, and the products by the number of revolutions per minute. (This product is known as the "*piston displacement*"). Divide this product by 33,000 and the result is the "*horse-power constant*," or the power developed for every pound of mean effective pressure. Multiply the quotient by the mean effective pressure, (ascertained from the diagram) and the result will be the indicated horse-power.

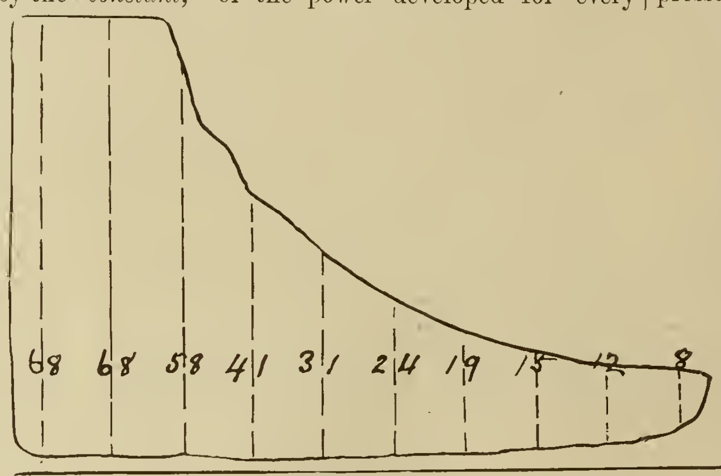


FIGURE 9.

The area of the piston

$$= 6 \times 6 \times 0{\cdot}7854 = 28{\cdot}274.''$$

The area of the piston rod

$$\frac{1{\cdot}5 \times 1{\cdot}5 \times 0{\cdot}7854}{2} = 0{\cdot}883.$$

Average area of piston, less one-half area of rod, = 27·391.

The speed of piston in feet per minute=

$$\frac{16'' \times 2 \times 108}{12} = 288 \text{ feet.}$$

The constant for this engine is, therefore,

$$P = \frac{27{\cdot}391 \times 288}{33{,}000} = 0{\cdot}239 \text{ the horse-power}$$

constant.

The mean pressure, as per diagram, is 34·4 pounds, and the power developed was,

$$P = 34{\cdot}4 = 0{\cdot}239 \times = 8{\cdot}22 \text{ horse-power.}$$

Where great accuracy is required in estimating the power of steam engines from indicator diagrams, care should be taken to calculate the power of forward and back strokes separately, as the mean effective pressures are not always alike.

In this manner the power exerted by an engine may be ascertained under every variety of circumstances, and also the power required for every kind of machine.

Measuring the power required by a single machine among many running in a manufactory requires great care, but can be done with certainty, even to a small fraction of a horse-power. It is necessary that every thing should be in the same condition during the whole experiment. The proper time to test is after running for several hours, and directly after stopping, when everything is in the best working condition; say, at noon-time. Then, first indicate for the shafting alone, afterwards put on the machine to be tested, the power required, for which is to be ascertained; after it has been running for a few minutes, and, finally, after the belt has been thrown off, indicate for the shafting again.

In case the pencil should run over the paper several times, it should be ascertained if it follows the diagram exactly when removed a little from the paper. The first and third diagrams (that is the friction diagram of the shafting) should be identical, and the excess of the second diagram is the power required by the machinery tested. Care should be observed that all the diagrams are taken at the same speed of the engine.

In all cases the greatest pains should be taken to determine if the diagrams are a true representation of the power exerted; see if the pencil will repeat the diagram both when in contact, and when not in contact with the paper. Often the diagram will not repeat exactly. Whenever this is the case, the pencil must be allowed to run over the paper a sufficient number of times, and the average of all the figures must be taken as the true one.

As before stated, the indicator-card is usually run out, or in other words, the mean pressure of the card is usually ascertained, by reading off with the aid of the scale the different mean pressures on each of the ten spaces; then adding them together and dividing them by ten, or whatever number of spaces there are. This is correct, provided each reading is an accurate one. The following is a far better and easier method: Take a long strip of paper, say, one-half an inch wide, and from 10 to 20 inches long, according to the nature of the card. Mark a starting point on the edge near one end. Then lay the strip of paper along the first ordinate and mark off the length of the ordinate, then lay it on the second space and its length to first ordinate, and so on to the tenth ordinate. By this means the length of each of the ten ordinates are laid end to end. If we now take a rule and read off how many inches there are in the whole length, and divide them by ten, we get the number of inches in the mean pressure of the whole card.

Generally expressed, we multiply the total number of inches read off the strip by the scale, and divide by ten.

This is one of the best and safest, if not the very best, way of finding the mean pressure of a card; it is certainly greatly superior to the method of reading off ten different pressures, and adding them together and dividing by ten as heretofore described.

There is another method of measuring cards, which at once disposes of many vexatious causes or error. It is by a most ingenious instrument called a planimeter, which is now mostly used for finding mean pressures. This instrument is about as large and as complicated as a pair of dividers. It will give the area of any card, however awkward in shape, in one minute, by passing one leg of the instrument along the outline. It gives at once the mean effective area without any second measurement being required for counter-pressure; or it measures any of the areas of a card, which may be desired. No skill or mathematical knowledge whatever is required to use the instrument.

One leg of the instrument is caused to remain stationary, and a tracer on the other leg is passed along the outline in one direction, till it returns to the starting point. The readings taken from a counter on the instrument, gives the area of the inclosed figure. Marvelous accuracy, and perfect simplicity are the marked features of the planimeter.

In working out a number of cards with a planimeter it is most important to remember that the length of the card must be taken into account, because this generally varies to a slight extent in cards taken from the same engine with the indicator, and it does not do to assume a common length for them all.

The appended paragraph was, by some oversight, omitted in No. II. of this series.

As a further illustration, figure 5 is a diagram that would be produced if the steam were cut off when the piston had moved one-fourth of the stroke. In this instance only one-fourth the steam would be required, as for fig. 3; but the total area of the diagram is about 0·54 of that of fig. 3, so that 0 54 or more than one half as much work is obtained for one-fourth of the steam.

LECTURE BY FRANK M. MERRILL, BEFORE KEYSTONE COUNCIL, NATIONAL ASSOCIATION OF STATIONARY ENGINEERS, PHILADELPHIA.

The relative merits of different Indicators, and the use of light springs for measuring back pressure accurately.

The subject of my talk this evening will be the relative merits of different indicators and the use of light springs for the accurate measurement of back pressure. To form an intelligent judgment of the merits of an indicator requires a close study of its construction and a clear knowledge of mechanical principles. An instrument may have one point of superiority over others, but, when all its parts are considered, be defective.

There are several excellent indicators in market. The best three, so far as I know, being American inventions. All are made in Boston; namely, the Thompson improved, Tabor, and Crosby No. 2, in the order of the time they have appeared on the market. I shall consider the construction of each, but will first state what the requirements of an indicator are and the construction of some of the earlier instruments.

What kind of a diagram do we want? For facility of measurement and in order to detect minute errors, the largest we can get. For example, suppose a diagram from an engine of 48″ stroke, of the same length as the stroke, and say 18″ high. If we had a 4-lb. spring, that height would indicate an initial pressure of 72 lbs. Can we get a correct diagram of that size? So far as moving the paper in exact time with the piston is concerned, that can be accomplished by a plan which your worthy President, N. W. Williames, informs me is in use in Germany, viz, attaching the paper to a board which is fastened firmly to the crosshead, and slides past the pencil the whole length of the stroke; but you will readily see that it would be very difficult, if not impossible, to make a drum large enough. It would have to be about 16″ in diameter to take such a card, and so light that its inertia would not throw it entirely out of time from the motion of the piston.

No indicator has been produced which would move a pencil through the distance of 18″, much less one the inertia of which was not so great as to render it entirely unreliable as a recorder of the pressure in the cylinder. I can see no great advantage, if any, in making a diagram the full length of the stroke of the engine, when the height is limited to about 2″, which cannot be exceeded very much without making the moving parts too heavy.

Such points in a diagram as the point of cut-off, release, and beginning of compression can be more accurately determined in a long diagram than in a short one, provided the height of the diagram is increased proportionately with the length. If the height of the diagram is not increased, the curves are so long that these points are not so sharply defined; consequently we lose the advantage of the magnified diagram.

The tendency of the day, among experts with the indicator, is toward small diagrams, because, on account of the errors due to the momentum of the drum, in the length, and that of the piston, pencil-arm, etc., in the height, small diagrams can be relied on as more accurate than large ones. With a planimeter, the area of a diagram 1½″ high and 3″ long can be very accurately measured, and with a draughtsman's dividers such points as cut-off, release, and beginning of compression can be measured with sufficient accuracy for practical purposes.

With an engine of very long stroke, say 10 or 12 feet, making 15 or 20 revolutions per minute, a diagram 6 or 7 inches long would be desirable, as the momentum of the drum in that case would amount to very little, and the motion would not have to be reduced so many times.

The requirements of an indicator may be stated in a few words. That its moving parts shall be as light as possible, and that the rate of compression of its spring shall be as uniform as possible, so that a movement of the pencil through an equal distance at the bottom, middle, and top of the diagram shall represent an equal change in the pressure of the steam; and also that the friction shall be reduced to the lowest point. I wish I could begin at the beginning and show you a Watt indicator, but I never saw one, and don't know where one could be obtained.

I have here an old-timer, a Hopkinson. It has a long, heavy spring, with the piston-rod and pencil attachment all very heavy as compared with modern instruments. The pencil is attached directly to the piston-rod, so that when the pencil moves through the space of one inch the whole weight of all the reciprocating parts has to be moved through the same distance. I have never seen a diagram from a Watt or Hopkinson, but have no doubt that at the low pressures and speeds used in the early days of steam engineering they would give good results.

[NOTE.—Some experiments were made with the Hopkinson instrument since, on a Corliss, at 60 revolutions, and the oscillations of the pencil were so great that nothing could be made out of the diagram.]

Mr. Richards, superintendent of the Southwark Foundry and Machine Co., Philadelphia, should have the credit of producing the first successful indicator for moderate speed, which we have here. In this the plan is adopted of multiplying the motion of the pencil, which is, in effect, reducing the motion of the piston, so that the movement of the heavier parts being reduced, and the weight reduced also, a very long step in advance was taken.

I will now consider the Thompson Improved. One striking feature in this instrument is its parallel motion, which is very beautiful in proportion and design. The multiplication of motion is the same as in the Richards, 4 to 1. The moving parts are much lighter than in the Richards and heavier than those of the Tabor or Crosby. The piston has a rod screwed firmly into it, helping to guide it and to prevent it from sticking in the cylinder. The spring is screwed firmly to the piston by a head, which is rather heavy. A perfect spring is an accident; the best springs made generally have some tendency to turn to one side in compressing. The piston rod, working through the cap, gives a long bearing and prevents this tendency from being a serious defect in the Thompson.

The Tabor follows the Thompson, and it is an excellent instrument, and the workmanship on them is excellent. The movement of the piston is the same as in the Thompson, one-quarter that of the pencil; and the moving parts are quite light. The parallel motion is theoretically perfect. There is no piston-rod, the piston being connected with the pencil arm by a link having a curved slot in it, in which is a little roller fixed in the cap. In making this link, one end of it is fixed in a very neat little machine to an arm of the same length as the pencil arm, at the same distance from the fulcrum. The other end is attached to a piece sliding in a straight line, corresponding to the motion of the piston, and while the pencil-end of the arm is carried in a perfectly straight line, the slot is milled out with a revolving cutter. The spring of the Tabor is a double coil, the Thompson being single. It is attached to the piston in the same manner as the Thompson, by a screw-head. The piston is slightly longer than in the other instruments. As I said, different instruments, equally well made, vary considerably in their action; one with a very nearly perfect spring may show very little tendency to stick; but generally speaking, Tabor cards may be picked out by very straight steam lines, very sharp cut-offs, and steps in the expansion line. They flatter an engine a little, as few engines produce straight steam lines and sharp cut-offs.

The Crosby Indicator No. 2 was invented by George H. Crosby and Gilman W. Brown. Mr. Brown (a very ingenious young Boston mechanic and thorough engineer, practically and theoretically) told me that he had been indicating locomotives at high speeds, and finding the instruments he used defective, endeavored to produce a better one. He gave the subject much study and conducted a series of careful experiments before designing the instrument in question. I think he has obtained good results, especially in lightness of the moving parts. Up to the time of his experiments I believe all indicator springs had been ground. Grinding is for the purpose of giving the spring the proper tension. Springs of a certain strength nominal, are made of the same sized wire, wound on the same sized mandrel, and of uniform length. They are still liable to vary in strength, however, and to correct them, are made a little strong, and after testing, ground on the outside. An experienced workman can adjust a spring in this manner so that it will be correct at any given point, say an inch, in the motion of the pencil. It may be correct at other points, but experiments proved that many were not. That is to say, a 40-lb. spring might draw a line one inch from the atmospheric, at 40 lbs. pressure, and be above or below 1½, at 60 lbs. The Thompson springs are tested, or were when I was in their manufactory a few months ago, by means of weights. The manufacturers of the Tabor and Crosby indicators test their springs in the instrument on a steam drum, the condition being as nearly as possible the same as they would be on an engine. On the Tabor spring there is a groove turned in each head, into which the wire is screwed and soldered, and the adjustment is made by running the solder more or less out on the wire.

[TO BE CONTINUED.]

MACHINE TOOLS.

BY J. RICHARDS.

PLANING MACHINES.

Reverting again to a subject before remarked upon, there seems to be among tool makers a want of those advantages that are derived from the habitual use of inductive or inferential conclusions. Before constructing machines on the method last explained, drawings were submitted to various tool makers, and the opinions given were nearly uniform, namely, that "the convenience and wide range of application for such a machine were obvious; but there would not be rigidity enough in the projecting brackets to support cutting tools."

The matter of compensation was not alluded to, except by one person, and he not an engineer, who said: "The distance at which you can work from the ways is a matter of support then?" Such things should not be dealt with as matters of opinion. Suppose there is given the length, area and position of guiding supports, why should not the rigidity and cutting capacity be computable in such cases? The torsion and flexure of projecting brackets need not be left to opinion, neither should the support afforded by guiding ways. Both things, if not computable in the strict sense, are certainly capable of comparative treatment, and would be so dealt with in most branches of engineering work. I make these suggestions with a full knowledge and consideration of the various obscure conditions and varied uses of machine tools, and think, after all due allowance is made, opinion and experiment are too much relied upon, and computation and comparison too little regarded.

The value of experiment should not of course be underrated, but it is nevertheless often overestimated, always expensive, and never conclusive. Continued use is not meant; that is a different matter, but certainly continued use should not be required to determine the strength and efficiency of tool supports any more than it is required to determine proportions for locomotive, marine, or other engines. The elements of motion and accidental strain prevent accurate calculation, but these factors are present in many cases where opinions are no longer regarded of much value, and the time has arrived when machines of slow action, such as metal-planing machines, should be "resolved" by rules, inference and comparison.

A screw motion is, without doubt, the best that can be applied to planing machines. Of this there has never been any difference of opinion among tool makers, who have in many cases adopted screws along with the objectional mechanical features which their use involves.

Carriages have to overrun the driving gearing when screws are employed on that kind of machine, otherwise the driving gearing would have to be placed beyond the stroke of the table or carriage, and that would be impracticable in most cases.

A screw applied to a carriage should be placed as near it as possible, and it is evident that the driving gearing, be what it will, must operate within this distance, or, as before said, the carriage must pass over the top of the gearing. Usually two pairs of level wheels are employed, one pair for the forward and one for the back motion; this is, however, a clumsy method, because the object should be to apply the driving power as far as possible from the center of the screw and thus avoid strain upon the teeth and bearings; bevel wheels in this respect occupy more space than spur wheels. The term clumsy applies to the method of reversing where two pairs of bevel wheels are employed; the slow speed wheel, sleeve and driving pulley all having to be reversed the same as the screw, but at a greater speed. Two driving bands at different speeds, with one pair of bevel wheels, perform the same functions, with various other advantages besides those named.

The screws, if made with 1 in. pitch, can be driven by pulleys 20 in. to 24 in. in diameter, and by bands 2½ in. to 3 in. wide. The speed forward, at 180 revolutions a minute, gives 15 ft. of cutting movement; the return or back stroke can be arranged at pleasure.

The friction of screws is more than that of tooth gearing, but this is a small matter when there is not too much weight to move, while the gain by simplicity of the mechanism, the smoothness of action, and absence of noise are not to be compared with, and much less balanced, against a loss of power that under ordinary circumstances is inappreciable. With the proportions given the cutting force will be found ample for ordinary work. Some makers pride themselves on the power of their machines, but any one with experience knows that it is better to have a machine safely geared, so that the driving barrels will yield, in case of obstruction, before other parts are destroyed. A band 2 in. wide, moving 1,000 ft. a minute, is enough for driving the tools of a small machine with screw motion.

Screws for planing machines are generally with a coarse pitch, and then geared to run at a slower speed than the first movers. What is gained by this is not clear. The angle of the threads increase as the pitch, and in this way there is lost more than is gained by diminished speed. If the object is to gain bearing surface in nuts, that can be done by increasing the number of threads and thus leaving the screw stronger. A screw of 1 in. pitch with two threads ¼ in. deep, has as much wearing surface as one with a single thread ½ in. deep, or a screw of 2 in. pitch with threads 1 in. deep, so there seems to be no object in employing gearing. Such gearing is perishable and noisy at the high speed it has to run. With a screw 3 in. in diameter, 1 in. in pitch, with two threads, there will be more than 50 in. of bearing area, and enough to last for years if the fitting is well done at the beginning.

The methods of operating the feed motion of planing machines have already been alluded to in so far as relates to convenience and other working conditions. Some remarks upon mechanism will be in place here. The table tappet system need not be noticed, that is well enough understood. The independent method, as it may be called, of actuating the feed of carriage machines from the rack motion, has now been applied by all makers of any note in America; its value has been proved by continued use for twenty years past. The feed links are operated by friction, but in two very different ways. In one case the friction is constant, yielding only during the time of feeding, and "dragging" for the remainder of the time. This plan is a clumsy, or, at least, unmechanical way of operating.

It can be explained by the aid of the drawings, Figs. 50 and 51 showing front and sectional views. Suppose the shaft, *a*, to be the axis of the second or third mover in the wheel train that drives the carriage, and to have a speed of twenty to thirty revolutions a minute, and *c* a disk, in the face which is a cross groove for altering the stroke of the feed link, *e*, by moving it toward or from the center in the usual manner. On the end of the shaft, *a*, is a disc, *s*, and on each side of this two washers of leather, *n*, *n*; there is a follower plate screwed into the disk as shown. When the disk is screwed up it presses the leather washers on the plate, *s*, causing friction enough, when the shaft, *a*, is reversed to carry the disk, *c*, around right and left until the stops, *o*, come in contact with the pin, *i*, making such part of a revolution as the length and number of the stops, *o*, may determine.

Fig. 50

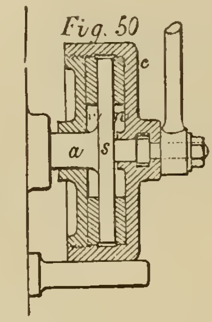


Fig. 51

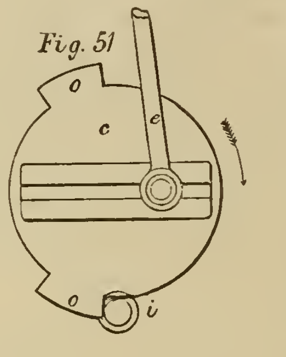


Fig. 52

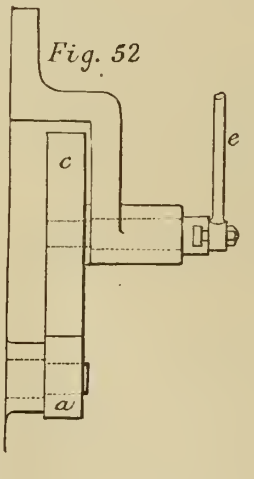
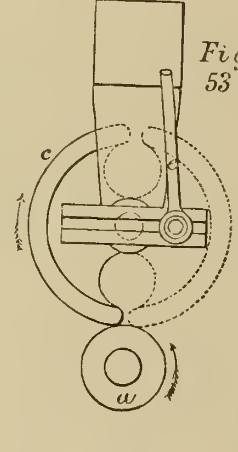


Fig 53



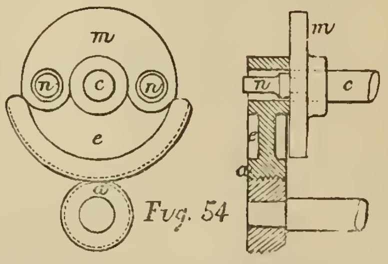


Fig. 54

After the disk, *c*, stops in the manner just explained, the plate, *s*, slips between the washers, *n*, until the motion is reversed. This is, of course, for the greater part of the time. The best tool makers in America do not employ this method; it is used principally by the commercial tool-making firms of New England, and is modified in various ways, the mode of operating the feed being the same, however. The drawing is not made from any example, but does not vary materially from practice, especially in all of its working parts being hid and nearly inaccessible.

The diagrams, Figs. 52 and 53, will serve to illustrate the other, or the intermittent method as it may be called. The disk or friction wheel, *a*, is fastened on the end of one of the cross shafts of the machine, as in the previous case. The semi-circular piece, *c*, is covered with leather, so set as to press on *a*, with friction enough to operate the feed link, *e*. When the wheel, *a*, is revolving in the direction indicated by the arrow, Fig. 53, the quadrant piece, *c*, is driven to the position shown; its gravity keeping it in easy contact with *a*. As soon as the motion is reversed this piece, *c*, engages again, and is rolled around to the position shown by dotted lines, ready for the return stroke. The crank and feed rod do not require explanation. When carefully made and properly mounted, this method answers very well, is simple, durable and accessible. The chief distinction from the motion last noticed is that the frictional faces run out of contact each way and cause no wear or loss of power. A feeding contrivance identical in its operation, except the contact was not maintained by gravity, was invented by Mr. Bodmer about forty years ago, and is illustrated in one of his patents.

One other form of feed clutches may be noticed, two views of which are shown at Fig. 54, the roller, *a*, and quadrant, *e*, corresponding to the former figures. The quadrant piece, *e*, is loose on the shaft, *c*, and swings free for a short distance each way, until it comes in contact with the stop pins, *n n*. The disk, *m*, is keyed fast to the shaft, *c*, so that when the quadrant, *e*, strikes the pins, *n n*, either way, the disc and shaft, *c*, are turned partially around as in Figs. 52 and 53. The purpose of the last motion or free movement of *e*, is to allow it to engage well with *a* before the feed acts, or there is any work to perform. This forms a very ingenious and useful expedient without adding intricate or objectionable mechanism. The friction faces can be of metal and grooved as shown, or may be covered with leather. The object of such feeding devices has been explained. When employed the band shifting apparatus only is operated by the tappets on the carriage, and the duty is so light they never slip; besides, the motion being independent of the feed is left free to be operated by hand, so a machine may be moved in either direction, stopped or started, without using the overhead gearing.—*Engineering.*

THE EXTENDED SMOKE-ARCH.

A correspondent of the *Railway Age* writes to that paper as follows:

"It is too late a day for any one to pronounce the extension as a failure, for it only reveals to the many roads now using the extension successfully, that there was either prejudice, poor workmanship, or bad management as a cause for the bad results.

"With regard to the evils mentioned by 'Experience' he says the mesh filled up with fine coal. We have used on our road a 4 by 4 netting, No. 14 wire, on 17 by 24 engines for over six weeks at a time without touching, and have had no trouble from 'plugging.' If the precaution is taken once in two weeks of opening the front door and rapping the netting with a hammer, it will remove all possibility of filling up.

"In our experience whatever water has worked through the cylinders has been thrown out of the stack, and never shown itself in any way on the netting.

"With regard to hot smoke arches burning the wood-work, I know of roads which have had serious trouble by getting the arches red hot, and it would have been the same on all if care had not been taken to have the smoke arch absolutely air tight.

"Instead of quantities of sparks coming from the stacks, our engines do not average a half-dozen live sparks to the mile. This statement is made from the result of actual observations, made at night for the purpose of seeing how efficient the spark arresters were. One of our enginemen remarked, after having run his engine with the extension, that he would about as soon expect to see a live fish come from the stack as to see a spark.

"One statement made by your correspondent reveals the secret of the non-success of the device on his road. He says he used 2½-inch exhaust nozzles. No wonder he burned from 15 to 20 per cent. more coal; no wonder he drew up his whole fire into the smoke-arch instead of leaving it in its proper place in the fire box; no wonder that the sparks went out through the netting when drawn up by a 2½-inch nozzle; no wonder that he made none too much steam. The wonder is that he made steam enough to pull a train, for he must have drawn the coal out of the fire-box almost before it was ignited. If 'Experience' had made the change to a $2\frac{3}{4}$, or better, a 3-inch nozzle before removing the extension and long exhaust pipes, he would, I believe, have obtained much more pleasing results than he did by going back to the old diamond stack and cone.

"By way of contrast I would state some of the general results of adopting the extension arch on our road:

"1. An almost entire absence of live sparks thrown from the stack.

"2. Engines steam more freely.

"3. A saving of considerably over 15 per cent. of coal, as shown by a careful comparison of the same engines doing the same work with and without the extension.

"4. A great reduction of smoke on the road.

"5. We are able to make steam easily with exhaust nozzles $\frac{1}{4}$-inch larger than with the old style. We use 3-inch for 16 by 24 engines, and $3\frac{1}{4}$-inch for 17 or 18 by 24.

"6. Tubes fill up less rapidly.

"7. What few sparks are thrown go so high as to be extinguished before reaching the ground.

"We can prove to the satisfaction of any reasonable person these statements. We can say that we have never had one of our engines which is fitted with the extension work poorly, except where the brick arch in the fire-box was burnt out or had a break in it."

AMERICAN LOCOMOTIVES DESCRIBED BY AN ENGLISH ENGINEER.

American drivers are expected to look after their engines themselves, and execute or superintend small repairs, and in this respect are superior to our men, who can seldom be trusted to take up wear in any direction. The nature of the duty of drivers in the two countries differs materially—an English driver is chiefly occupied with looking after his distant signals, seeing that his firemen wastes no coal, and putting on the feed whenever his engine threatens to blow off. In America there are few signals of any kind, and none that can be called distant, while nearly every engine is still fitted with an easy valve to enable the safety valve spring to be slackened and steam blown off—that is, wasted—when standing; while, as a general rule, very little attention is paid to the quantity of coal burnt. The enormous natural resources of America, and the boundless supply of nearly every raw material, induce a lavish and reckless waste, which is especially noticeable in timber and coal, but which extends to every article, and is a marked characteristic of the American people.

* * * * *

The cab is, as usual, made very comfortable for the men. Padded arm-rests outside the window sills, and padded backs and seats, give them the equivalent of easy chairs. It is usual for the driver to sit down comfortably when running; and certainly the rest and comfort thus obtained should and does preserve his faculties of sight and hearing from fatigue. The comparative absence of signals and fences obliges a more constant watchfulness than at home, where the distant signal once sighted, all is often taken for granted until the next distant signal may be expected.

* * * * *

One engine has four coupled wheels 6ft. 2in. diameter, with 18in. by 24in. cylinders, and is now running express trains between Providence and New London, part of a route between New York and Boston. The following particulars of its performance are interesting. The usual train comprises eight cars weighing as under :—

	lb.
4 Drawing room cars, 60,000 lb. each	240,000
2 Ordinary passenger cars, 57,000 lb each	114,000
1 Smoking car, 48,000 lb	48,000
1 Baggage car, 50,000 lb	50,000
Total	452,000
Weight of the engine	80,000
Weight of the tender	48,000
Grand total	580,000 or 259 tons.

The regular running time is sixty-four miles in 1h. 25m. without any intermediate stoppage, and in 1h. 37m. with two stoppages; but this distance has been done in 1h. 15m., which is very fast, and would be considered an excellent performance on any English railroad. At the time this run was made the track was in bad condition owing to a thaw. The consumption of coal, however, is something calculated to astound those used to English practice. For the trip of 128 miles, from New London to Providence and back, there are used 10 tubs of coal, each tub containing 800 lb., making a consumption of 62·5 lb. of coal per mile. This performance may be compared with that of the single driving-wheel express engines designed by Mr. Bromley for the Great Eastern Railway. They took a train of seventeen to twenty coaches, weighing about 180 to 200 tons, in 1h. 35m. from Liverpool-street to Ipswich. Deducting the distance and time between Liverpool-street and Forest-gate, where the speed is restricted, owing to the numerous signals and junctions, the remaining distance, about sixty-three miles, is run in 1h. 20m., the worst gradients ranging from 1 in 100 to 1 in 84. The consumption of coal would be about half that of the American engine, but the English engine would be taxed to her utmost capacity with such a load, and could not possibly make up time to the extent of ten minutes. In America economy of fuel is not regarded as a primary object, though coal is, on the whole, more expensive than in England. If the trains can be run regularly in any weather, the coal bill is cheerfully paid, and on one well-known line no effort is made to ascertain, much less check, the consumption of coal, costing \$4.50 per American ton, or £1 1s. 1d per ton of 2240 lb., which is probably a higher average price than is paid by any important railway company in Great Britain. This indifference to the consumption of coal certainly does not arise from a general looseness and carelessness in collecting and collating figures and statistics. On the contrary, in the offices of the chief locomotive superintendents of this and many other lines, singularly neat indicators show at a glance the condition, as regards repair, of every engine on the road, with the running shed where they are stationed, and the nature of the traffic they were built for, and are engaged in respectively; while an elaborate set of books fully record the age and history of each engine, and the mileage and condition of its principal parts. In fact, the conditions of American railways require the heaviest possible train to be drawn the greatest possible distance by the lightest possible locomotive, and this can only be done by overworking the locomotive, which, of course, entails an extravagant consumption of fuel, and corresponding wear and tear of engine.

* * * * *

The Brooks Locomotive Works, of Dunkirk, New York, exhibited no less than seven remarkably fine and well-finished locomotives, probably the finest collection of engines built by one firm ever exhibited. It will be noticed from the engraving that the smoke-box is extended, and that a diagonal baffle plate intercepts the direct passage of the cinders to the chimney. A wire netting is placed in the smoke-box, and arrests any sparks that have passed under the baffle plate and have not lodged in the lower front corner of the smoke-box, which, being a sort of dead space, gradually fills with cinders while the engine is running. The smoke-box is emptied by the drawings—which conducts a jet of steam to the hopper at the bottom of the smoke-box and blows the ashes out. A hand-hole, as shown, is provided in the upper part of the smoke-box for cleaning the wire netting, &c. This "extended smoke arch," as it is termed in America, has come into extensive use within the last two years, and is said to be the best method hitherto found of dealing with sparks.

There are few main line passenger engines in Great Britain that equal this engine in tractive power, though the weight on the driving wheels is very moderate. This is partly due to the steel fire-box, the plates of which are thinner than is possible with copper, and the difference in the specific gravity of the metals. The shell of this fire-box weighs 1,730 lb., whilst a copper box of the same size would weigh about 2,950 lb., a difference of 11 cwt. The running board, a plank supported on brackets on the boiler, weighs considerably less than the lightest English foot-plating and outside frame; and the remaining difference in weight is mostly accounted for by the lighter hornblocks and main frame. The centre line of the main frames and journals coinciding, the hornblocks do not require to be strongly bolted to the frames to resist the side strain, and in fact are simply wearing pieces of channel section butting against the vertical face of the bar frame. A bar measuring $3\frac{1}{2}$ in. or 4 in. square can better resist compression than a plain plate 20 in. to 24 in. deep and only 1 in. thick, though the latter frame is nearly double the weight. Thus the lightness of the American engines is due more to their peculiar mode of construction than to weak scantling or small bearing surfaces. On the other hand, it must not be forgotten that plate framed engines can be made lighter than American framed engines if desirable. For example, the Gladstone is a more powerful engine than this, but it weighs only 19 cwt. more.—*London Engineer.*

THE MUTUAL AID BRANCH OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

The National Convention, held at Chicago in October last, resolved to adopt the Mutual Aid Benefit for their members, and the Constitution relating to it is published herewith.

ARTICLE 1.—This Association shall be known as the National Stationary Engineers' Mutual Aid Association of the United States of America, its object being to aid and benefit the families of deceased members of the Association in a simple and substantial manner.

ARTICLE II.—No person shall become a member of the Mutual Aid Association, or retain his membership therein, unless he be a member in good standing in a Subordinate Association. But should a member be suspended or expelled from a Subordinate Association he shall not forfeit his membership in this Association, unless his Subordinate Association fail to reinstate him within one year from the date of his suspension or expulsion, provided he pay his assessments during such term or expulsion.

ARTICLE III.—No applicant for membership in this Association shall be admitted unless in good health and free from any disability that will prevent him from following his occupation.

ARTICLE IV.—The officers of the Association shall consist of a president and general secretary, who shall act as treasurer, and an executive committee of three, all of whom shall be elected annually.

ARTICLE V.—The general secretary shall receive all moneys for the Association, and hold the same subject to the order of the president. He shall keep a true record of all the business and proceedings, and shall keep a register of the members and date of policies issued, and make a correct report annually, or oftener, if required by a majority of the executive committee, of all receipts and expenditures, number of members, and condition of the Association, and perform such other duties as pertain to his office.

ARTICLE VI.—The members of the Mutual Aid Association in each Subordinate Association shall elect annually one of their number to act as secretary and treasurer, and he shall be responsible to his Association for all moneys he may collect.

ARTICLE VII.—The secretary of each Subordinate Association shall keep a list of members of the Association connected therewith, and forward their names to the general secretary as soon as possible after placing them on his list. He shall also erase the names of those who fail to pay any assessments within the specified time, and report the same to the general secretary, that the names may be erased from the general register.

ARTICLE VIII. *Sec.* 1.—When the death of a member of this Association occurs, the secretary of his Association shall transmit to the president and general secretary, a report thereof, signed by two members of the Mutual Aid Association in good standing, together with the certificate of a physician or coroner, stating the cause of his death. The secretary shall also give the name and residence of the widow or heirs of deceased, to whom aid is payable. Upon receiving this information the president and general secretary shall notify all the subordinate secretaries, and order an assessment of one dollar and ten cents on each member to be collected by the subordinate secretaries, and forwarded to the general secretary within sixty days after receiving such notice.

Sec. 2.—When the general secretary has the proof of the death of a member, he shall at once forward one-third of the assessment on hand to heirs of the deceased. Should three deaths occur near each other, he can pay one-third to each.

ARTICLE IX.—The benefits of this Association shall not exceed $1,000 on any one claim. The surplus over and above the amount received from assessments shall remain in the hands of the general secretary and treasurer until a sufficient sum shall have accumulated to pay one assessment. It shall then be used for thea purpose, and no assessment shall be orderdt when there are sufficient funds in the hands of the secretary and treasurer to pay the same.

ARTICLE X.—Within thirty days after an assessment has been collected, or any part thereof shall have been received by the general secretary, he shall, by order of the president, pay the same over to the proper claimant, taking a receipt for all money thus paid.

ARTICLE XI.—The general secretary shall keep a correct account with each Association of all moneys received or paid over, giving and receiving proper receipts for the same to be signed or accepted by both the president and general secretary.

ARTICLE XII.—The secretary of each Association shall furnish a dated and numbered receipt for each assessment as it is paid, or give credit on the books, or both. Such receipt or book credit shall be sufficent evidence of the good standing of the member, and entitle him and his heirs to the full benefit thereof.

ARTICLE XIII.—Expenses incurred for printing or transacting the business of the Associa- shall be defrayed from moneys accumulating from initiation fees.

ARTICLE XIV.—It shall be the duty of the executive committee to examine the accounts and see that the business of the Association is honestly and properly conducted, to decide all points of dispute and questions of doubt which may arise previous to the meeting of delegates, and to fill any vacancies which may occur, either of officers or committees.

ARTICLE XV.—A fee of two dollars and ten cents will be required of any person becoming a member of the Mutual Aid, the same to be paid to the general secretary, one dollar for general expenses, the remainder for an assessment in advance. All members must pay one assessment in advance.

ARTICLE XVI.—Association secretaries shall be allowed ten cents upon every assessment collected by them, to defray all the expenses of their office and services.

ARTICLE XVII.—Applicants for membership shall be duly accredited as members of this Association from the date of signing the application and depositing the fee with the subordinate secretary, taking his receipt for the same.

ARTICLE XVIII.—Any member failing to pay the assessment when ordered as provided in the constitution, or within the prescribed time, shall forfeit his membership, and shall forfeit all right and title he or his heirs may have to any benefit or claim in or against this Association.

ARTICLE XIX.—It shall be the duty of all members of this Association to keep their secretaries correctly informed of their place of residence, or address, when absent from the immediate vicinity of their respective homes, and provide for the prompt payment of all assessments as they may become due.

ARTICLE XX.—This constitution shall take effect at once, and printed copies at the same time will be furnished to all members of the Association.

ARTICLE XXI.—The general secretary shall give bonds in the sum of two thousand dollars to the trustees.

ARTICLE XXII.—It shall be the duty of the president to appoint a secretary, and when appointed it shall be his duty to apply to the general secretary for all blanks and all information that may be required in the discharge of his duties.

◆

THE WONDERFUL SPIDER.

Professor Wood says that the spider's thread is made up of innumerable small threads or fibers, one of these threads being estimated to be one two-millionth of a hair in thickness. Three kinds of thread are spun: One of great strength for the radiating or spoke lines of the web. The cross lines, or what a sailor might call the ratlines, are finer and are tenacious, that is, they have upon them little specks or globules of a very sticky gum. These specks are put on with even interspaces. They are set thickly along the line, and are what, in the first instance, catch and hold the legs or wings of the fly. The third kind of silk is that which the spider throws out in a mass, by which it suddenly envelopes any prey of which it is afraid, as, for example, a wasp. A scientific experimenter once drew out from the body of a single spider 3,480 yards of thread or spider silk —a length a little short of three miles. Silk may be woven of spider's thread, and it is more glossy and brilliant than that of the silk worm, being of a golden color. An enthusiastic entomologist secured enough of it for the weaving of a suit of clothes for Louis XIV.

It is also asserted that the spider spins from 4,500 holes, or teats at once, the ordinary thread being made up of 4,500 threads joined together. The spider spins four webs only. After that if she wants another she takes it by force from the nearest neighbor.

◆

A VERY YOUNG CONTEMPORARY complains in a recent issue that we inclosed one of its honorary titles in inverted commas, meaning thereby to ridicule it. We would not ruthlessly sandpaper the sensitive, but may we not remind our young friend that the title does not make the man? It is the man that becomes the title.

◆

THE FOURTH ANNIVERSARY of the National Association of Stationary Engineers, Providence, R. I., No. 1. will be held on Saturday evening, the 15th inst., when a large attendance is expected. The members have our best wishes for their continued prosperity.

◆

JAMES MAHONY & SON, 73 Astor House, N. Y., report business particularly good for the season. They have begun to apply their furnace to upright Corliss and sectional boilers in the Eastern States, effecting a saving of 10 to 20 per cent.

◆

IF THERE IS ANYTHING that is not known about belts it will be told before long. The amount of belt literature published is one of the curiosities of the times.

◆

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which, with one exception, make a reduction in their rates in connection with us. All complaints of irregularity in receiving other papers must be made directly to the publishers of them, not to us.

	Publication Price per Year.	With THE MECHANICAL ENGINEER.
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SPECIAL NOTICE.—The rates on the *American Machinist* will not be accepted for old names. We have no arrangement with that paper, and can send it only to those who have never taken THE MECHANICAL ENGINEER.

THE MECHANICAL ENGINEER FOR 1884.

In return for the many favors accorded us in the past by the trades we represent, we put forth renewed energy to merit a continuance of the good will shown. To this end we announce the following serials, which will appear in all of 1884.

HOW I SERVED MY APPRENTICESHIP.

This will run through many issues, and is an account of an actual service by a mechanical engineer now in charge of work. It deals with such matters as will be of interest to all in similar positions—not merely beginners, but others who have not had the fullest oppor tunities for informing themselves. The opening chapter takes a common wheel-press. such as is in use in every locomotive shop of any size, explains its principles and construction, the action and how to calculate its power. The problems are all in simple arithmetic and quite within the reach of mechanics. The style is easy and in narrative, so that, aside from its intrinsic worth, it is very entertaining.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks, of the University of Pennsylvania, will, in a series of papers. touch upon various points in the construction of steam engines, rendering the principles involved in their action clear to all. These papers will be as useful to designers and constructors as to working engineers, for the author will not follow others and expound text books already published, but reason from his own deductions and observation.

BOILER MANAGEMENT.

Under this head, Mr. A. H. Goff, a practical engineer of St. Louis, Mo., will give his experience with boilers of various kinds, as to the care and course to be pursued to insure the best results. The author will consider the subject from a practical standpoint, so that persons in similar situations can apply the instruction conveyed if it seems good to them.

A SERIES BY H. L. STELLWAGEN, ESQ.

These papers cannot be announced definitely as to the title, but we have made an engagement with the author, who is an engineer of ability, to give our readers the benefit of his experience, and from his previous contributions we know that the writer will both interest and instruct us.

In addition to these positive announcements, we shall have many other short papers through the year, which will be of permanent value. The Indicator Series, now publishing, will be continued well into 1884. and all who wish to know what their engines are doing as well as inform themselves upon the use of an instrument indispensable in every engine-room, should not fail to renew for 1884.

Locomotive work will have special attention in construction and management on the road. The success which has attended the efforts of the publishers during the past year is evidence to them that their enterprise will be supported, and the very considerable outlay involved in the serial papers announced above—all of which are paid for—is some evidence of an intention to deserve the reputation for practical value to workers in its line THE MECHANICAL ENGINEER has won.

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◆

THE INDICATOR SERIES.

Many friends have written us that they are getting up clubs for THE MECHANICAL ENGINEER, to commence from the Indicator Series. We have to advise these friends that we have at the present writing but a few hundred copies—by count 200—of the last issue on hand, notwithstanding that we printed a large extra edition from the beginning. Those who wish to have the series intact should not delay one moment. Three or four more clubs, like some we have received, would make 200 copies look sick!

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

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THE MECHANICAL ENGINEER.

INDEX NUMBER.—SUPPLEMENTARY.

New Series. Vol. VI.—No. 14.
Enlarged 1883.

New York, December 29, 1883.

Single Copies 8 Cents.
$2.00 per Annum.

TYPES OF AMERICAN STEAM BOILERS.—NO. II.

VERTICAL BOILER FOR STEAM YACHT.

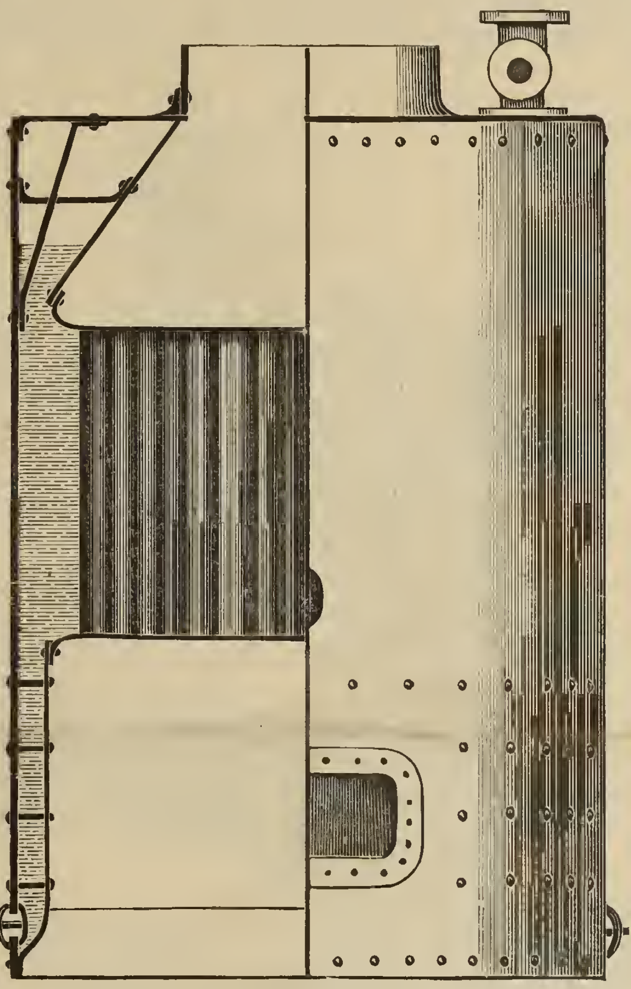
Under this head we shall present sketches of the boilers in general use throughout the country, with diagrams of details and sizes of sheets marked in figures, so that any one can make them if they see fit. These details and dimensions are furnished by a foreman boiler-maker in one of the largest shops in the country. They will be found of value to the trade.

The boiler here illustrated is 48″ diameter of shell, and 72″ high. The fire-box is 44″ diam. and 28″ high; cone, 42″ diam. and 19″ over all in height. There are 119 tubes, 27″ long by 2″ diam., and it is rated at 25-horse power. The shell-sheets, two in number, are 80″ × 71″ × 5-16″; C. H. No. 1 iron, in shell. The fire-box sheet is 141″ × 29″ × 5-16; cone sheets, two in number, are 60″ × 30″ × 25″, should be cut to 40″ radius. Heads are 52½″ diam.; 48½″ diam., and one-46½″; that makes the cone 2″ smaller than the fire-box. "We always put braces on the side of cone and from head to side of shell. The shell-plate shows how we mark off the stay-bolt holes, brace-holes, and door. When there are two sheets, by laying the one marked on the other everything will come right. The firebox is left blank, all but top row of holes and ends until after it is flanged; then shoved in and door and stay-bolt holes marked in place. I have shown the door marked on the shell-sheet, but it need not be marked on the other sheet, for I have left the stay-bolt holes clear, or the door can be put in any place on the sheet that parties want it."

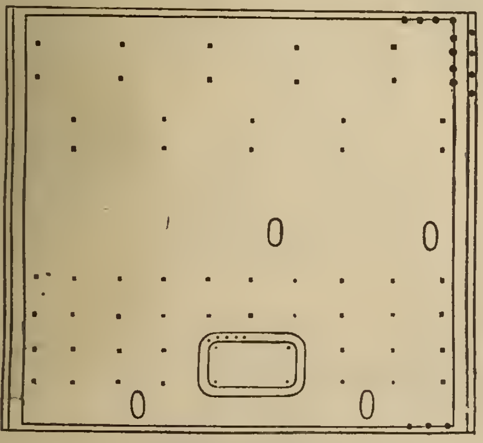
SOME INTERESTING experiments with Portland cement have been made in the office of Mr. Bradlee, a Boston architect. Three glass bottles were filled with cement and sealed tight. One burst in two days, one in eight days, and the third in ten days, proving that the cement does expand.

SOME OF THE DIFFICULTIES which attend students in technical colleges, are tersely mentioned by our contemporary, *The Tech*, published at the *Boston Institute of Technology*.

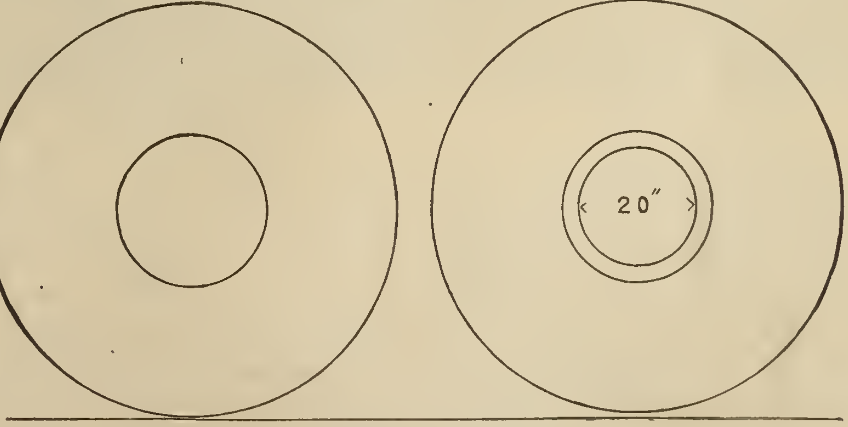
> "Several accidents have occurred lately in the carpentry shops. The tendency of the mechanicals seems to be toward turning the shops into dissecting-rooms."



VERTICAL BOILER FOR STEAM YACHT.



SHELL SHEET.



OUTER SHELL HEAD.

A WRITER in the *Industrial World* says: "It has been a somewhat common thing to find that engines have consumed more steam after a condenser had been attached than before, to the surprise and the confusion of attendants until the real state of the case had been discovered. It was then found that leaky valves had allowed the steam to pour freely and unsuspected into the condenser, while before it had escaped in less quantity against the greater resistance of the atmosphere."

UNDERGROUND TELEGRAPH CABLES in France are inserted in cast-iron pipes laid at a depth of more than 1½ meters, chambers for repairs being inserted every 500 meters. Every 100 meters the pipes are united by cast-iron couplings. Joints between pipes are made with an india-rubber washer or lead collar.—*Iron.*

A CONSPICUOUS OBJECT in the office of an architect in New York is a large section of what seems to be alternating strips of red and white wood, arranged in waved or undulating lines, presenting a novel and very pretty effect. It is an entirely new thing and is not yet introduced in the market, but when it is bids fair to have a good demand. It is intended for fine floorings, wainscoting, and fancy ceilings in the best class of buildings. It is made of regularly tongued and grooved strips of cherry and maple, and a not unimportant feature about it is that, owing to an ingenious way of producing it from the log, it can be made at no higher cost than that of ordinary hard-wood flooring. — *The Builder.*

THE MORMON TABERNACLE, a correspondent of the St. Paul *Pioneer Press* says, is the most wonderful whispering gallery in the world. When everybody in it is quiet the faintest whisper may be heard in the remotest part of the house. It will seat 20,000 persons. There are no means of heating it. The other large edifice in Salt Lake City has cost, the Mormons say, $10,000,000 and they will require $5,000,000 to complete it; but a Boston architect recently offered to duplicate the structure and finish it within two years for $800,000. Its walls are solid granite, 9 feet 9 inches in thickness. They have reached a height of about 100 feet, and the six towers will rise another 100 feet.

MR. JAMER NAYLER, JR., of Kilroy, Ont., writes to the *Northwestern Lumberman* that the balance wheel of his engine recently broke, and he ran without it. With the wheel attached to his engine he cut 23 cords of stave bolts a day, but without it he cut 25 cords. This showing leads him to the conclusion that the steam formerly used in driving the balance wheel was afterwards employed in another direction.

Mr. Nayler, Jr., has not got through yet; he may find before long that he would be making money to put the wheel on again.—EDS.

MANY A SUBSCRIBER is caught on the fly, as it might be, by sample copies. We shall be glad to send samples to all who have never seen a copy of this paper.

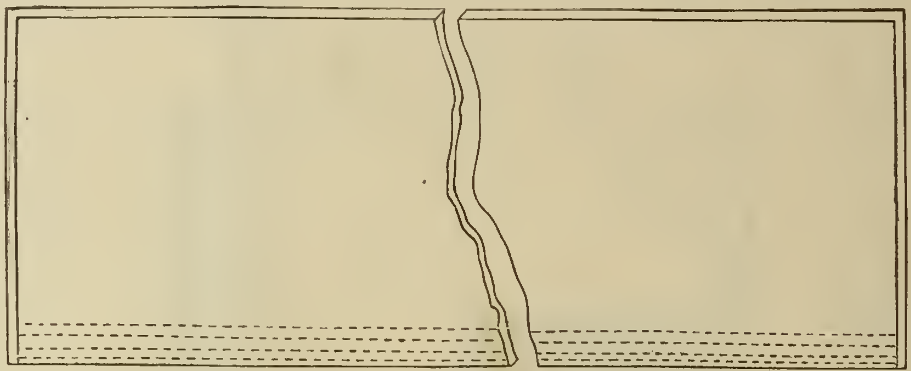
A FIRM who manufacture tinners' solder, recently wrote to the *Plumber's Journal*, inquiring the cause of the failure of some goods they had made of the character mentioned. They shipped the same make to various parties, and while some reported in favor, others reported adversely. The cause is probably impure lead, for it is stated in a foreign contemporary, that very small quantities greatly affect alloys. The presence of $\frac{1}{30000}$ of a pound of antimony in a pound of melted lead increases the rapidity with which the lead oxidizes and burns.

IF YOU KNOW of any one in your vicinity whom you think would care to see a sample copy of THE MECHANICAL ENGINEER, please give us his exact address.

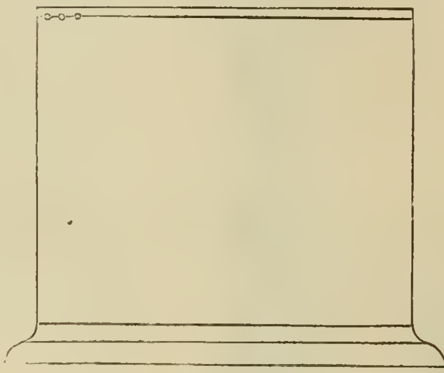
SOME ENGRAVINGS of engines put forward as examples of the style manufactured convey no idea. They are taken from a three quarter front view and show merely the cylinder, guides, cross-head and connecting rod; the valve motion and how it is driven being invisible. Such engravings are unsatisfactory and unlikely to attract purchasers.

NEW METHOD OF MAKING LEAD PIPE.

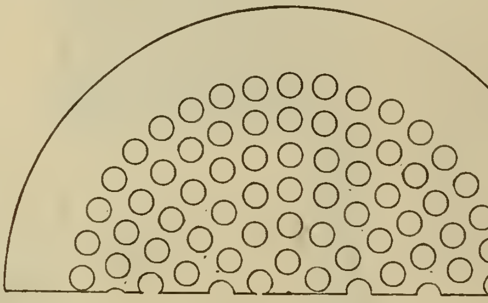
The manufacture of lead pipes and sheets, has engaged the attention of many engineers, and it is not generally known how they are manufactured. Formerly they were produced by drawing through dies or by bending sheet lead, of the necessary width, over a mandrel and soldering the edge together, but the more universal method was by casting and drawing. The casting-box employed, was an iron cylinder made in valves put together with flanges; inside of this was placed an iron core which was so fixed as to be concentric to the cylinder without touching it, a space was then left into which the molten lead was poured, when this was set the core was removed and the cylinder opened so as to withdraw the pipe, its substance being reduced by drawing it through a series of holes in steel plates diminishing gradually in diameter until the desired size is obtained. The new method of squirting, by hydraulic machinery gives better results, and is arranged as follows. This patent hydraulic machinery consists of a strong copper-lined hydraulic cylinder, ram, and crosshead, having central opening supported by four wrought iron columns. The ram is fitted with a portable lead container and to the crosshead is fixed a ram or plunger within which is fitted a die for forming the outside of the pipe, the core for forming the inside of the pipe is fixed in the center of lead container. The molten lead is conveyed from the melting pot by a portable conductor to the container, and after being filled is allowed to set or solidify at a temperature of about 400°F. The water ram being then forced up by the hydralic pumps at a pressure of from 25 to 30 cwt. per square inch, raises the container and presses the surface of the metal against the ram and die, and having no other means of escape, it passes out through the aperture between the core and the die, resulting in the continued formation of a solid pipe, until the metal in the container is exhausted, when the hydraulic return motion in connection with the pumps is put into operation, and the lead container returns to its original position and is then refilled.—*Eng.*



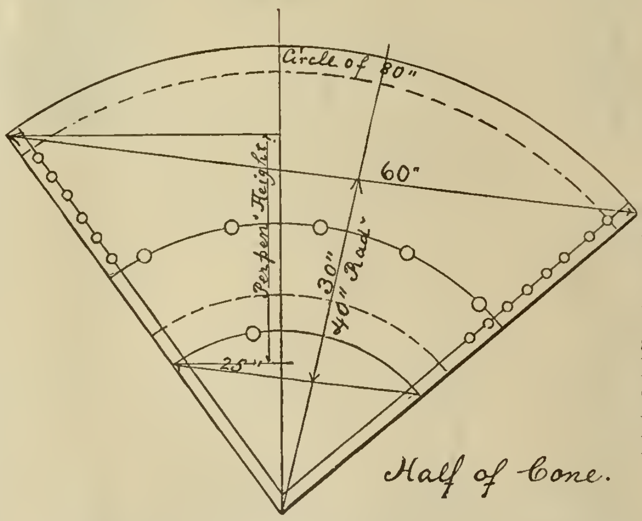
FIRE-BOX SHEET; WHEN OGEE FLANGE IS ON IT WILL BE 28″ HIGH.



FIRE-BOX ROLLED AND FLANGED.



HALF TUBE SHEET.



RIVETED JOINTS.

The literature of the strength of riveted joints is already extensive; we have no intention of augmenting it. What we are about to say concerning them at present bears relation to workmanship, and not to proportions. No doubt workmanship affects the strength of structures joined by means of rivets; but the fact is not too much note is taken by those who carry out experiments and tabulate results for the benefit of engineers. It is commonly assumed that it is a riveted joint, and that suffices. As a matter of fact, however, there are wide differences in the qualities of riveted joints, and more attention should be paid to the circumstance. Thus it is very commonly assumed that a single riveted joint properly proportioned has a strength of 56 per cent. of that of the solid plate. We have ourselves seen machine-riveted seams tested, which broke with less than 30 per cent. of the strength of the plate, albeit that externally, the seam was to all appearance a good and well made seam; and we believe that in practice seams with a strength equal to that given for them in text-books, such as Fairbairn's, are rarely met with except in the very best class of work; experience can alone be relied on to settle the point, When we come to deal with boilers we get on very delicate ground. It is not to be denied that many men who are very particular about the workmanship of their boilers will not have machine riveting at any price. They rely entirely on skilled labor, and a thoroughly well made locomotive boiler is the most beautiful specimen of hand riveted work that can be had, Such boilers as made in this country require no caulking, and one result is that the strength of the seams in locomotive boilers are often in excess of that laid down in text-books, the 75 per cent. for a double riveted seam rising to as much as 78 per cent., or a little more. It is urged that machine riveting cannot produce such results; it is far too inflexible; it takes no account of the heat of a rivet, or its quality, whereas an experienced man knows exactly what to do with a rivet, and feels his way, so to speak, along a seam in a way that the machine cannot do. As bearing on this point, we may say that cold riveting has been extensively practiced in the United States, The high-pressure boilers used on the muddy rivers consist of wrought iron tubes, seldom more than 3ft. in diameter $\frac{3}{8}$in. thick and about 30ft. long. These are arranged side by side, with a large furnace at one end, and in many cases a flash flue running straight to the chimney. Such boilers will work with water far too dirty to be used in a tubular boiler. They carry pressures of about 150 lb., and the seams are made up with cold rivets of a peculiarly soft and ductile iron. It is said that these joints stand far better than any hot riveted joint that could be made, and we have no reason to doubt that this is true of the very thin plates used. Going to the other end of the scale, we have the modern marine boiler, with plates $1\frac{1}{8}$in. thick and rivets $1\frac{1}{4}$in, It is asserted by one party that such rivets cannot be closed by hand in a satisfactory fashion, and that the aid of machinery must be called in; but, on the other side, it is pointed out that boiler fronts have always to be put in by hand, and that this hand riveting is quite as good as the machine work, and it is also contended that machine riveting is so far from securing tightness that every rivet head has to caulked inside the boiler to make certain that it will not leak. Many able engineers hold views entirely opposed to these, and assert that the best kind of boiler work cannot be produced at all without the aid of machinery. The arguments they urge in favor of machine riveting, as a matter of workmanship, are that it compels the rivets to fill the holes, and effectually closes the plates on each other. The arguments against it are that split heads are apt to be produced, and that the rivets not only fill the holes, but now and then burst the plate; and that in most cases, unless unusual care and vigilance are employed the iron will be severely strained, and a bad, instead of a good boiler produced. Nothing of this kind can, however, be urged against the machine system, when several plates have to be joined, as in bridge work, because the great length of the rivet permits it to give way without straining the plates.—*London Engineer.*

An Exchange says:

"The diameter of the crank-pin is found by multiplying the diameter of the cylinder by ·16.""

Who gets up these "rules?" Sóme one must "evolve them from their inner consciousness." What sort of a crank-pin would $1\frac{60}{100}$ths be for a 10″ cylinder? Answer; poor sort.

Friends are particularly requested not to send postage stamps for fractional sums. We have large quantities on hand and cannot sell them except at a discount,

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LIST OF OFFICERS OF TROY ASSOCIATION, No. 6, STATIONARY ENGINEERS, FALL RIVER, MASS.

President, William Berwick; Vice-President, John C. Blaisdell; Recording Secretary, Chesley Burns; Financial Secretary, Edward Miles; Corresponding Secretary, Robert Place, No. 3 Alden street, Flint Village. Fall River, Mass.; Treasurer, Thomas Place; Conductor, Lysander Gifford; Doorkeeper, C. Murphy; Librarian, G. Todsen; Chaplain, Charles A. Palmer; Trustees, Samuel Taylor, Thomas G. Nay, Walter Griffith. Number of members, 30

In relation to the article on *"Air in the back connection"* on our editorial page of the this issue, Mr. E. Platt Stratton, whom we have seen since it was written, says that the steamers *Huntsville,* and *Montgomery* had such an arrangement which was not satisfactory. It is conceivable that in many cases it might not be. With slow combustion and where the velocity of the gases is low they might be consumed, or be too cool, before reaching the back connection, but with forced combustion it would seem worth while to try the experiment.

We find in a contemporary, an article entitled, "A Substitute for Musk." About the only substitute for the alleged perfume would be the old original skunk himself.

The potato is supposed to grow anywhere, but there is at least one place in this country where it will not, and that is on the Platte river in Colorado, so says the *Denver Journal of Commerce.*

WASTEFUL GAS BURNERS.

In 1871, the gas referees made an examination of a number of gas burners collected from newspaper offices, warehouses, shops and dwelling-houses, and they found that burners generally employed by the public would only give about one-half the light the gas was capable of yielding per cubic foot consumed; several of the burners tested gave only one-fourth of the proper light of the gas.

They say in their report to Parliament: "The economy to the public, arising from the use of good gas burners instead of bad ones, is so obvious as hardly to need remark,

The result of careful trials, made with a number of burners taken lately from private houses and shops, shows that, as a rule, the amount of light obtained by the general public from five cubic feet of gas, is less than one-half of that which it is capable of giving. The iron and metal burners, of which a great many are used, give the best result in light when they are worn out, although the shape of the flame is bad. The reason is that in order to obtain from what is a compound of hydrogen, marsh gas and carbon, its best effect in light, the burner must be made that the quantity of gas required to be consumed is proportionate to the size of the burner, so that it cannot exceed the maximum quantity which the burner is made for. The outlet of the burner itself, whether it be of the Argand or the flat-flame form, must be so arranged that the gas issues forth at a sufficiently low rate of velocity, so that it has time to get heated to a proper degree by the hydrogen and marsh gas before it comes into combustion with the oxygen of the atmosphere. When this rate of velocity is obtained in the Argand burner, the pressure at the point of ignition is almost nothing. In flat-flame burners the pressure of the gas must be raised to a point sufficient to blow out the flame to a fan-like shape, but it must only be sufficient to do this if it is desired to obtain a good result per cubic foot of gas consumed.

One more point is of great importance in the construction of a gas burner—that is, that the gas should not be heated until it arrives at the point of ignition. The body of the chamber below the point of ignition must, therefore, be made of material which is a bad conductor of heat, so as not only to prevent the undue expansion of the gas before it arrives at the point of ignition, but also to maintain heat in the flame.—*Journal of the Society of Arts.*

THIS IS A CASE in point concerning an article entitled "Runaway Locomotives," in our last issue:

"As the engine 'Ashmont' was backing off the Milton Branch of the Old Colony Railroad at Neponset station on the evening of Dec. 3, to connect with a train from Boston, it collided with the cars of the Milton train. The jar threw open the throttle of the already reversed engine, and it started in the direction of Milton, the engineer and fireman having jumped off. It ran as far as Mattapan, taking down the gates at Neponset avenue crossing, and, upon reaching Mattapan station, the terminus of the branch, dashed into a freight train, passing entirely through one car and smashing another. The engine was badly damaged."

* * *

THE *American Miller*, easily the leader of milling journals, says:

> "We invite the discussion of all topics of interest, with the suggestion always that contributors will avoid personalities. Perhaps it has never occurred to the reader why newspapers, as a rule, discourage personalities in communications. There is the general reason that they do not wish to be made the vehicle of doing any one an injury; but there is another: they know that such letters lead to long-winded replies and interminable recriminations of no interest to any one except the participants."

Quite so; and that is not what subscribers pay for. They have a right to a quiet life, and columns free from jar or backlash.

A JUVENILE CONTEMPORARY, animadverting upon some articles recently published in THE MECHANICAL ENGIEER says "one should never write upon things they know nothing about." that is excellent advice, but our juvenile contemporary easily sees that it embarasses itself; if it followed its own advice its columns would be very bare.

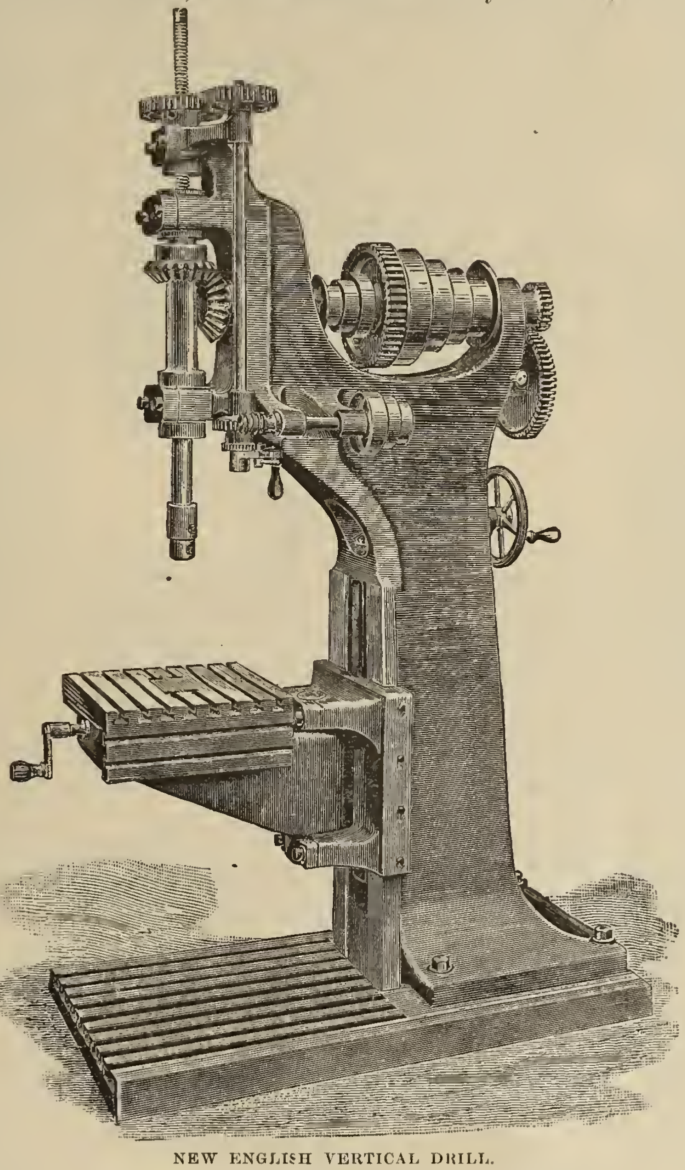
* * *

PERSONS NEEDING BINDERS for the current volume can be supplied with them for $1.25 free by mail.

* * *

NEW ENGLISH VERTICAL DRILL.

Our engraving represents a new tool of this class which has some excellent features, not the least one of which is the position of the feed, and system employed in it. Respecting the details, *The Mechanical World* says:



NEW ENGLISH VERTICAL DRILL.

"This machine has a radial rectangular table, which may be turned out of the way when large pieces of work are to be fixed on the base plate. This table will raise or lower by means of screw and bevel gear, operated by the hand wheel at the back of the standard. The spindle is driven by a revolving tube with adjustable gun-metal bearings, and has a self-acting down-feed motion by a screw and nut, adjustable for taking up the wear. The cone pulley is 4-speed, with strong single and double gearing, and the machine is suited for the general work of a shop. The sliding top to the upper table is an item which is too frequently omitted in drilling machines, though it is well recognized by all practical men to be a necessity for a drill quite as much as for a slotting machine."

* * *

DIRECTIONS TO AMATEURS, in the papers of the day, for making various articles for household use incite the cynical mechanic to smile. Operations which require a long time, and wide experience to carry out successfully are described as if they could be done by women, through merely reading the directions. The result is in most cases a waste of good material and futile tears.

UTILIZING BEGASSE (SORGHUM-CANE TRASH) AS FUEL.

The Champaign Sugar Works, Champaign, Ill., were the first large Sorghum sugar works ever started in the United States. They have ground the cane this season raised on about 1,000 acres of land, and the result is a perfect success in the way of making a first-class quality of sugar that polarizes 97 degrees, and much sweeter than sugar made from cane or beet-roots. For years experiments have been made to find out some way to change Sorghum syrup into sugar. The attempt was unsuccessful up to last year, when the State of Illinois offered a bounty to any one who would succeed in granulating the syrup into sugar. Experiments made at the State University of Illinois, in Champaign, by Profs. Weber and Scovell, succeeded in accomplishing the result. A ready sale is found for all the sugar and syrup made, and the success here will cause a large number of sugar works to be erected all over the West, for Sorghum cane will grow where corn can be raised, and where farmers can make $15 an acre in raising corn they can realize $30 an acre in raising Sorghum cane to sell to these factories.

The result of this discovery is likely to make as great a change in this country as the making of beet sugar has in Europe, where to-day two-thirds of all the sugar in the world is made.

Out of a total production of three million tons, France, Belgium and Germany produce two million tons. The Champaign Sugar Works have introduced all the modern improvements. The sugar-cane trash called "begasse" is carried on conductors directly from the grinding mill and dropped into the furnaces in its green, wet state. The boilers are set with the Jarvis Patent Furnace, and hot air is discharged directly over the fires, igniting the gases generated by the burning fuel.

The intense heat made by joining the gases with hot air (*oxygen*) causes the green crushed cane or begasse to burn as well as dry cane under the old system.

The Jarvis Furnace is now in successful operation in the islands of Cuba and Santo Domingo, Guatamala, also in the Sandwich Islands. In the West Indies the begasse has to be dried on the "batey" before using. With free labor this is a costly job; and as the slaves are being gradually emancipated, every possible means will have to be used to burn the begasse without drying. In the United States, at New Orleans and the West all this material has heretofore been thrown away, and coal or wood used for fuel.

HOLDING DRILLS.

We do not know where the quotation below originated, for we find in a journal, which steals right and left assiduously. The article may be are right, but it does not sound so to us. For example:

> In common practice there are but two ways of holding drills in drilling machines; a taper fit with a flat tit on the end of the drill to project into the keynote in the spindle (!) and the universal drill chuck. The former will slip and twist off the flat tit. The machinist then puts in a set screw, and that is about the end of improvement in that machine. The chuck will also slip unless screwed up with the gas pipe tongs, or some other powerful agent; then it slips in the spindle unless the set screw will hold it, and that is not entirely reliable. The only way out of this difficulty is to make the drills of square steel, with a taper fit without the flat tit, and a square collar close up to the spindle. Then screw a socket on the end of the spindle, having a square hole to fit the collar loosely. The driving is done by the square collar, which is the largest part of the drill. This is for common drills. If twist drills could be had with square collars they would be much better.

* * *

THE ELGIN WATCH COMPANY keeps a small Westinghouse engine on hand to use in case the main-line shafting is disabled from any cause. By the aid of a split pulley, and a temporary steam pipe, they can run part of the tools, at least, until repairs are made.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

CONCISE ANSWERS TO MANY QUESTIONS.

Editors Mechanical Engineer:

I wish to ask a few questions, to be answered through the columns of The Mechanical Engineer.

1. I wish to obtain a few photographs of engines and machinery, suitable for framing; do you think it best to write to manufacturers direct or to advertise? I intend to hang the same in engine-room. Please inform me of the best method to obtain them.

2. Can I use a siphon to draw water 8′ that is heated to 110° F?

3 I wish to ascertain the heat of feed-water. Can it be done by obtaining a bucketful and placing a thermometer in it? If this is not the usual way please state and describe instrument and its cost.

4. How much oil ought I use in an engine 8″×10″, making 200 revolutions per minute, working 10 hours per day, carrying 45 lbs. steam?

5. Can a Blake pump pump water hotter than 180° F.; water to be taken from tank and then to boiler?

6. What is the best covering for steam pipes?

Willis F. Gordon,

1513 Wash. St., East St. Louis, Ill.

[1. Most manufacturers will gladly send photographs to hang up in engine rooms if they receive reasonable assurance they are to be used for that purpose. We think our correspondent can show cause.

2. You cannot use a siphon at 110° Fahr., as the vapor at that temperature would destroy the vacuum.

3. The hydrometer is an instrument used for obtaining the temperature and density of feed water, and should be in every engine-room. Mathematical instrument makers sell them, and those advertising in our columns will furnish prices.

4. If an engine is in good order and properly fitted with cups all round, and suitable sight-feed for the cylinder, the quantity of oil used is small. Exactly how much we cannot say. Perhaps correspondents will furnish their experience in this matter.

5. No; not unless the hot water runs into the pump; it will not lift water at 180°.

6. Prof. Ordway made some experiments recently on this subject and said that of all the plastic compounds fossil-meal was the best; hair felt is the best, undoubtedly, but it is expensive and in some places inapplicable.—Eds.]

USEFUL INFORMATION FROM THE "SCIENTIFIC AMERICAN."

Editors Mechanical Engineer:

I find the following matter in the last *Scientific American:*

"(4) R. B. writes: I am running a Corliss engine 16 inch cylinder, 42 inches stroke, and it runs 81 revolutions per minute, with 40 and 45 pounds pressure. I can change the wheels on the upright and engine shaft, and run it 70 revoutions and carry 75 pounds pressure. What will be the difference in the fuel consumed? A. It will be most economical to run it at the fast speed if your cut-off is allowed to cut short enough to meet the change in velocity; but under your conditions we could not recommend the change. Carry 75 or 80 pounds in boiler and throttle down till your cut-off has control of the speed of the engine."

This puts me in mind of the old lady who complained about the inconvenience of snuffing her tallow candle with her fingers. She was made a present of a pair of snuffers, and the first time she used them, she snuffed the "dip" with her fingers as usual, and put the burned wick in the box attached to the snuffers, exclaiming, with great satisfaction, "What a great invention snuffers is!"

So it is with the *Scientific American.* After Geo. H. Corliss has spent years of time and large sums of money to perfect a cut-off arrangement to take the place of the throttle-valve for controlling steam engines, and revolutionized the practice of the world, the above *scientific journal* recommends to patrons that they shall increase their boiler pressure "and throttle down till the cut-off has control of the speed of the engine!"

There's wisdom for you! "Turn down a leaf and make a note of it," as Captain Cuttle says.

New York, N. Y. Cut-off.

[This is doubtless the practice of that eminent engineer, Mr. Alfred Beach, when in the engine room. These are not anonymous letters.—Eds.]

TRACTION ENGINES, ETC.

Editors Mechanical Engineer.

I will be very brief in asking two questions, which are of considerable importance to me.

The first is: What are the chief obstacles to the success of traction engines in hauling and plowing in competition with horses, mules or oxen?

The second is, for the sake of light weight and for compactness, I want to use a small high speed engine, to make 500 turns per minute. I want to gear back 30 to 1. Could a screw and wheel (worm) be used instead of gears?

George F. Major.

Brandy Station, Va.

[There are no obstacles to the use of traction engines, except local ones; traction engines can be used successfully wherever there are roads fit for them to run on. Obviously for plowing by steam to be economical, there must be a large area to be worked, for the system is cumbrous as compared to animal power. The late Mr. Wellington Lee spent a large amount of money in trying to introduce English steam plowing machinery in Southern cane fields in Louisiana, but, for causes unknown to us, failed. We believe also that some large Western farmers have tried them but abandoned their use.

The objection to worm-wheels is their excessive wear and friction under heavy loads. We should prefer spur gearing.—Eds.]

CHIEF ENGINEER JAMES H. REID TO CHIEF BELL.

Editors Mechanical Engineer:

In The Mechanical Engineer of December 22d, Mr. Marion Bell, chief engineer of the steamer *Pilot*, asks how to avoid grease getting into his boilers. I have never had any trouble from that cause since I stopped using tallow lubricants in the cylinder. I have for the last eight years used the Kellogg anti-corrosive cylinder oil, manufactured in New York city. I use only 52 gallons of this oil in 140 round trips of 230 miles each, and the cylinder is glossy and smooth. I think most engineers use more oil than is necessary, and more or less gets into the boilers by the feed-water. But if this oil gets into the boilers it will not do any harm, as it is a good cleanser, and some engineers use it for that purpose. If Bro. Bell will write to Mr. E. H. Kellogg, No. 17 Cedar street, New York city, he will receive a circular.

In regard to tightening follower-bolts with the wrench, when I think that I have put force enough on the bolts to screw them down tight (iron on iron), I then take a hand hammer, and tap the bolt on the corner, holding my hand on the opposite corner, and I can tell at once, by the feel and sound of them, if the bolt is tight. I never have any bolts come loose or break off to damage the cylinder or cover. If a bolt cracks or is defective, I throw it away. I can tell by the sound of the bolt when screwing it down if it is giving away. I then take it out and examine it.

J. H. Reid,

Chief Engineer Steamer "Northwest."

Detroit, Mich.

TRACTION INCREASERS.

Editors Mechanical Engineer:

In your edition of Oct. 27th, I notice a clipping from the *Railway Age*, saying that one Orlando Wetmore, had invented a device for increasing the tractive power of locomotives, by throwing the weight of the end of the tender on to the rear driving wheels, and it also stated that M. Forney would like to see him. I just want to state that M. Adees, Moss Point, Mississippi, is putting a traction increaser on this road that works on the same principle, viz., by throwing the weight of the forward end of the tank on to the rear driving wheels: "praps" M. Forney would like to see him, also! Please make mention of this in your valuable paper, and oblige a subscriber.

Charles S. Rea, Draughtsman,

Dennison Shops. *P. C. & St. L. Ry.*

[Mr. Forney has seen the above letter, and says that the idea of putting part of the weight of the tender on the rear driving wheels is very old, and has been patented many times in various forms; he further says: "My patent on tank locomotives was issued in 1866, and has therefore expired; another patent was granted to me last year; it is, perhaps, this that Mr. Rea refers to in his letter."—Eds.]

CARELESS WRITING OF THE "SCIENTIFIC AMERICAN."

Editors Mechanical Engineer:

I clipped the following from the Philadelphia *Evening Bulletin:*

The "Scientific American," in answer to a question as to how many gallons of water are required for a steam boiler per horse-power, at 60 pounds pressure, says: "At the Centennial Exhibition and tests, 30 pounds steam per horse-power per hour was taken as standard: this is little less than half a gallon, but it depends much on the character and condition of the engine through which the steam is worked. The quantity of water may vary from one-third of a gallon to two-thirds of a gallon and even one gallon in a very bad engine."

"What kind of an arithmetic does the *Scientific American* man use, in which 30 pounds of water is "a little less than half a gallon?"

Philadelphia, Pa. Querist.

[We don't know, but we may, perhaps, receive an anonymous letter in the course of a week from the office of the paper in question, with a sarcastic reply. If we were to correct all the stupid blunders of the *Scientific American*, we should have little time to devote to legitimate business.—Eds.]

CONCERNING WHISTLES.

Editors Mechanical Engineer:

In Vol. 5, No. 10, page 110, you give credit to England for the invention of "a steam demon!" as you call it, or a steam whistle with which varying tones or notes, can be given, and you say at the end of the article:

"This is not a mere invention but an article of trade regularly sold in England."

Now, let it be known that America deserves credit for this invention. I invented this same whistle at Sandusky, Ohio, and have obtained a United States patent for the same, dated August 26th, 1873. Soon after I sold the patent to parties in Cincinnati, O., who have manufactured and sold them ever since.

Americans need not go to England to learn how to whistle!

Otto Kromer.

Klotz & Kromer, Mach., Co., Sandusky, Ohio.

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which, without exception, make a reduction in their rates in connection with us. All complaints of irregularity in receiving other papers must be made directly to the publishers of them, not to us.

	Publication Price per Year.	With The Mechanical Engineer.
Railroad Gazette	$4.20	$5.25
Scientific American	3.20	4.40
North-Western Miller	2.00	3.50
American Miller	1.00	2.75
Modern Miller	1.00	2.75
Builder and Wood-Worker	1.00	2.60
Manufacturer and Builder	2.00	3.50
American Machinist	2.50	4.20
Trade Review	3.00	4.50
North-Western Lumberman	4.00	4.80
Mechanics	2,50	3.87
Cotton, Wool and Iron	3.00	4.25

We have made an arrangement with the American Machinist Publishing Company whereby we can furnish their paper to all subscribers who may wish to club it with The Mechanical Engineer at $4.20 for both papers, new names or old, without distinction. Parties who have clubs in hand can remit us $2.20 in addition for each person who wishes the *American Machinist.*

A WHOLESOME CHANGE.

Mr. Joseph M. Wade has been chosen editor of *Cotton, Wool and Iron*, Boston, Mass. Mr. Wade is a woolen manufacturer of wide experience, and will no doubt make the paper indispensable in his specialty. It will at any rate be purged of much that was offensive to sane persons under its former management. Mr. Wade has our best wishes for his prosperity and success.

AGAIN THE CANNON-BALL.

We have received several (three) letters, dissenting from our view of the cannon-ball question, but we do not publish them, as it seems to us that the writers have not fully studied the matter, and that their reasoning does not apply. We invite the attention of those who think a cannon-ball would fall to the ground, if the cannon was fired when moving at the velocity the ball would travel at, to the position of a man on a railway train moving at the rate of 60 miles an hour. He wishes to reach the end of the last car. How much effort is required on the part of the man to enable him to do so? Does he put forth more than his natural effort? Is he not going through space at the rate of 60 miles an hour? and, in order to walk to the rear, would he not have to oppose 60 miles an hour, As the man lifts his feet, the car moves under him; it may be said that he stands still. In reality he does not; he moves (relatively) over the floor of the car, and goes from seat No. 1 to seat No. 10 with no more than his usual effort. Why? The second law of motion tells why.

"A given force always produces the same effect, whether the body on which it acts is in motion or at rest; whether it is acted on by that force alone or by others in connection with it."

Reduced to an absurdity, a man astride of a cannon moving backwards at the rate of the velocity of the ball, would be able to catch the ball in a bushel basket, if our friends' propositions were tenable !

"A BAD GIVE-AWAY."

A copy of the appended letter was sent to the editor of *The American Journal of Railway Appliances* some weeks since, but was not published by him. Simply as a favor to the writer of the letter, who is personally a stranger to us, we give him an opportunity to be heard. This closes our connection with the matter, as we do not intend our readers shall be annoyed by controversies, especially one in which they have no interest:

Doctor Robert Grimshaw:

My attention has been called to an article of yours headed "*A Bad Give Away,*" in *The American Journal of Railway Appliances*, Nov. 15, 1883, attacking me upon the worn-out indicator-rig controversy, and giving me undue credit for an article on the same subject in THE MECHANICAL ENGINEER, of Oct. 13th.

I beg to assure you that you are wrong again, as you generally are, when you draw upon your imagination. I am not the author of the article referred to in THE MECHANICAL ENGINEER, and I would not write an article, particularly when of a personal character, without signing my true name in full; nor would I put "an honorable title in quotation," nor when * * * assumed. * * * Otherwise, I can endorse the article in question as correct, and a similar article appeared against you in the *London Engineer*, but neither of them emanated from me.

In your article on "*Practical Hints on Locomotive Indication,*" published in *Mechanics*, Jan. 27th, 1883, you appropriated my indicator-rig as your own, and recommended the same to apprentices for gaining experience, but after I claimed it as mine then you condemned it as wrong.

In *Mechanics* for Feb. 24th, 1883, you attempted to mislead the public with your * * * on indicator-rigs, but your misstatements were corrected by Mr. Irvin Lee in *Mechanics* for April 7th. Now you attempt again to mislead the public on the same subject in *The American Journal of Railway Appliances*, but any mechanic, who has read your articles and understands indicator-rigs, knows that you are wrong.

When you write, you ought to make distinctions between facts and suppositions, for when you draw upon your own imagination, *ad libitum*, without appropriating ideas of others, your statements are very apt to become misrepresentations.

I respectfully request that you publish this letter in *The American Journal of Railway Appliances*, as a reply to your article headed "A Bad Give Away."

Yours Respectfully,
JOHN W. NYSTROM.

QUALITY OF IRON FOR STEAM BOILERS.

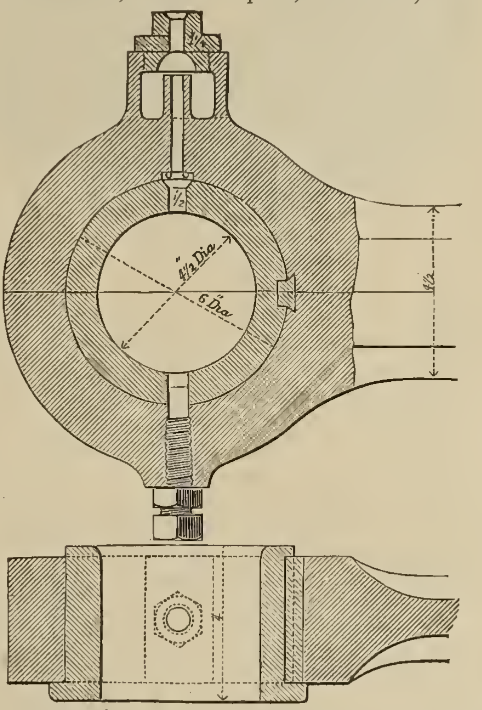
There is so much discussion and controversy in regard to the real value of the different grades of iron offered in the market for boiler plates, that we have felt compelled to investigate the subject in order to ascertain what the brands used at present mean, and what quality of iron is indicated by them. We find that the brands as formerly used were: C. H. No. 1, flange, C. No. 1; C. H. No. 1, shell, Tank. Some manufacturers were not satisfied with these brands because they did not indicate the true character of the iron, and boiler users were often deceived by having an inferior iron palmed off upon them by boiler makers, when they supposed they were securing a first-class article. The brands were subsequently changed, and the following are those used by most, if not all the prominent iron manufacturers in the country: C. H. No. 1, flange, Refined; C. H. No. 1, firebox, Tank; shell.

If these brands are honestly used, the quality indicated is as follows, viz.: C. H. No. 1, flange, and C. H. No. 1, firebox, are strictly charcoal iron. Shell has only a thin cover or outer skin of charcoal iron. Refined has no charcoal iron in it, but is simply refined from the pig. The pigs are selected with reference to the quality of carbon which they contain. They are divided into foundry and forge pigs. Those containing the least carbon being selected for conversion into malleable, or wrought iron. The process of refining need not be described here. From the refinery the iron is usually run out into large molds, and then broken up into what is technically distinguished as "plate metal." Now the term "refined" iron is very indefinite, and means anything from "muck bar" to that which has gone through several processes. The value of charcoal pig-iron, and charcoal blooms, is owing to their being produced with a fuel that is free from impurities, and while other irons can be purified it can only be done at expense and loss, and the danger is that in some cases at least it will be only purified sufficiently to "pass muster," and sell. The brand of "refined" iron in the market is often recommended as a superior article because it is "refined," and the purchaser is led to believe that it is something unusually good.

Another test of quality is this: the price of refined iron at the time of our inquiry was 1¼ cents per pound less than the price of C. H. No. 1, Flange. The prices were, "Refined, 3¼ cents per pound; C. H. No. 1, Flange, 4½ cents per pound. Questions relative to the quality of boiler plate are frequently asked us, and we take this way of answering them. We believe in the best material for boilers and always recommend it. We know that there is sharp competition in business and that the margin of profit is often very narrow. But the purchaser should know what he is buying and be willing to pay a fair price for a first-class article. The purchaser is often as much at fault as the boiler maker, by trying to get a first-class article for less than its cost. We know all reputable boiler makers would prefer to use the best material, and get a fair price for their work, and some will not make estimates if inferior material is called for.—*The Locomotive.*

SOLID-END SIDE ROD OF AN ENGLISH LOCOMOTIVE.

Our engraving represents a solid end side-rod as constructed for fast passenger engines. It is taken from *Engineering*, and is part of the details of the locomotive illustrated on our first page of last issue. The method of holding the bush in the rod seems, in one respect, defective; that is the steady-pin end of the bolt at the bottom. The end of this bolt is $\frac{9}{16}$ths diameter and the hole goes clear through the bearing, thus affording a chance for dirt to lodge as well as oil to leak out. The bush should have been merely "spotted" with a drill, to the depth of one quarter of an inch.



LECTURE BY FRANK M. MERRILL, BEFORE KEYSTONE COUNCIL, NATIONAL ASSOCIATION OF STATIONARY ENGINEERS, PHILADELPHIA.

The relative merits of different Indicators, and the use of light springs for measuring back pressure accurately.

(*Concluded.*)

The Crosby spring has some excellent points. In making it, a piece of wire of proper length is cut off and a small ball slipped on to its center and brazed. The ball is then held in a socket in the end of a mandrel, which advances as it revolves, so as to wind the two ends of the wire at a uniform pitch. In this way they get rid of the weight of the moving head and attach the spring to the piston by a ball and socket joint, which prevents any inequality in the action of the spring from producing friction between the piston and cylinder. The head of the spring has four wings, through which holes are bored at the same pitch as the wire in the spring, and the wire is screwed into it. Then it is tested on a steam drum by an accurate gauge. If not correct, it is adjusted by screwing the wire in or out of the head, there being no solder in the spring where it leaves the head to give way or alter the tension.

The multiplication of the motion of the piston in the Crosby is 6 to 1. This has its disadvantages as well as advantages. One disadvantage is that a certain amount of lost motion in the connections is multiplied more at the end of the pencil arms. This is compensated for by greater facilities for reducing the lost motion to the lowest amount.

The advantages of this multiplication are that as the heavier moving parts only move through two-thirds of the distance they do in other instruments, the momentum is reduced in that proportion. The spring being stiffer, there is less tendency to vibration at high speeds than in the other instruments.

The reduction of the movement at the piston was the great step taken by Richards in advance of indicators previously made. That this may be carried too far is obvious, but experience has proved that a multiplication of 6 to 1 gives about the best results attainable.

The relative weights of the reciprocating parts of the three instruments are as follows:

THOMPSON IMPROVED.

	Grains
Piston, piston-rod and connecting link..	401
Pencil arm	48
Radius link	9
Spring (40 lb.)	415
Total	873

TABOR.

	Grains
Piston and connecting link	230
Pencil arm	25
Spring (40 lb.)	370
Total	625

CROSBY, NO. 2.

	Grains
Piston, piston-rod and links	290
Pencil arm	30
Spring (40 lbs)	180
Total	500

But this comparison of weights does not correctly represent the relative inertia of the instruments. To find that it is necessary to weigh each part separately; balance it to find its center of gravity; find the distance through which the center of gravity moves while the pencil is moving a given distance, multiply the weight by that distance, and divide by the distance the pencil moves. This gives the value of the weight of that part acting at the end of the pencil arm. The value of the 873 grains in the Thompson, acting at the end of the pencil arm equals 170·7 grains; the 625 grains in the Tabor equal 114·5 grains; the 500 grains in the Crosby equal 71. grains.

The inertia of the three instruments is therefore, relatively:

Thompson Improved	100
Tabor	67+
Crosby	41+

All indicators so far as I know, except the Crosby, use a flat coiled spring in the drum. Mr. Crosby found by experiment that this spring did not give an even tension on the cord and he adopted the helix instead. To adapt the instrument to very high speeds, the drum is made only 1½" in diameter, taking a card about 3½ long. Larger drums are made if desired, but that size is considered best for high speed indicating. A given tension on the cord means a certain amount of stretch. If the cord is stretched equally during the whole length of the stroke the position of the drum at any point will correspond to the position of the piston of the engine. If the tension of the cord is uniformly increased the cord will be lengthened, and the movement of the drum will be less than that of the reducing motion, but it will correspond at all points to the motion of the piston. If, however, the tension on the cord increases and decreases irregularly, the motion of the piston and drum will not coincide. I have here some enlarged diagrams from Mr. Brown's drum-spring testing instrument which show the strain on the cord at different speeds, of the Thompson, Tabor, and Crosby indicators.

I have also some enlarged diagrams taken with a 4 lb. spring to show the back pressure. In these the piston comes up against a stop and consequently the top of the diagram is lost, but the back pressure line is separated so far from the atmospheric that the amount can be measured with very great exactness. It is of great advantage in determining the amount of fuel consumed in heating with back pressure.

THE COLLIAU FURNACE CO., of Detroit have in course of construction for the N. Y. and West Shore R R two of their largest size cupolas, for the shops at Frankfort N. Y.

THE
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FORTNIGHTLY.
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☞All subscriptions must invariably be accompanied by the cash. No deviation from this rule.

☞Papers will be discontinued at the expiration of the time contracted for, with due notice of same by postal card

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

Subscribers are requested to notify us promptly in case of any failure to receive the paper. We use every effort to reach subscribers, but in some cases the wrappers get torn in transit; in others where the address is general, and not specific, papers get mislaid by postmasters. It is better in all cases to give street and number, when possible.

THE PUBLISHERS TO THEIR FRIENDS.

With this issue we close the current volume, and, it being our third anniversary of the occasion, we improve the opportunity to say a few words which may interest our friends.

For some unexplained reason new ventures in periodical literature have to undergo probation for three years, being more or less tolerated during that term. Some drag out a feeble existence and calmly (but judiciously) expire on the threshold of the allotted time. Others exhibit occasionally a spurious vitality, being galvanized into a frenzy of hope by specious promises made but to be broken. Venturing boldly into unknown waters they meet the fate of all unseaworthy craft, and go ashore, or sink outright, leaving no sign.

Others there be who essay a timid flight until their pinions are strong enough to bear them further. To the latter class belongs THE MECHANICAL ENGINEER. Although the profession of journalism was by no means a new field to its projectors, they still had doubts as to the possibility of establishing another paper of its class. The field was already so well occupied that it seemed almost rash to crowd in where there was scarcely room. Thinking, however, that it was possible they might be able to impart a different tone and present some new features, the venture was made, and, so far as the publishers are concerned, they have no reason to repent of their enterprise.

No paper could be projected under apparently more hopeless conditions. The matter of capital at command was beneath mention, and the great reliance was upon the staunch fidelity of mechanics to those they recognize as sincere in their professions. This, and a personal acquaintance with the machine trade, were the sheet-anchors of the projectors of THE MECHANICAL ENGINEER. Knowing by a lifelong experience with the trade it appealed to, that if they could show cause it would be supported, the projectors proceeded to show the best reasons for their existence. To wit: Sincerity in profession, punctuality and precision in performance, exactness of statement, and the best mechanical execution their means would permit. These principles and positions were carried out to the best of the publishers' ability, and the result is shown in THE MECHANICAL ENGINEER as it stands to-day compared to what it was three years ago. Such as it is, the trades connected with it have made it. Manufacturers have recognized the publishers' intent and have given it their support, and individuals everywhere discerning, in the green tree promise of fruit in the future, have fostered and encouraged its growth.

The editors and proprietors of THE MECHANICAL ENGINEER have always addressed their readers frankly, and as if they were face to face with them, feeling that all who take an interest in their enterprise, to the extent of subscribing for the paper or otherwise forwarding its ends, are in the light of personal friends. Many who noted this peculiarity of the paper were doubtful of the success, or propriety of it, feeling that it would impart a frivolous or insincere tone, and discourage many who might otherwise become attached. In a word, it was thought to be a mistake. This opinion was also held by an editor on one of the most influential daily papers in this city, and was duly considered. Feeling confident, however, that the connection of a lifetime entitled them to know their audience, the editors and proprietors continued their policy, and if the constant renewals of old subscribers, and increase of new ones is any evidence, the peculiarity mentioned has been no disability. It has been been a factor in the success of the publishers in attaining their ends. As to the success itself the publishers have better means of judging than any one else, and do not need to enlarge upon that point.

Communications which reach the editors and proprietors are different in tone from those they have received while upon other journals. They read more like the communications of old acquaintances than formal business epistles, and the endeavor has been to meet them in a similar spirit. Candor is of two sorts, real, and assumed for certain ends. The editors do not think they can be ranked among those who use the latter form.

In thus writing the publishers do not wish to be understood as pluming themselves upon a great achievement; least of all boasting "as one who putteth his armor off," but to state, with more or less necessary detail, that they feel they have made a success and to acknowledge how it was made. It is due to those who have assisted them to place the credit where it belongs.

Their own trials and disappointments, their straits at times, and their disabilities, are not intruded here by the publishers, for these are inseparable from every new enterprise, and by no means disassociated with old ones; but it may not be improper to say that THE MECHANICAL ENGINEER is not disfigured by one word or line in print that savors of doubt or anxiety as to the future. In the darkest hours and when hedged about with uncertainties, it spoke in no uncertain tone, and with no halting utterances. With *Dryden* it said:

> "All desperate hazards courage does create;
> As he plays frankly who has least estate.
> Presence of mind, and courage in distress,
> Are more than armies to procure success."

Neither do the publishers wish to convey the impression that they rest upon their arms and consider they have no more to do. The opposite is the case. Stimulated by recognition and by the conviction that it has been fairly won, they will put forth much greater efforts in the future than they have already, their hope being that in the fullness of time they may reach a still larger circle of well-wishers.

Renewing their acknowledgements of services rendered, and warm appreciation of those who have assisted them, the publishers beg to wish all of their friends a Merry Christmas and a Happy New Year.

◆

AIR IN THE BACK CONNECTION.

It is a well known fact that the gases of combustion require a certain proportion of air mingled with them to insure their ignition, not merely in the furnace, or through the grate-bars but after the gases are evolved from the burning coal. In some patent furnaces this knowledge is taken advantage of in various ways, or methods, to the very great saving of fuel. We are led to believe, however, that the ordinary return-tubular boiler would be greatly enhanced in efficiency, if a greater or less quantity of air were admitted into the back connection direct, to effect ignition before the gases passed through the flues or tubes. What is called flameless combustion now goes in the back connection, that is the gases charged with heat are invisible, and in a great measure unconsumed for want of air to dilute them. We have been forcibly struck with this from observing the action of an ordinary house range burning anthracite. When a fresh charge of coal is put on, the area back of the fire (over the ovens) is filled with gas. If now the rear covers of the range be slightly tilted, so as to admit air, a sea of brilliant yellow flame fills the space, giving forth intense heat. If the covers are closed the flame expires.

Also, we published in an early issue of this volume an account of a ferry-boat, the *Baltimore*, which had a boiler with a central combustion chamber. That is the tubes were simply divided by a chamber in the middle of their lengths. The gases poured into this direct from the furnace, and at the bottom there was an air-duct. When this was open the observer could look directly into the chamber, and the effect was surprising as to the visible combustion. If any more evidence is needed as to the value of air in the back connection, we have it furnished by the extended smoke-arch, now so common in locomotives. If the smoke-box door is not absolutely air tight, the smoke-box itself will get red hot in very short order, showing that greater heat is developed then when no air is present.

Our suggestion is that an air-duct of greater or less size, according to the boiler used, be made in the back connection; it should be furnished with a slide so as to regulate the quantity of air at will, and the result will certainly be a great gain in the quantity of fuel used. It is not a costly experiment to try, and is quite within the control of any one, but of course is not available where the back connection, as in some cases, is not thoroughly fireproof. If made of iron it would be liable to set woodwork in proximity on fire.

POUNDING CAUSED BY CHANGING VALVE MOTIONS.

Many engineers alter their valve motions and thereafter have trouble from pounding. Engines which ran silently, so far as pounding was concerned, begin to protest against the new condition of things so soon as the times of the valves are changed. This is to be expected, but of the two evils, waste or noise, the latter is the least; that is to say if cards show that steam is being used wastefully, and corrections are made, it is natural that an engine should pound, and for this reason. The bearings and connections are all worn to suit the old state of things. Wherever the greatest pressures came, before the valves were altered, there the greatest wear will be found. Change the times of the valves and the greatest pressures come at another point in the stroke, earlier or later, as the case may be, and the result is thumping.

This is one cause of the unpopularity of taking off compression of the exhaust from an engine. So soon as this is done in an engine which has always run under a high degree of compression it pounds badly, and the engineer says it was just what he expected, and that an engine cannot be run without compression and run silently. The troubles in such a case, as we have mentioned, lie not in the want of a cushion for the piston to bring up, but in the bearings and connections. These should all be bored out and refitted where compression is taken off, and, probably, the crank pin trued up. Among the leading high-speed engine builders, the amount of compression is decreasing rapidly. Cards before us from four of the largest concerns, makers of 700 to 800 H. P. engines, show, from very slight to none whatever.

CONCERNING RENEWALS.

We hardly need to remind our friends that in order to secure the new volume promptly on issue renewals should be made at once, for by the time this is read our lists will be revised. According to our custom we omit all not paid, as we consider this to be equivalent to notice to discontinue. We have had three such notices this fall, but it is quite probable there are many more who do not want THE MECHANICAL ENGINEER for 1884. Those who do should act upon their intention and remit now.

Our prospectus (omitted from this issue) gives only a brief announcement of our intentions for the year to come. We think that those who have favored us with their support in 1883 will find the paper greatly improved in the year approaching.

ANNUAL CONVENTION OF MARINE ENGINEERS.

The Marine Engineers' Association will hold their annual convention at Pittsburgh, Jan. 8th, 1884. President Reid, in issuing the call, says in regard to delegates:

"In the selection of representatives you will be governed by the following law, promulgated by the National Association:

"'Associations with sixty members, or less, are entitled to one representative; if over sixty members, two representatives.—Journal of 1880, p. 25.'

"'Associations with fifty or more members cannot be represented by proxy.—Journal of 1880, p. 25.'

"Should you be unable to send a representative, and desire representation by 'proxy,' * * * * * *

"In your annual report, give a brief *resume* of the work done during the year, and add any items in connection with the service in your section that you think will be of general interest.

"We have every reason to think that the forthcoming session will be one of vast importance to all concerned, and for that reason it is desired that you make special effort to have your Association represented."

We have no desire to influence legislation on the part of the Brothers in any way, but in justice to an earnest and indefatigable worker in the cause of the elevation and improvement of marine engineers, we hope James H. Reid will be re-elected to office.

SIEMENS.

We present herewith a portrait of the eminent English engineer, Sir William Siemens, lately deceased. His works and discoveries are too numerous in extent for us to give even a synopsis of them in these columns, but we may say that he is chiefly known in this country as the inventor of the regenerative gas-furnace which is called by his name, and by the process of making steel in the open-hearth furnace. The engraving originated in *Cassel's London Magazine.*

SIR WILLIAM SIEMENS.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLVI.

How hard it is to bear prosperity! Some of us can bear adversity much better. Many a man who would have plodded soberly along with a load on his shoulders, bearing his burthen manfully, flies off at frightful velocity just so soon as it is lightened in any degree. I said this to myself in substance coming back from a New Jersey town recently, where I had gone in obedience to a call from the ——— Sewing Machine Company, concerning a tool we make, which they thought would be useful in their works. I went into the business office and there I saw a man whom I knew at a glance. I believe he knew me, too, but if he did he was careful to make no sign. It was a splendid place, with its massive furniture, its cut glass inkstands, its fine carpets and its general air of elegance. So thick were the walls that although not fifty feet away there was an army of operatives, and machinery without end hard at work, not a sound broke the stillness of the place. It was like a church. When I went in our friend at the broad table eyed me with a cold, far-away look, very much as if, for the first time, he saw that great curiosity—a workingman. He did not address me in any way, but before I had proceeded many steps, a youth darted out of a nook and inquired my business, standing before me as though to intercept me from reaching the august presence before me.

"My business is with this gentleman here," said I, "who is, I believe, the superintendent of the works. I want to see him, not you. Get out of the way!"

At this unheard of proceeding, the youth looked first at his boss and then at me, but he got out of the way all the same—for I had gone right on without heeding him. By this time our friend had resumed his writing and was paying no attention to anything that went on, least of all to me.

"Look here my friend," said I, "your name is ——— I think."

"Yes," said he, frigidly, holding his pen suspended half way to the inkstand and trying to freeze the life out of me with a glance. "What is your business?"

"My business is with you in reference to this letter," and I threw down their inquiry as to how soon we could furnish one of our patent machines.

He took it up gingerly, and putting on a pair of glasses that hung from his vest by a little gold chain about a thirty second of an inch thick, read it through without speaking.

"Oh, yes," said he; "take a seat. I will attend to you presently."

"Not much you won't," said I. "You will attend to me now or not at all, Josh Young! You must not undertake anything of this sort with me, for I am one of the kind who don't understand it, and won't put up with it, as you doubtless know well enough, if you will just turn back a few years in your memory."

The man turned all sorts of colors, but managed to have presence of mind enough to send the youth out of the office on some fictitious errand, so that he would not be a witness of anything detrimental to the superintendent's dignity.

"Who are you?" said he, looking at me; meaning how could I dare address so distinguished an individual as he was in such a peremptory manner.

"You know me well enough," said I, "but you thought you could play off the grand seignior on me, Josh! I remember away back, and you tackled the wrong man. I remember when you were in the shop with the rest of us; how you got a little advance in taking charge of a certain class of work; how you took a contract and made money on it, and finally got in here as superintendent. Long before that the wind used to whistle through you on the dark December mornings you went down to work without an overcoat on; nothing but a flimsy black frock coat that was only fit for summer weather. You used to carry your dinner in a brown paper parcel, and a darn poor dinner it was, as I remember. Now you are here, in the lap of luxury, and you forget all about old times and old friends, and want to freeze them out. Josh, it won't work—not with me it won't."

"Moulton," said the superintendent, "I swear I did not know you when you came in. You must excuse me. There was something about you that looked familiar, but with all the work I have on hand, I cannot stop to trace out recollections. You are the same old two and sixpence as ever, I see," said he, thawing a little; "bound to have your say."

"Yes, I am, and I am down on all shams and humbugs wherever they are, and this is one of the biggest ever was—for you to surround yourself with all sorts of preventatives against transacting business. Don't you see you waste your time and mine? What did that boy suppose I came here for, but business? Do you think I was going to tell him and wait outside, or sit down until you got through your job, leaving mine till you got ready? Not at all. Business is a mutual advantage; if you did not want my machine what did you ask me to come here for, and after asking me, compel me to wait until you got good and ready to attend to it? That is in itself a discourtesy, because it implies that your time is more valuable than mine, a matter you know nothing about. If you have millions under your charge, I have thousands under mine; and these are as important to me as yours to you. Suppose you were in the middle of a letter when I came in, you should not ignore me; you should recognize my existence, and ask to be excused for a moment, when you would be through and would be at liberty. For the matter of that, no letter is so important that one cannot lay it aside for a moment."

"Well," said Josh, a little vexed, for he did not like my plain talk, "I have no doubt you are right in the main, but if you were in my place you would see things differently."

"How would I see them differently?" said I; also nettled—for I have traveled miles where Josh has traveled feet.

"You would know that in order to transact business at all in these large places there must be some order and system, otherwise everything would be at sixes and sevens."

"I do understand it, and acknowledge what you say to be true in principle, but I observe that you have neither order nor system, if I may judge from my own reception. You might take a little trip down to Rhode Island and learn something from the Browne and Sharpe Manufacturing Company how to run a shop, or to have a system that is all which the word implies. I went in there on the same errand that

I came here on, and it did not take five minutes to do it. True, I went into an outer office and was politely asked whom I wished to see, and then I went into Mr. Sharpe's room. No one darted out at me and stood in front of me, but that gentleman turned to me at once, and in a few decisive words told me all I wanted to know—that settled it. Now you go and take a leaf out of his book—if he will let you—and you will learn something.

"Josh," said I, rising, "it's just as well in this world to treat all men courteously, and as you would like to be treated yourself if you were a stranger in a strange place. Your office, or your position does not make you, it is you who make the office, and adorn or disgrace it, according to circumstances, over which you have much control. Don't you turn your back or try to freeze out any one who comes in here, no matter what his circumstances are, so long as he is a respectable man. Good bye."

"Well, what about the machine," said Josh, "aren't you going to send it to us?"

"I'll send you one or fifty, but what passed when I came in put the whole thing out of my head."

"Wait till I write the order," and he sat down and gave us one for six machines, and they are in the shop now.

This man, of whom I write, was all right in the main, but he had been somewhere and seen some potentate acting in the way I have described, and it impressed him as being the correct thing to do under the circumstances; and I have no doubt but that he made lots of good men dance upon his whim, but I think I gave him some new ideas which will be of service to him.

Take off the garments from men of equal intelligence and social standing and put them in a row as naked as God made them; there is no difference between them. You could not tell the man of thousands from the heir to poverty and trial. Why should there be any difference in our treatment? There is no distinction in persons in the sight of God, why should there be in man's?

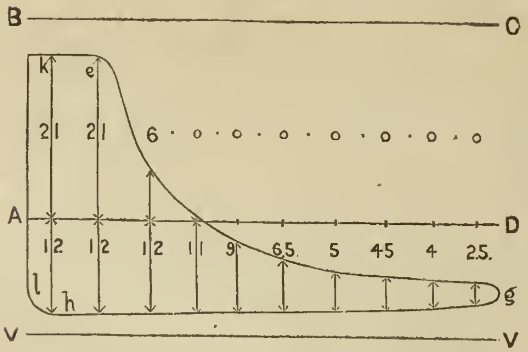
THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER 6.

BY WILLIAM BARNET LE VAN.

A diagram from a condensing or "low pressure" engine differs from one produced by a non-condensing or "high-pressure" engine, from the fact that in the latter the line of back-pressure, instead of being a little above atmospheric pressure, approaches more or less to that of perfect vacuum.

In calculating the power from diagrams of condensing, or "low-pressure" engines, it is usual to measure the area above and below the atmospheric line separately. This method gives the value of the average vacuum obtained, and thus indicates the extent to which the back-presure is reduced below atmospheric pressure; see diagram, figure 10.

FIG. 10.



In this the average mean pressure due to the steam was 21+21+6=48 pounds, which divided by 10 (the number of divisions on the card) equals 4·8 pounds; and the average vacuum realized was 12+12+12+11+9+6·5 +5+4·5+4+2·5=78·5 pounds, which divided by 10 equals 7·85 pounds; showing that the power realized in this case by removing the resistance of atmosphere was about *sixty per cent.* of that shown by the indicator, thus:

$$\frac{7{\cdot}85-4{\cdot}8}{4{\cdot}8}=60 \text{ per cent.}$$

In well constructed engines with an early cut-off, the expansion curve, *e g*, (diagram 10,) will often cross the atmospheric line, *A D*, before the piston has moved half the length of the cylinder. In such cases as this the mean pressure represented by the area above the atmospheric line, *A D*, will be less than below it, which difference is due to the reduced back-pressure by reason of the comparative vacuum in the condenser. The above diagram, figure 10, indicates a large amount of expansion.

INDICATED HORSE-POWER.

The *indicated horse-power* is the power developed by the steam on the piston of the engine, without any deduction for friction. The indicated horse-power is calculated from the diagram or cards taken by the application of the indicator to the steam engine cylinder. It is the total unbalanced power of an engine employed in overcoming the combined resistance of friction and the load.

EFFECTIVE HORSE-POWER.

The *effective horse-power* is the actual and available horse-power delivered to the belt or gearing and is always less than the indicated, from the fact that the engine itself absorbs power due to the friction of its moving parts.

ENGINE FRICTION.

The power absorbed in driving an engine against its own friction is a most variable quantity. With a good and well constructed engine having ample bearing surfaces, efficient means of lubricating them, and valves nearly balanced without over-complication, the friction may not exceed *ten per cent.* of the indicated power. But in badly constructed engines the friction may be nearer fifty per cent. In the case of an engine having ordinary unbalanced slide valves, of the whole frictional resistance, it is probable that quite one-third is due to the valve. The heat due to the internal engine friction—that is to say, the friction of the valves and piston—is imparted to the steam, and either the whole or greater part of it is carried to the condenser or atmosphere with the exhaust steam.

The power absorbed in overcoming friction is not only wasted, but it is wasted in wearing out the engine.

In the diagram, figure 9, (see Article 5, Number 13, current vol.,) the calculation gave what is called the indicated power, that is, the effective available power of the engine. It does not show the gross or whole power of the engine. This gross power is reduced to effective motive power in three ways, namely:

First.—In expelling the steam left in the cylinder at the end of the stroke, the expelled steam carrying its *heat* with it to the atmosphere in a non-condensing or "high pressure" engine, and to the condenser in a condensing or "low pressure" engine.

Second.—In compressing the steam in the cylinder after the exhaust-port is closed, but as this steam is again used after compression the power used in compression it is not necessarily wholly wasted.

Third.—In overcoming the friction of the moving parts of the machinery, including (in locomotives) the friction on rails and in stationary engines the friction of the belt or gearing.

The effective, available motive power will therefore vary in proportion to the power lost through these reducing causes. The less power required to expel and compress the steam left in the cylinder and to overcome the friction, the greater will be the effective motive power and *vice versa*.

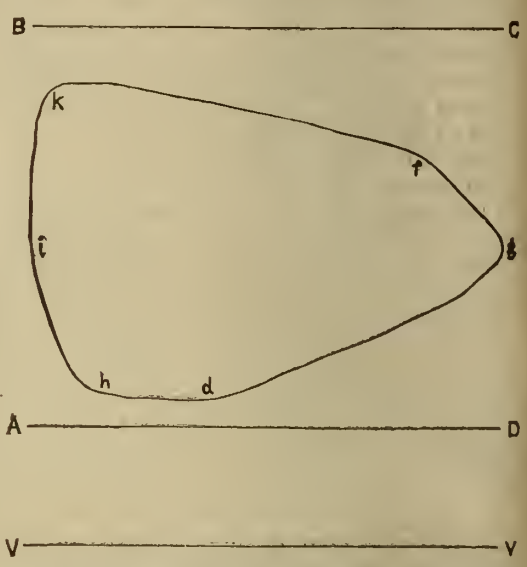
In calculating this power, however, from a diagram, only the first and second of these causes are, or can be, considered.

The piston of an engine is always acted upon by two opposing forces; one propelling and the other repelling, and the difference between them is what in practice is called the effective motive force or power.

The propelling force must, of course, in all cases be sufficient at least to overcome the repelling force or back-pressure. This back-pressure, as will presently be seen, is always greater in non-condensing or "high-pressure" engines than in condensing or "low-pressure" engines. In the former the propelling steam left in the cylinder at the end of the stroke (that is the exhaust steam) escapes, or is expelled into the air. In the latter, into the condenser. In the former the back-pressure must necessarily be at least the pressure of the atmosphere, which averages about fourteen pounds to the square inch (see Fig. 8, Article No. 4, current volume, by mistake marked Fig. 7), but it is always greater than this because of the friction of the exhaust steam in the ports and pipe connections, and in badly constructed engines it is much greater. In condensing, or "low-pressure" engines, the back-pressure should always be less than the pressure of the atmosphere, depending upon the approximation to vacuum obtained in the condenser.

In the diagram, figure 11, taken from a non-condensing engine, it will be seen that the back-pressure line, *g d h*, is considerably above the atmospheric line, *A D*, and indicating excessive back-pressure.

FIG. 11.



Excessive back-pressure in a non-condensing engine is caused by, or results, from too great impediment to the escape of the exhaust steam, and in condensing engines to imperfect vacuum in the condenser. The value of the indicator in revealing defects of this kind cannot be overestimated.

The difference between non-condensing and a condensing engine is, as has been seen, that in the former the exhaust steam escapes or is expelled more or less directly according to the construction of the port-passages and pipe connections into the air, and in the latter into the condenser.

In the former the back-pressure is the pressure of the atmosphere increased more or less as the escape of the exhaust steam is more or less impeded. In the latter the back-pressure depends chiefly upon the pressure of the exhaust steam, or, in other words the degree of vacuum, in the condenser.

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THE MECHANICAL ENGINEER.

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STEAMER "CITY OF GLOUCESTER" AND HER ENGINES.

DESIGNED BY HERMAN WINTER; CONSTRUCTION OF ENGINES BY PUSEY & JONES COMPANY, WILMINGTON, DEL.

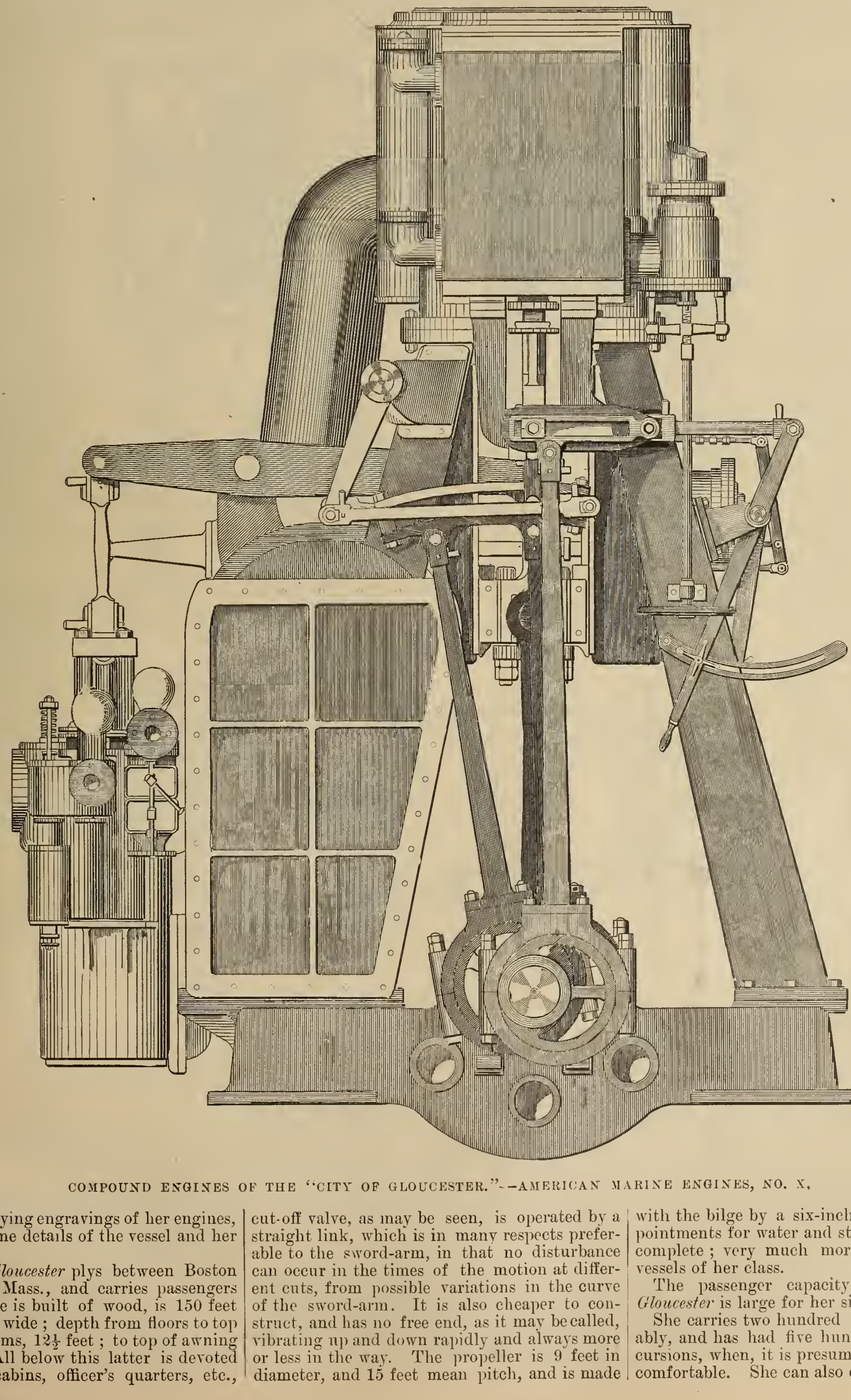
The steamer *"City of Gloucester,"* built during the past season, from the designs of Herman Winter, Esq., is a very marked success and we have pleasure in laying before our readers the accompanying engravings of her engines, together with some details of the vessel and her appointments.

The *City of Gloucester* plys between Boston and Gloucester, Mass., and carries passengers and freight. She is built of wood, is 150 feet long, and 28 feet wide; depth from floors to top of main deck beams, 12½ feet; to top of awning deck, 8¼ feet. All below this latter is devoted to freight; the cabins, officer's quarters, etc., being on the awning deck. The vessel has two masts, with "leg of mutton" sails, and stay sails on each, and is steered either by hand or by the cargo engines, as desired, which are arranged to be so used when occasion arises. The frames and planking are of oak.

The engines are very conveniently arranged for access and are compound, 21″ and 36″ by 30″ stroke, with the usual link motion. The cut-off valve, as may be seen, is operated by a straight link, which is in many respects preferable to the sword-arm, in that no disturbance can occur in the times of the motion at different cuts, from possible variations in the curve of the sword-arm. It is also cheaper to construct, and has no free end, as it may be called, vibrating up and down rapidly and always more or less in the way. The propeller is 9 feet in diameter, and 15 feet mean pitch, and is made of Pusey & Jones' semi-steel. With 90 pounds of steam the engines make 91 revolutions and upward per minute. There is one boiler with cylindrical shell and furnaces, and all the heating surfaces are of steel except the tubes. The refrigerating water is driven through the condenser three times by a special engine and centrifugal pump, which latter can also be used for a bilge-pump in an extremity, being connected with the bilge by a six-inch pipe. All the appointments for water and steam service are very complete; very much more than is usual in vessels of her class.

The passenger capacity of the *City of Gloucester* is large for her size.

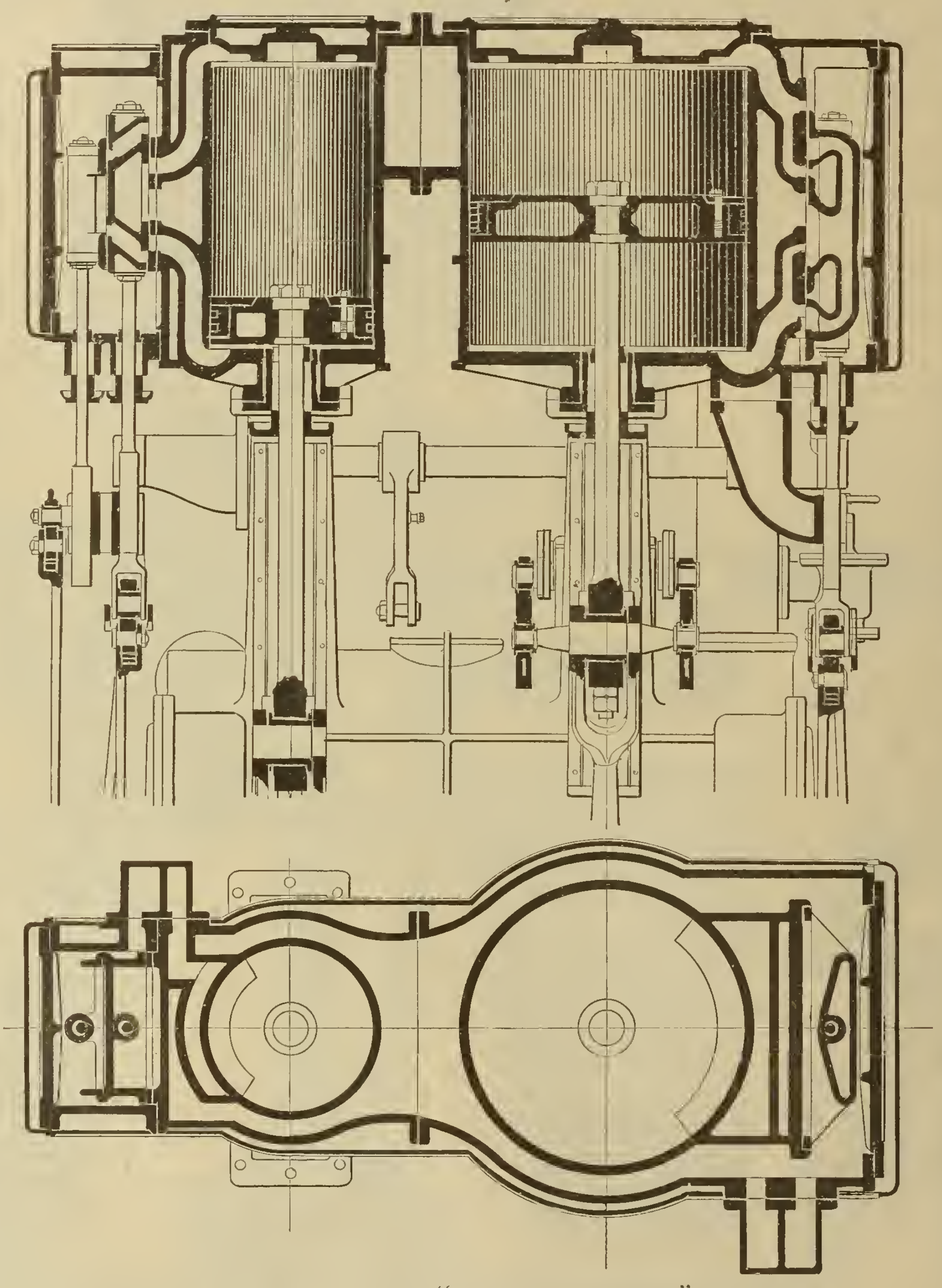
She carries two hundred passengers comfortably, and has had five hundred aboard on excursions, when, it is presumed, they were not so comfortable. She can also carry 400 gross tons


COMPOUND ENGINES OF THE "CITY OF GLOUCESTER."—AMERICAN MARINE ENGINES, NO. X.

of cargo. The *City of Gloucester* is very fast, her time being two hours and fifteen minutes between the two cities, a distance of thirty miles. For her dimensions and full model, about 5½ beams to the length, this is an excellent performance, and seldom equalled in boats of her class. Everything in her is designed for strength and hard service, and no sacrifices in this direction are made for speed alone.

Her seagoing qualities are admirable. She never omits a trip on account of the weather, and her route is a particularly exposed one, as all know who are acquainted with the locality. The fuel consumption, based on twenty-four hours run, is five tons.

Mr. Herman Winter is an American engineer of nearly thirty-five years experience, and is to congratulated upon this vessel; it being exceptionally good in all respects.



ENGINES OF THE "CITY OF GLOUCESTER."

FINE MEASURMENTS.

At a recent lecture, Coleman Sellers, Esq., said: "There was a time when the two foot rule and a few simple tools readily answered all mechanical purposes for measurment. There was a saying in Germany that every hair in a carpenter's head is one-eighth of an inch diameter. There was a meaning in that. As a carpenter does not measure so fine as a machinist does, his measuring to a hair's breadth was measuring within one-eighth of an in. That style of measurement led to the expressions 'overfull' and a little 'scant,' which indicated measurements sufficiently close for practical purposes. A change in this respect has come over all mechanical industries. Now the parts of machines are made interchangeable, and accuracy of dimensions must be obtained. One branch of business may need only coarse measurements, while another may require the most minute measurements and accuracy. A two foot rule may answer for many purposes and be very convenient, but there are measurements in the works which require the use of this convenient little device which measures to one thousandth of an inch. (Here he showed a Brown & Sharpe micrometer caliper. He also exhibited a French micrometer gauge, finely graduated. This he used to measure fine metallic cubes that had been finished by tool work alone, and were suprisingly accurate.) These instruments, continued Mr. Sellers, are remarkably fine; but Mr. Bond, who will lecture during the course, is connected with a shop (Pratt & Whitney's) that makes gauges of various kinds, and they have perfected a machine which records more closely the actual size of materials than anything ever made before."

* * *

A FRIEND connected with the Farist Steel Works at Windsor Locks, Conn., in renewing his subscription sends another for a friend, adding:

> "The young man says he intends to become a mechanic, a good competent one, and how can he be that without THE MECHANICAL ENGINEER?"

This is the conundrum in its most pleasing form; answer will be given sometime during the year!

ENGLISH CHILLED ROLLS.

A fine specimen of chilled roll turning has just been completed at Bilston, by Messrs. Thomas Perry & Son. Its extreme length from end to end is 18 feet, the length of the working body is 12 feet 10 inches, and the diameter 28 inches. Through the entire length of the 18 feet a hole 4 inches in diameter has been bored in the center of the roll. The cast weight of the roll was about 14 tons. It was run out from two furnaces containing a united charge of from 16 to 17 tons. The mixtures were, with one exception, English cold-blast irons. The exception was an American charcoal iron, which, laid down in the works, cost £10 per ton. Though the depth of the chill was about three-quarters of an inch, yet the boring of the center was effected without more resistance than might be looked for from a roll incapable of bearing any chill. [Why not?—EDS. M. E] There is therefore every prospect of the roll proving long-lived as well as effective. The whole work has been accurately denominated "a triumph of roll engineering." Upon the whole surface there is not a speck of blemish, and it has the sheen of burnished steel. To complete it the firm went to an outlay in new machinery of £1,000, and they accepted the order upon a second appeal, after it had been rejected by other roll-making firms in England and the United States.

* * *

THE EXISTENCE of a blue tinge in a glass vial of oil is assumed to indicate the presence of mineral oil, but this is an illusory test, since the same effect is frequently observed in the purest and freshest vegetable oils.

RESPECTING THE VALUE of snow a [illegible]ier to cannon-shot, *Engineering* says:

"An experiment was made to calc[illegible] he resistance opposed by snow fortificatio[illegible]n-non-shot. A wall was erected 16½ feet [illegible]d 5 feet high; the back was formed [illegible] ½-inch planking, and the front of snow, in varying thicknesses. It was divided into three distinct sections, in the first of which the snow was 4½ feet thick, in the second 3 feet 3 inches, and in the third 20 inches in depth. Twelve shots were fired against the first section, at ranges of 246 yards, 328 yards, and 437 yards; but none of them traversed it. Shots fired from distances of 246 yards and 328 yards pierced the snow of the second section, but were stopped by the planking, while those at the longer range were stopped by the snow. All the shots pierced the third and thinnest section. Shots fired from 1,200 yards and 1,300 yards only penetrated the snow from a depth of from 15 inches to 18 inches. It is evident from these experiments that, wherever snow is to be had, it constitutes an excellent material for entrenchments."

IT IS SHORT-SIGHTED policy to buy engines with automatic cut-offs and put them in charge of persons who do not understand the management of them. The idea of many steam-users is that an automatic engine is economical simply by reason of its construction. The facts are that an automatic engine can be made as wasteful as any other, through unintelligent management and want of knowledge.

BY A COINCIDENCE our first issue in January last contained engravings of a marine engine by Herman Winter, Esq., the coincidence lying in the fact that this issue also contains one designed by him. The inference is that Mr. Winter designs only one engine yearly, but this is erroneous. He is now building three others, which we hope to present views of in due course.

SOME CAREFUL lathemen rig up a shield to cover the leading screw for a distance of, say, three or four inches on each side of the carriage. This keeps dirt from falling in or being thrown in when cleaning the lathe, or when it is at work, and is unquestionably of service in preventing wear. It would seem to be a good permanent attachment to be put on all lathes by builders. The expense would be inconsiderable.

* * *

APOLOGETIC.

Owing to circumstances beyond our control, the engraving on the front page of this issue is one of the worst ever seen.

This work was given to a leading Bank Note Concern of this City, with instructions to make a superior engraving, and the result is shown. As our Paper has to go to press on a certain day, we are unable to do otherwise than publish it with our apologies.

* * *

WHEN SHORT HAIRS can be pulled out of an "all-wool" blanket, probably three-fourths of it is cow's wool.

TRANSMISSION OF ENERGY.

In a revolving shaft, says Prof. Osborne Reynolds, in a lecture delivered before the British Society of Arts, neither the stress nor the velocity are uniform over the section, both varying uniformly from nothing in the middle to their greatest value on the outside, so that their mean product is exactly half the product of the greatest values. The greatest power per square unit of section a shaft can transmit is half the product of the greatest stress into velocity at the outside of the shaft. Taking, then, the greatest safe working stress for steel at 15,000 pounds on the square inch; taking what is the greatest practical velocity at the surface, 10 feet per second (the speed of railways journals), the work transmitted is 75,000 foot-pounds per square inch of section—135 horse-power; so that we should have to have a shaft of upward of 7 square inches in section to transmit 1,000 horse-power—that is, a shaft of over 3 inches diameter. The friction between such a shaft and lubricated bearings is well known (0·4) so that, calculating the weight of the shaft, 24 pounds per foot, we have power spent in friction about 52,000 foot-pounds per mile—that is, one-tenth the total power the shaft will transmit. That is, if we put 1,000 horse-power into a 3-inch shaft, making 500 revolutions per minute, we ought, at the end of a mile, to be able to take 900 horse-power out of it. If we had to go further, the size of the shaft might be diminished, so that in the next mile we should again lose a tenth, and if we repeat this process seven times we shall, at the end of seven miles, have left about half the original power put in.

It will be thought, perhaps, that a 3-inch shaft is very small to transmit so large a force. This is because the speed of 500 revolutions per minute is inconveniently high for purposes of employing the power; but if it were merely a question of transmission it would be about the best speed. This, then, shows the limit of the capacity of shafts as transmitters of work. In another part of his lecture, speaking of steel ropes as transmitters of power, he says these have a great advantage over shafts, for both the stress on the section and the velocity will be uniform, which velocity may be at least 10 to 15 times as great as with shafts—say, 100 feet per second; the rope is carried on friction pulleys which may be at distances 500 or 600 feet, so that the co-efficient of friction will not be more than ·015, instead of ·04. Taking all this into account, and turning to actual results, the work transmitted per inch would be 1,500,000 foot-pounds per second; so that a $\frac{3}{4}$-inch rope is all that is necessary to transmit 1,000 horse-power in one direction; this would make the loss per mile only $\frac{1}{60}$. But in practice rope has to be worked backward and forward, and the tension in the backward portion of the rope must be half the tension in the forward portion. This reduces the performance from $\frac{1}{60}$ to $\frac{1}{20}$, which would cause half the work to be lost in 10 miles. If we use a bigger rope and run at a lower speed, then the co-efficient of friction would be reduced to 0·1, and the distance extended to 15 miles.

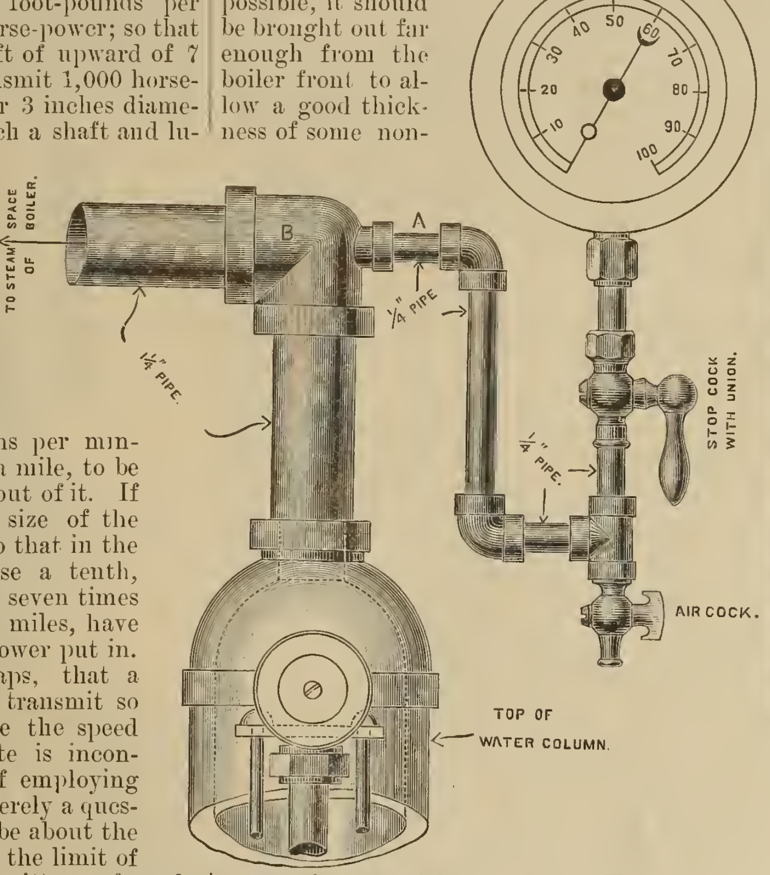
* * *

ABOUT STEAM-GAUGE CONNECTIONS.

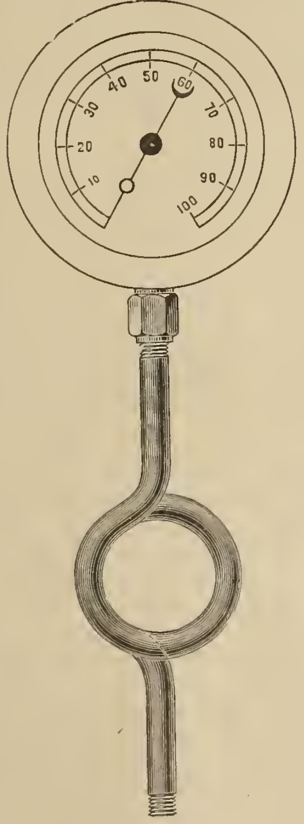
It is a very simple matter to properly connect a steam-gauge to a boiler, but in nine cases out of ten it is not correctly done for some reason or other which it would be difficult to assign.

The chief points to be considered in connecting steam-gauges are: To locate them so that they cannot be injured by the heat radiated from the boiler front or uptake; to provide an inverted siphon or other arrangement which shall insure the spring or diaphragm always being filled or covered with a body of water while the boiler is under steam, and to so make the connections that the pipe may be blown out at any time without removing or disturbing the gauge. The gauge should also admit of easy removal while the boiler is under steam for the purpose of testing and correction.

Some engineers, when erecting boilers, attach the steam-gauge directly to the uptake, or to the portion of the cast-iron front which covers the end of the boiler and forms the front connection. This should never be done, as under such circumstances the heat will inevitably injure the spring, and the gauge will in a short time indicate anything but the correct pressure. Much trouble has been caused boiler owners by this practice. The gauge should be carried to one side and secured to the brickwork; or, if for any reason this is undesirable or impossible, it should be brought out far enough from the boiler front to allow a good thickness of some non-conducting material to be placed between it and the boiler sufficient to effectually prevent injury.



The second of the above objects is generally accomplished by attaching the gauge to a pipe bent into the form shown in Fig. 2. This form of siphon, while it accomplishes perfectly what it is designed to do, namely, the keeping of a body of water on the spring, possesses the disadvantage of not allowing the pipe to be cleared of sediment without removing the gauge and causing great inconvenience. Moreover, whenever a pipe bent into this form becomes filled up with a solid deposit, which sometimes happens, it is peculiarly difficult to clean out, owing to the impossibility of driving a rod or wire through it. It is also impossible to clear a siphon of this type of water when it is necessary to do so, which occurs when a boiler is stopped for any cause in cold weather. In such cases, unless the gauge is disconnected, and it and the pipes cleared of water, they are very apt to freeze up, and when they do the spring is generally burst open. The number of gauges which we are called upon every winter to test and "solder up," whose springs have been split from this cause, is quite surprising.



The form of steam-gauge connection shown in Fig. 1 is what we have found to best serve all purposes. The cut shows the details so clearly that no explanation is necessary. Where no combination or water column is used, the nipple shown at A extends to the boiler and enters it at any convenient point in the steam space. When a water column is used, as shown in the cut, it screws into the reducing tee on top of the column, as shown. The air-cock shown permits of easy and thorough cleaning of the pipe by simply opening it when steam is on the boiler and blowing through for a few seconds. When this is done the stop-cock between it and the gauge should be closed or the gauge may be injured.

The stop-cock, with union, should always be used, as it admits of the removal of the gauge for testing, adjustment, or repairs while the boiler is under steam. Care should be exercised that this cock be put on *right end up*, or it will be useless for the purpose intended. In many places where they are used we find them put on, strange as it may appear, with the union *below* the cock. This, with most of the arrangements of pipe which we find in use, renders it impossible to disconnect the gauge without considerable trouble.

We would add a word of caution to engineers who have charge of vertical boilers. Where such boilers are used the pipe to the steam-gauge is generally taken from the boiler near the top and then dropped down several feet, to bring the gauge where it can be conveniently read. Engineers should recollect that the pipe in such cases fills with water, and that its weight will cause the gauge to indicate a higher pressure than that actually due to the steam pressure. The excess of this pressure over and above the actual steam pressure will be one pound for every 27$\frac{3}{4}$ inches in height of water column standing on the gauge. While this is of no consequence in ordinary running, it should always be taken into account when indicating an engine or making a test. The indicator, will, of course, show nothing above the actual steam pressure at the top of the boiler; and unless the weight of the water column is taken into account, there will be an undue difference between the boiler pressure as shown by gauge and that realized in the cylinder.—*Locomotive.*

* * *

A FRIENDLY HINT.

A fortuitous train of circumstances may bring about great events in men's lives, but nothing is more certain than that, in the main, success in any pursuit depends upon the amount of work and earnest effort men put into it. Mere work, physical or mental effort, goes for little if it is misdirected; if the energy is not intelligently put forth failure is certain.

We have in mind, in writing these words, young men who are starting in life, and who feel, possibly, that they are overweighted. They labor under the disadvantages of poverty, mischance, want of opportunity, inexperience, and perhaps the disfavor of those they serve. All these are certainly stumbling blocks to the immediate realization of schemes, but to the determined spirit they serve only as so many spurs to quicken it into fiercer action. If one has an object in view—say to become an accomplished, versatile and thorough engineer—and will be true to himself in steadily following up his plans, discouragements will disappear. No great achievements follows upon desultory efforts. "Man cannot reap where he has not sown," and it is necessary to sow many times in some cases to reap once.

Our exhortation is that during the coming winter months those anxious to excel should remember that acquiring knowledge is labor, quite as much so as muscular effort. If they learn one branch or one subject thoroughly, they have done a great deal, and taken one step toward rising higher.

* * *

ALL SUBSCRIPTIONS FOR 1883 have expired, and those who desire to renew for 1884, will please forward their subscriptions upon receipt of this sample copy which is sent to all irrespective of expiry.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

WHAT THE INDICATOR REVEALED.

Editors MECHANICAL ENGINEER:

I have read with much pleasure numerous articles in the correspondent's columns pertaining to the experience of practical men, who, upon taking positions that had been left by some of more or less experience, have found points that interfered with economy.

Two years ago I took a position under similar circumstances. As soon as I had learned the ropes I commenced to study the different parts of the engine, and all other details of the engine room and boilers. I soon noticed that out of nine steam gauges no two were alike. Upon questioning my superior officer, the superintendent, I found that three years had come and gone since they were last tested. I proposed an immediate test, also an application of the indicator to the engine, but was informed that in the course of a few weeks they would attend to it. Six weeks passed away when I was notified than an expert would be present on the following day prepared to put things on the right track again. It was supposed that the boilers had been carrying eighty-five pounds of steam, and they were burning fifteen tons of coal daily. The indicator was applied, and the first card showed the steam pressure was only sixty-eight pounds. The next step was to apply the indicator to the boilers. There we found a pressure of seventy-one pounds. They had been running a long time with a much lower pressure than they had supposed. The gauges were put in order, the steam pressure raised to eighty-five pounds, and the result was that the week's work was done with nearly five tons less coal; all on account of defective steam gauges.

The indicator, however, also found considerable fault with the engines. It detected two leaky steam valves, also a large amount of compression. The exhaust-valves were reset and the steam valve-seats rebored, and new valves put in, which improved the vacuum very much. Before the valves were fixed the vacuum was twenty-five inches; after, it was twenty-eight. Several other minor points were corrected, but, as all engineers know, when a pair of engines get down to the bottom of the hill, it is a hard matter to get them back on the top again and keep running every day. "A stitch in time" often saves more than nine. By reading the experience of others, it has stimulated me to write this letter.

TIVERTON, R. I. F. S. B.

ON ALL THEIR COUNTERS.

Editors MECHANICAL ENGINEER:

I consider THE MECHANICAL ENGINEER the best paper of its kind published, and I am proud to say that I was one of the first to introduce it in Baltimore.

I came across the first number in Charleston, S. C., in 1881. At that time it was not to be had at the newsvenders here, but now it is on all their counters.

OLD POINT, VA. IVON L. BRAY,
Steamer "Pilot."

THE BOILERS OF THE NEW CRUISER "CHICAGO."

(*Communicated.*)

Within the past few weeks frequent criticisms have appeared upon the merits of the new steel cruisers now in course of construction for the United States Navy from plans and specifications prepared by the Naval Advisory Board, which may be capable of advising on other questions than naval construction and marine engineering, if we are to take the boilers and machinery of the *Chicago* as an example. This vessel is to have fourteen externally fired cylindrical boilers, 9′ 10″ long, and 9′ diameter, made of steel five-eighths of an inch thick, each being set on an independent brick furnace. The leading English mechanical paper, the *Engineer*, says :—"To go to sea with such boilers is to simply court destruction," and we fully agree with its editor in this particular, for experience has shown in this country, as it would in all others if the experiment was tried, that to apply heat externally to the shell of a boiler over one-fourth of an inch in thickness is impracticable on account of the liability of the iron to blister and buckle. This can be seen by reference to many externally-fired boilers on Western river steamers in this country. Congress, also, has made recognition of the fact in the United States steamboat laws, by specifically providing that heat shall not be applied externally to any boiler, whether made of iron or steel, which is externally fired, of more than $\frac{26}{100}$ths of an inch in thickness.

Yet in the face of this experience and requirement the Naval Advisory Board proposes to make the boilers of the *Chicago* five-eighths of an inch thick and apply heat to the outside of them, with an internal pressure of 100 pounds per square inch. This seems bad enough, but when it is seen that in the construction the girth seams of these boilers will be $1\frac{1}{4}$ inches thick, and exposed to the direct action of the heat of the furnace for a distance of half the circumference of the shell, say for 14 feet, which will be equaled if not exceeded in intensity on the lap of the sheet at the back end of the furnace, where the crown-sheet joins the back tube-head. At this point the most intense heat will be continually acting directly on the two thicknesses of metal $1\frac{1}{4}$ inches thick, and burn them out in a remarkably short space of time.

Without discounting the dangers to be incurred, and the destruction that must result whenever any one of the fourteen boilers gives out, liberating its immense volume of steam and water at 100 lbs. of pressure in the lower hold of a ship, we quote Mr. Richard Sennett, Chief Engineer of the Royal Navy, in a paper to the "Royal United Service Institution," Vol. 26, No. 118, for 1882. This gentleman says :—

> "It is the usual practice in the government dockyards to burst by water pressure, for the sake of experiment, one boiler out of each set condemned, and a mass of very valuable information as to the ultimate condition of the boilers is thereby obtained. I have had in the course of my duty to conduct many of these bursting experiments, and so far as my experience goes the weakest part has proved in every case to be the furnace or combustion chamber. I think it quite safe to say that while the present form and dimensions of furnaces and combustion chambers are retained—and there appears to be no tendency to increase the thickness of the plates in these parts—there is no necessity to use a higher factor of safety for the shells than 5. Even with this factor I believe that when the boilers come to be worn out the furnaces and combustion chambers will be found to be the weaker parts, notwithstanding the fact that they had apparently a much greater margin of strength than the shells when new. It must not be forgotten that in these parts the material is weakened to some unknown extent by the working, or flanging, during manufacture, and when the boilers are under steam unequaled and unknown strains are brought on material by the expansion resulting from the heating of the furnaces. It is also probable that the material deteriorates from the alternate heating and cooling to which it is exposed, and corrosive action, if it occurred at all, would probably produce more effect upon the heating surfaces than on the shells, which are kept at a much lower and more uniform temperature. The plates in these parts also are generally thinner in the shells, so that the percentages of loss of strength for a given amount of corrosion would be greater."

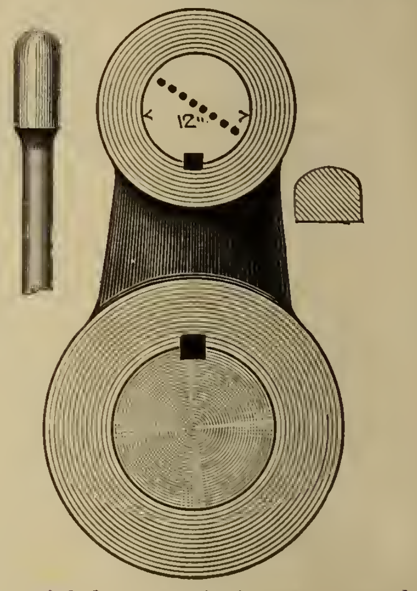
We quote the above to show what English experience is with boilers internally fired, and where the pressure on the heating surfaces is direct, from compression instead of tension, and the shells have simply to retain the steam and water they contain under pressure. The boilers of the *Chicago*, however, have not only to carry the proposed increased pressure of 100 lbs., but resist all the known difficulties due, and common to, the inequalities of expansion, contraction, and bad mechanical execution of flanging, riveting, etc. To make the boilers of the *Chicago* still less desirable they will have two direct rising currents of circulation on the sides of the shells, which causes the water in them to be in a thorough state of agitation incessantly, thus ensuring complete entrainment of all the water thrown into the steam space (by the two rising currents from the lower portion of the shells) directly over the center of the furnaces, which receive the most intense heat. The effort to overcome the above difficulties by passing the saturated steam through the steam-chimneys or super-heaters, might accomplish the desired result in a merchant steamer, but in naval vessels in action the use of these steam-chimneys, or super-heaters must be dispensed with, on account of their position above the water line and consequent extreme liability to puncture by an enemy's shot or shell. It is extremely doubtful if it will be in the power of any engineer, however careful he might be, to work the engines of the *Chicago* at half speed with the steam chimneys, or super-heaters shut off, for the engines would be literally flooded by entrained water from the boilers. High pressure of steam and boilers below the water-line are a necessity for the successful man-of-war, and the Naval Advisory Board have certainly not been guided by the light of the best practical ex e attainable in the direction of marir neering.

THREE S

TIGHTENING A LOOSE CRANK-P

FROM HERMAN WINTER, ESQ., RESIL T ENGINEER, MORGAN LINE S.S., N. Y.

You and your engineer-readers everywhere will, perhaps, be amused and interested by an account of the manner in which I recently fastened loose pins in the steamships *Glaucus*, of the Metropolitan Line s. s., and the *Morgan City*, of the Morgan Line s. s. These pins were shrunk in, but the shrinkage allowance was so great that instead of holding them it expanded the crank-eyes, with the result stated. It was impossible to make new pins, as the time at disposal did not permit of it. I therefore adopted the following expedient : I drilled holes $\frac{3}{8}$ths of an inch in diameter the whole depth of the eye, as shown in the sketch herewith, and about one-eighth of an inch apart, merely so they would not run into each other, and also to have but little metal to cut apart after drilling. In these holes I put cartridges or plugs of Muntz's metal (see small figure on sketch), about half to five-eights of an inch thick, having a pointed end. Of these a row was put in across the pin and driven home by a steel drift made for the purpose, as shown on the sketch. This also has a rounded end, and the cartridges are put in round end towards the driver, so that they would expand from the center. You will readily see that the effect of this is to expand the split pin with great force against the crank-eye, when all the holes are driven full of plugs.



The operation was an entire success, and may be used to great advantage by others in similar straits, with a larger or smaller pin. I think it is a much better plan than drilling holes alongside the pin, between it and the eye, and driving steel pins in as commonly done. This latter injures the crank-eye irreparably for fitting a new pin to it at any time.

THE ONLY RATIONAL CAUSE OF BOILER EXPLOSIONS.

From an English report to the Board of Trade, we make the appended extract upon boiler explosions:

"A detailed examination of the abstract and reports would seem to justify the following general conclusions: (1) The terms 'inevitable accident' and 'accident' are entirely inapplicable to these explosions. The reports show that so far from the explosions being accidental the only accidental thing about them is that they should have been so long deferred (2) As in three cases only can the explosion be attributed to neglect, or ignorance of management on the part of the boiler attendants, there is no reason for assuming that any material diminution in the number of explosions may be expected from granting certificates to men employed in working the boilers.

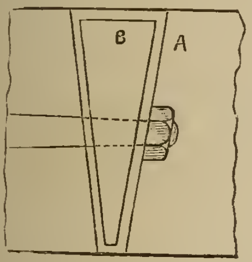
"The prevailing cause of explosion is the unsafe condition of the boilers through age, corrosion, wasting; etc., and a noticeable feature in many cases is the absence of any effort on the part of the steam user to ascertain the condition of the boiler, and consequently of any attempt on his part to repair, renew, or replace defective plates or fittings. As regards the neglect of owners to see that their boilers are made and kept safe, I may say that in one of the most serious cases a prosecution for manslaughter was instituted against the manager. The case, however, broke down, the judge before whom it was tried holding that the defendant could not, for lack of intelligence, be held criminally responsible."

From the above it would appear that abuse of steam boilers is pretty common the world over.

SINGULAR QUESTION.

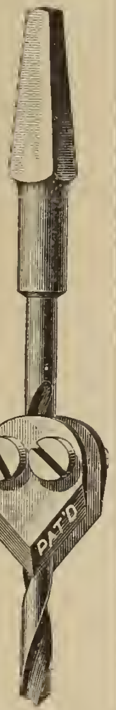
We find in an English contemporary, whose name is purposely omitted, the following:

"Will some one enlighten me on the following point: Suppose *B* to be a piston in a cylinder *A*, so made that the rings at the top are wider than at the bottom, the piston thus being taper in section, will not this construction cause the wear upon the cylinder to be less at the bottom, the weight upon the piston being sustained by the pressure of steam on the inclined faces?"



This paper has a plan of publishing the question one week and the answer to it the next week, so that our inquiring friend above will be kept in a state of suspense for that time.

A UNIVERSAL COUNTERSINK.



The Cleveland Twist Drill Co., of Cleveland, Ohio, have recently brought out the ingenious and useful appliance herewith illustrated, and we think all will agree that it is well named, for it can be used upon any boring tool employed by mechanics. Its construction is so simple as to require no explanation, and its advantages for adjustment or facility of sharpening are equally obvious. Both sides of the cutter are alike, except that one edge on each side is a little longer than the other, thus giving the cutting lip a lead. This little device is not only useful as a countersink, but also as a depth gauge, as mechanics will readily see at a glance. But one size, that for a $\frac{3}{16}$ths gimlet or twist-drill, is made at present, but all usual sizes will be put on the market in due course. It is sold for 25 cents, and is indispensable in every tool-chest. Address as above.

Regarding hand-cut files, as against machine-cut, a Western file-maker says, in the *Age of Steel* (which steals our paragraphs):

"In a file 12 inches long, the first 6 inches from the point does the most work. In a machine-cut file the teeth of this part are shorter, and in practice will not bite as they will further up. This is because of the shape of the files, in many instances, making it impossible for the machine to work on all parts with the same effectiveness. Out of a dozen or more machine-cut files you will not find more than one that is perfect looking, and very few machine-cut files will bite as well as the hand-cut article. For this reason, their teeth break out less easily, because they wont bite. There's an awful sight of trash turned out lately in the way of files."

Water of Ayr stone is the best for polishing and sharpening edge-tools. It works best with water.

EXTRACTS FROM FOREIGN EXCHANGES.

From time to time during the past year we have published engravings and articles from English contemporaries which serve to show, in some sense, what is being done in England in the line of steam-engines and shop machinery. The articles also indicate the current of thought and the tenor of opinion upon topics of interest to the trades we represent. We consider this a valuable feature of our paper, and one which we shall continue to present in the current year. In following this course, we have in no instance intentionally appropriated our neighbors' goods or the fruits of their enterprise without acknowledgment. Neither have we made caustic comments with the view of disparaging or belittling them. Such remarks as we have made are intended to show the light in which such inventions or designs would be considered from an American point of view, or by the average American engineer and machinist. In the current issue, for example, we have noticed some peculiarities of English machinery, but in none of our strictures are we Anglophobic. In plain phrase, we endeavor to hold the balance truly, for or against.

An editor who properly fills his office knows neither race, sect, or condition in life, and it is our aim to make The Mechanical Engineer a record of the day and time of what is passing all over the civilized world in its special line.

TO THE STATIONARY ENGINEERS OF THE UNITED STATES.

One year ago the first charter was issued by the N. A., and since that date the officers of that body have issued charters to forty-four different associations, and have a membership (judging from the few reports at hand) of over 1,500.

The objects of the Order have been thoroughly explained by the technical press, but like that old story which is ever new, will bear telling again. They are *educational*, and we believe that engineers, by meeting together, discussing the different kinds of engines, types of boilers, and relating their experiences in break downs and giving the results of experiments, that a better knowledge of engineering would be obtained by all, which could not otherwise be acquired in years of study and practice.

The officers of the N. A. earnestly hope that the engineers of the country will look at this matter in the proper light. The association is in no sense a trade's union banded together to force claims by striking, thus causing employers, as well as ourselves, irreparable loss Rather, we strive to improve ourselves in our profession, and by so doing confer mutual benefit.

The question may be asked, "How then are we to receive any benefit from the organization?" At present, perhaps, none, beside the very great one of associating with men of wide experience; but in the near future, when our objects are thoroughly known to our employers, and they have more confidence in our platform, and come to know that by engaging a member of any association for an engineer, they in reality engage the brains and experience of the whole association of which he is a member; they will be ready to give higher compensation.

Already there are cities where it is impossible for an engineer to get any desirable position unless he can show that he is a member of the National Associations. These are constantly called upon by builders of engines for men who are capable of going out with their machines and doing them justice. The time is coming when a man presenting the card of the association will be asked for no further references in regard to his qualifications.

We also have an Aid Association in connection with the Engineers' Association. And let me say to the different organizations, set apart *one* entire evening early in January for the purpose of working up the "Aid," and by the first of February let Bro. Cullinan have at least 1,000 names on his register; if he does, and a member should pass on, under the Orders of the Great Chief Engineer of the Universe, his family would receive $1,000. The amount to each will be trifling, yet the aggregate will keep want from your loved ones for months to come.

I would also suggest that the members be permitted to invite engineers, or employers, to attend the meetings of the different associations, and that they be allowed to take part in the different debates; we have known such proceedings to be the means of inducing many first-class men to become members.

Engineers, employers or superintendents, who may be interested in organization will be furnished Constitutions and minutes of the annual meeting of the N. A, by addressing the Sec,

Detroit, Mich. A. M. Davy.

OFFICERS OF BALTIMORE NO 1, NATIONAL ASSOCIATION, STATIONARY ENGINEERS.

Editors Mechanical Engineer:

At the last regular meeting of Baltimore City Association of Stationary Engineers, held at Druid Hall, Dec. 28, the following officers were elected for the term of six months:

Past President H. L. Boesehee.
President, J. N. Hammond.
Vice-President, G. T. Tittle.
Recording Secretary, Samuel F. Rose.
Financial Secretary, C. E. Hause.
Corresponding Secretary, J. B. McClure.
Treasurer, R. Hamilton Sehultz.
Conductor, J. D. Lookingland.
Doorkeeper, John Rose.
Trustees, Thomas A. McKibben, Philip Smith, Harmon Wollenberg.

J. B. McClure, 212 Elleott Street.
Baltimore, Md.

An esteemed contemporary observes, in a recent issue:

"There is a chief draughtsman in a machine shop in this city who is color blind, and none of his friends knew that his color vision was defective till he was some time at work. As he could not distinguish between green and red lines, he got blundering with the colors, and the draughtsman he was working under discovered what the trouble was."

This seems a little obscure—just a trifle. There are no green lines on mechanical drawings, and the chief draughtsman does not work under other draughtsmen.

Some indicator diagrams recently published in a foreign paper are marked as from the "north end" and "south end" of the cylinder. This, doubtless, has local significance, but the worldly outsider is irresistibly reminded of one of Marryatt's novels, where a bystander informs another that the west side of his coat is covered with paint!

The latest novelty is an illuminated fish bait, or a crystal glass minnow, which is coated on the inside partly in silver and partly with luminous paint. With reference to it the manufacturers mention that it is a well-known fact that game fish lie at rest in the daytime and feed after night, making it a difficult matter to catch them, while their luminous bait is sure to attract. They claim that for night fishing, cloudy days and deep waters, it is just the thing, and sure to kill.

Concerning this last, we fear the manufacturers are somewhat at fault. We have a distinct recollection of killing a great many game fish in the daytime without luminous bait.

This issue is sent to a great many new names, with the hope of getting a subscription from them. We are quite insatiable in this respect, and never get so many but what we would like more. If by chance a paper marked "sample copy" should get into the hands of those who have already subscribed, they will understand that it is an error.

A feature of The Mechanical Engineer during the past year has been its engravings of marine engines. This issue is a case in point. Our connection embraces the leading marine engine constructors and designers of note in the country, and we are under great obligation to them for communications and drawings. They will be continued during the current year.

A remarkable small steam-engine was exhibited at the Vienna Electrical Exhibition. The whole thing was only about 5 inches by 10 inches, but it was able to work up to 2½ to 3 horse power, and give motion to a dynamo for the production of twenty-five incandescent lights of 16-candle power each. The whole apparatus, steam-engine, boiler and electrical machine, can be packed in a box 40 inches long, 26 inches wide, and 13 inches high. [It must have had a pretty good boiler to do that.—Eds.]

Our friends understand, of course, that in the indicator series the illustrations of diagrams are mere sketches reduced to fit our columns, and therefore not strictly to scale in all respects. They serve the purposes for which they are intended, but are not accurate diagrams.

In 1882 the crucible steel produced in this country amounted to 85,000 tons.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,
Editors and Proprietors,

150 Nassau Street, New York.

VOL. VII. NEW YORK, JANUARY 12, 1884. No. 1.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

THE NEW CRUISERS.

Universal interest is centered in the machinery of the new cruisers now building, and if the vessels are not a success, it certainly will not be for want of advice on their weak points. We made some remarks on the subject of these vessels last year, Numbers 11, 12, Vol. VI, taking issue with our contemporary, the *London Engineer*, as to the fitness of the type of engine adopted. In support of our remarks, we instanced the *Louisiana*, of the Cromwell Line S. S., which vessel has had as hard service as a cruiser would have, [except, as regards her being shot full of holes.] Her record is in all respects creditable and encouraging. Our contemporary, above mentioned, quotes our last article and says :

> "We had no thought of the Louisiana when we wrote. What we said was based on experience acquired in this country. We are quite content to let facts speak for themselves. If the "Chicago" is not a failure she will form a glorious exception to the rest of the experimental craft built in the United States. We would ask our contemporaries one question; we put it to them as sensible men—Is it not more likely that the engineers of this country, with their unparalleled experience in the construction of ships-of-war, should know what is and what is not right, than the members of a naval advisory board, who have had no experience whatever with such machinery and boilers as they propose to put into the Chicago? If they are right and we are wrong, then experience is worth nothing; and the merest tyro from the shops who can design an engine is as good as the man whose life experiences have taught him what it is and what it is not expedient to use at sea.

We regret that we cannot answer our contemporary as, possibly, it would like to have us. It also embarrasses us by calling us sensible men, and disarms any criticism we might have to offer. All we can say is to repeat what we have already said.

As regards the Naval Advisory Board, the *London Engineer* does not know the individuals composing it, or it would not have asserted that the members of it have never had any experience with the types they recommend. It is by reason of their experience that they have recommended them. Miers Coryell, Esq., is chiefly responsible for the beam engine and the brick furnace, *as he would build them.* In regard to his experience, he has had over forty years of it, actively engaged in the profession. Twenty odd years of this was as Superintendent of one of the oldest marine engine shops in this city. Many years of it were in China, in charge of an English line of steamers. Mr. Coryell is very well known at the Messrs. Inglis, and to Continental engineers with whom he has come in contact professionally. Probably no one man has ever had a more extended and generally successful career than Mr. Coryell, who, by the way, will not thank us in the least for these remarks. If the Chicago's machinery is a failure, it will be because his advice has not been followed as regards details. The other members of the Advisory Board we have not the pleasure of an acquaintance with. Mr. Alexander Henderson we know by reputation only, and he is a naval engineer of very wide experience and high standing. We hardly think that these gentlemen should be ranked with tyros from the shops. A man sixty years of age, who has buffeted the ocean in nearly every quarter of the globe, who has had the advantages of observation and actual experience that few have had, even in England, can scarcely be called a tyro. A personal acquaintance since the year 1850 entitles us to speak *ex cathedra* concerning, at least, one member of the Advisory Board.

Our contemporary will not understand us as deriding the value of experience, or desiring to make odious comparisons. We believe it to be sincere, and devoid of any intent other than friendly service in its criticisms, for we have noticed that it is quite as zealous and outspoken in regard to engineering short comings in its own country.

AS TO SETTING VALVES.

A contemporary whom we esteem, says, that an English engine was recently sent to Nicaragua and no one could set the valves, but an American engineer happening in with the requisite knowledge, the owners of the steam boat offered to pay his hotel bill and give him $180 in gold to set them. The offer was accepted and the work done satisfactoril *day*, and the engineer thinks he was highest price for valve setting of any one

We have no doubt of the gentlema portune arrival, but we presume the *o* mentioned is "a clerical error." Thirty utes sets a valve with a link-motion, if the parts are properly proportioned. It remains to be explained, moreover, why our English friends sent the engine over without setting the valves in the first instance.

COMICAL CORRESPONDENTS.

Viewed superficially, steam engineering does not seem to be a calling calculated to make a man laugh; but some aspects of it, or the questions put by some interlopers in the trade, are amusing enough to make the Sphinx smile. Look at this, which we cut from a Western paper:

> E. H. G.—1. Please inform me how to set an eccentric; I had the motion of my engine changed, and the eccentric has slipped, and I do not understand valve motion.
>
> ANS.—1. Set your eccentric so as to open the valve one-sixteenth when the crank is on the center, turning your engine the same direction it runs.

How can he, when he says he doesn't understand valve motions?

Here is another drop from the same fountain:

> N. J.—I have a six-horse power engine, made of good material. The cylinder is five-inch bore, but there seems to be a defect somewhere; the engine stops dead still sometimes, when the packing is plumb tight. The stoppages occur as well with light as with heavy feed.
>
> ANS.—The cylinder may fill with water; the eccentric may slip on the engine-shaft; the slide-valve may not be securely fastened to the valve-rod, or it may have too much lead, and take steam before the crank gets near enough to the center to be carried over by the fly-wheel. This last condition would occur with a slow motion without a load, or if the engine should be overloaded. You may have your packing so tight as to absorb all the power, or the heating of the wrist or journals of the main shaft would cause the same result. You should get a good engineer to examine your engine and locate the trouble.

We don't know which is the worst, the question or the answer. The last two lines explain the situation pretty clearly.

FLOOD TIDE.

For the past two weeks an unusually high tide has prevailed in our subscription department, with, at present, no indication of subsidence. Not only have old friends come to the fore, as usual, but they have kindly taken our article of Dec. 22d, "*What One Man Can Do,*" literally, and have acted on its suggestions so generously that we almost feel ashamed of our hint.

In some instances old friends have brought half a dozen new ones with them, while the lapses, or notices to discontinue in the past ten days have been—two.

Unlike most high tides, this one has not been attended with disaster to those in its vicinity. On the contrary, it has had a beneficial effect, not only as a token that our efforts during the past year have been satisfactory to our connection, but also as a stimulus to further exertion on our part. It is also evidence to us that our friends have confidence in our ability to interest them, and we have tried to show our appreciation of all this in the present issue.

We make no promises that we do not fulfill. The best way, perhaps, is not to make any. Performance is better than promise. An appreciative audience is able to judge for itself whether it has received value for its outlay.

POWER METERS.

Judging from inquiries addressed to us on this subject there is a demand for an instrument which will record the amount of power given out by a line-shaft on an engine, and register the same so it can be readily taken off by anyone. Some months since we published engravings of such an instrument which was invented in England, and this has given rise to inquiries for the manufacturer of it.

Of course we are aware that dynamometers of various forms do exactly this thing—after the diagrams they make are figured up, but it is this latter duty which is to be avoided. Steam users, or power consumers, do not understand diagrams, as a rule, or what they are for; neither can they manage the dynamometer. What they need is a power meter which has an open dial and an index marked with horse powers. Such an instrument would have a ready sale.

CAUSTIC BUT CORRECT.

The recent report of one Hines, in the case of the *Riverdale* explosion, has caused a great deal of unfavorable comment among engineers in this vicinity, who feel that the whole thing is a travesty. The *Herald* says caustically in relation to it:

"Special Agent Hines reports to the Secretary of the Treasury that the inspector who last June pronounced good the *Riverdale's* boiler, which exploded within two months, is not to blame. The inspector was too large to get into the boiler, the engineer had not told him about the patches, the boilers were not in the right place anyhow, and the inspector acted 'in accordance with the long-established usage of the office.' As to the corrosion discovered after the accident, it was 'of so phenomenal and unprecedented a character, and at so inaccessible a point in the shell, that the most prudent and skilful man could not have anticipated it.'

"The conclusions seem to be that man-holes of boilers should be made larger and inspectors smaller; boilers should be so constructed and placed as to be hoisted on deck and turned inside out on inspection day, or else be made transparent, so that inspectors may see through them from the outside. All of which is somewhat discouraging to people who have to travel on steamboats."

Yes, and unjust to engineers also.

TALKS ABOUT THE STEAM ENGINE.—No. VI.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

Continued from Page 131, *Vol. III.*

It does sometimes seem that for the engineer's purposes the oldest results of practice are preferable to the newest discoveries of science.

The reason is that we generally have to increase the perfection of every part of the improved machine for each increase in the perfection of a single part.

* * * * * *

Possibly as good an illustration as I can give of this is the making of machine-cut files. The cutting machine works with great regularity of spacing and force of blow, but in order to get a good file the blanks must be ground of an exact shape and be of uniform softness, for the machine is so regular that it won't adapt itself to irregularities as does the skilled file cutter, who literally feels his way from end to end of the file and so gives a uniformity of cut not always realized by the machine.

* * * * * *

This is true with regard to wrought iron. We cannot afford to make assumptions based on the best results of test specimens of small dimensions, or on the accurate results of an Emery-testing machine.

Our inferences can never be more correct than our premises, and decimals to four places don't help matters.

The ever-varying chemical constituents of the various brands of wrought iron, the fact now fully ascertained that however carefully made and worked wrought iron may be heterogeneous in its composition, that the reduction of the area of cross-section from pile to bar has a very great influence upon the strength. (The greater the reduction the greater the strength per square inch cross section) : that a high tensile and compressive strength is often obtained by a loss of ductility and welding power. All these being considerations of a purely practical nature, demand a large factor of safety.

We will therefore assume 10 as the factor of safety, meaning by that that we will assume the safe stress to be put on the material of construction as one-tenth of the strain which will break it. In bridges and roof trusses and similar quiescent structures 5 or 6 is regarded as being the proper factor.

* * * * * *

The piston-rod of a steam engine has very severe duties imposed upon it. It is stretched as a tension rod ; it is compressed like a short column, or it may be buckled like a long column. The rod passes through the gland at one end of the cylinder and often is subjected to a bending stress by it, because it is not exactly central, or because it is not squarely screwed home on the packing. The rod helps to keep the piston head square to the cylinder, and at the other end it is fastened to a cross-head, which often has a "kick" in it because of wear in the guides, or perhaps because of untruth in the crank-pin. It is obvious that the rod must, in addition to being strong enough to sustain these stresses, be rigid enough not to bend in the slightest degree. * * *

As between rupture by crushing or by stretching, wrought iron has the greatest tendency to rupture by crushing. The wrought-iron piston-rod will have a greater tendency to break by buckling than crushing when its diameter in inches is less than its length in feet.

The greatest stress which the rod has to sustain is due to the initial pressure of the steam. This stress is somewhat reduced by the inertia of the piston-head, but as this stress is irregular we will neglect it because neglecting it will still leave us on the safe side. * * *

Hammering wrought-iron, particularly with a very large hammer, will contribute to perfect welding and density in it. We will assume 3,100 lbs. as the safe crushing stress per square inch. Then :

TO DEDUCE THE DIAMETER OF A WROUGHT-IRON PISTON-ROD,

Take the square root of the initial pressure in lbs. per square inch ; multiply this by the diameter of the cylinder in inches ; divide this product by 56 ; the result will be the diameter of the piston rod in inches.

Example :—

Initial pressure=40 lbs. per square inch.
Diameter of the cylinder=32 inches.
Length of stroke=48 inches=4 feet.

```
Square root of 40=          6·324
                               32
                           ------
                            12648
                           18972
                         --------
                       56)202·368(3·61
                          168
                          ---
                           343
                           336
                           ---
                            76
```

Therefore, to resist crushing the diameter of the piston-rod must be 3·61 inches. But we observe that the diameter of the rod in inches is less than its free length (a trifle greater than the stroke in most cases) in feet. So we must compute the diameter to resist buckling.

Take the fourth root (the square root of the square root) of the initial pressure in pounds per square inch.

Take the square root of the diameter of the cylinder in inches

Take the square root of the stroke in inches.

Multiply these three quantities together and divide their product by 25 63. The result will be the diameter of the piston rod in inches.

```
The square root of    40=6·324          5 657
 "    "    "  "   6·324=2 51            2 51
 "    "    "  "      32=5·657         -----
 "    "    "  "      48=6 928           5657
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Therefore to resist buckling the diameter of the piston-rod should be 3·84 inches.

The diameter of the piston-rod must not be deduced from the horse-power of an engine, as the initial pressure is always much greater than the mean effective pressure, save in the case of an accurately-balanced engine, and when the most of the weight of the reciprocating parts is concentrated in the piston-head.

(*To be continued.*)

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLVII.

I have been very much interested of late in a subject which many have settled long ago to their entire satisfaction—that is, compression. I had settled it to mine, and I believed it was as essential to an engine as a supply of steam; but I have materially changed my views, and am not ashamed to say so. Neither do I say I have settled the question. That would be a rash statement, and I do not wish to be rash in anything.

Where engines run at a high velocity, with small clearance, some compression is inevitable, simply because the piston is smarter than the steam, and gets on to it before it can escape. Then the piston squeezes it. Especially is this the case where the engine is worked at a high degree of expansion. Then the terminal pressure is low; the steam is tired out with stretching so much; it has no legs, as billiard experts say of slow balls, and more or less compression ensues. In a word, at high-piston speed, and with high expansion, more or less compression is inevitable in non-condensing engines without separate exhaust valves. What I want to know is whether we shall make a virtue of a necessity in such cases, and say we can't help it, or whether we shall boldly stand up against it and say compression is an evil to be avoided where it can be.

I suppose the object of letting steam on to a piston is to get all the work out of it that is possible, by driving it through from one end of the cylinder to the other. So many pounds total effect on one end, and so many on the other. That is all right so far as it goes; but it seems to be the idea of some that I should relinquish a portion of this useful effect and sink it in compression. I must take off part of the pressure, where it does the most good, and put it where it yields me no return. I must devote a certain portion of the work to pushing a useless load up a hill of greater or less height. I don't see why.

Those who favor compression say I am wrong; that I experience no loss, for I get it all back again at the commencement of the next stroke. I compress steam at a low pressure to a higher one, and have my ports and passages all full and ready to start, thereby saving just so much live steam from the boiler.

That is what the compressionists say.

Let us see if this is so. I look back and say: Yes, that is true; I do take steam at a low pressure and push it into a higher, and the ports are full of steam, also the clearance spaces. But what has done this work? Is it not live steam, originally, on the other side of the piston? Have I not taken something from the useful effect and banked it on the other end? I certainly have, for assuredly I cannot get something for nothing. Whether I compress steam with the piston, or grind corn with it, I have done work, and I cannot get back as much as I put in. I never can. There is always a loss in the transfer of power from one end to the other, and in pushing the steam up hill only to let it roll down again, I have made a loss. I am not so well off as I was before I started. I have taken power from the flywheel, put into it by the steam, and used it for compressing the exhaust, and I say I have lost something by so doing. In effect, I have cut two inches off one end of my blanket and sewed it on the other. At the least, I have lost the portion taken up by the cut.

Non-compressionists can also cite card areas, and say that where the piston works close up to the cylinder-head the corner is as square as this page, and consequently shows a greater percentage of useful effect than the compression card, which has the end of its nose cut off. The latter represents so much loss, for it is taken from the power already expended and stored in the flywheel, while the card without compression shows no extra expenditure of steam, for the work done on the compression end is done by expansion.

I have said nothing at all about mere mechanical action, or the mechanical function of compression—that is, as a buffer to arrest motion—for this seems to me to be begging the question. It implies that I can't build an engine which will run silently without a soft cushion to buck up against gradually. As to this, I can only say that engines which I have seen running at from 500 to 800 feet piston speed per minute, and from 26″ to 48″ diam. of cylinder, were absolutely noiseless. I *mean* noiseless. Not a jar, or thump, or click of any kind, save, possibly, from some cut-off trap externally indicating that there was an engine in the place. It hardly seems necessary to consider this point in favor of compression. In fact, I cannot see that there is anything in favor of it, as I have already set forth. I am open to conviction, and I shall be very glad to know where I am wrong. I say this devoid of pretended humility, and with a sincere desire to hear the views of other parties. There must be some virtue in compression, or else a great many excellent engineers are making a mistake. One side in employing it and the other in opposing it.

HOW I SERVED MY APPRENTICESHIP.

BY GEORGE SLOCUM.

NUMBER I.

When I left school at 15 years of age I had what might properly be termed a good common school education. I had always intended—and my father encouraged me—to learn the machinists' trade, and with that aim in view I shaped my studies so as to get as thorough knowledge as possible of arithmetic, particularly common and decimal fractions, proportion, square and cube-root and mensuration. I also read everything that came into my hands treating of the steam engine and machinery in general. We had a large flour mill in our village, and every chance I got I used to slip down there and watch the big engine and the many whirling cog-wheels and pulleys, and wonder how they were made, and if I could ever get to understand them. About this time my father moved to a large city, and shortly after—through a friend of his—procured me a situation at the ——— R. R. Shops, where it was agreed I was to serve three years in the machine-shop..

The first morning I went to work I started early and got to the shop a half hour or so before the whistle blew. I spent the time looking around the shop, which was a very large one, and the first I had ever been in. There was a railroad track down the middle of the shop, and a cross track with a small turn-table in it, besides overhead traveling and huge stationary cranes. On one side of the shop I counted 20 pits, and 18 locomotives being repaired and one new locomotive nearly finished. On the other side were all the machines, and a forest of belts running in every direction. Pretty soon the whistle blew and the men hustled about and started to work. I now began to look around for the foreman, and after a little found him at his desk. When I told him who I was, he looked at me sharply and sort of sized me up, and stood for some minutes without saying anything, as though he was puzzled as to what he should do with me. Finally he told me to follow him, and took me over to a stout-looking Irishman and told him to set me to work. It didn't take me long to find out that the stout man was boss of the helper's gang, and that I was to lend a hand in hauling iron and stuff all over the shop, help the machinists when they asked for a lift, clean off grease, and make myself generally useful. I spent about a month in this gang, and was generally referred to as the “new kid.”

Some days we had it pretty rough, and were kept busy hauling stuff around to and from the different machines. I was just beginning to get tired of this sort of thing when one morning the foreman came to me and told me to go and help the man at the wheel-press for a few days. I was mighty glad to get a change, as this new job was a sort of relief to me, for although I had lots to do and was kept busy handling wheels and axles, still I had only one boss now, where before I had any number of them, and frequently several bosses at the same time. It was “say Bill !” from one, “give me lift, John,” from another, while a third wanting help at the same time would whistle with his fingers to attract my attention. Besides, I was so unlucky as to get my fingers pinched, and once a big chunk of iron fell on my foot and laid me up for several days. Smith, the wheel-press man, was a good fellow and a hard worker, and was never worried by the foreman coming around and poking him up, like he used some of the other hands. Gradually I got the “hang of things,” as Smith called it, and thought I would like to understand how the press was put together and how it worked, so one day I asked him to explain it to me.

“Well, said Smith, “I've run this press for ten years. I can take it apart, clean it, and put it together again, and that's all I know about it. Maybe Jones over there can explain it to you, I can't.”

“But I am not acquainted with Jones, perhaps he will bluff me off.”

“Oh, you needn't worry about that ; he is all right.”

Now Jones was a man about 50 years of age, had worked for 32 years at the trade, and was counted a first-class mechanic. He was a sort of leading man in the “frame gang,” and turned out good work and lots of it. He talked very little, but seemed to do a good deal of thinking, and looked to me like a very cross man.

One day I mustered up courage enough to approach Jones on the wheel-press question, and opened out with :

“Mr. Jones, I would like to ask you a few questions about that wheel-press over there.”

Jones eyed me sharply for about half a minute, and said, rather roughly :

“What do you want to know about it ?”

“Well, I would like an explanation of its construction, and operation, and whatever of theory there is about it, if any.”

“That sort of a question strikes me as rather a strange one for a boy to ask ! I have been in this shop a good many years, and you are the first boy I ever heard ask questions of that kind. The kids in this shop, seems to me, are more concerned in base-ball games and pin-pool than in anything touching the trade they are trying to learn. You talk like a boy who means business, and if you hang around these frames after six o'clock, until I get washed up, I'll try to give the information you want.”

I spent the rest of the day thinking over the questions I should ask Jones, and well pleased at my good fortune in falling in with him so easily. Six o'clock finally came, and so did Jones, ready for business.

“What's your name ?” said Jones.

“George,” said I.

“How are you on figures ?”

“Pretty fair, I've been through an arithmetic twice, besides, I've read some in a book on mensuration.”

“I suppose you understand common and decimal fractions ?”

“Yes, sir.”

“And ratio, proportion, square and cube root ?”

“I think I do. At any rate as far as arithmetic goes.”

“All right. Now for business. You see this pump ; it is what is called single acting, there is a small brass valve here, between the oil-reservoir and this plunger. There is another small brass valve in here, between the plunger and this ram. The diameter of this plunger is ¾ of an inch, the diameter of the ram is 7½ inches. Here you see a heavy weight to draw the ram back into its barrel, when the oil flows back into the reservoir after turning this hand wheel, which opens a valve between the ram and the reservoir of oil. Here is a Wootten's patent hydrostatic gauge ; it is so marked, you see, because this is not a wheel-press nor a hydraulic press either, but a hydrostatic press—its proper name. This outside circle of graduations represents tons pressure on the whole area of the ram ; that is, on the entire surface of its end. This inside circle, on the other hand, shows the pounds pressure on each square inch of the area of the ram. The tons increase by 10, from zero up to 140. The pounds increase by 500, from zero up to 6,500. This gauge connects with the chamber or barrel of the press. You see this button on the underside of the gauge, it connects with a toothed wheel inside, to which the pointer or index is fastened ; so that every advance of the index is caught and held to prevent its flying back and forth at every stroke of the plunger.

THE STEAM ENGINE INDICATOR AND ITS USE.—NUMBER 7.

BY WILLIAM BARNET LE VAN.

The condenser is an air-tight iron box, or vessel fitted with valves, and connected more or less directly by pipes with the exhaust ports of the cylinder. Its office is to condense the exhaust-steam and thus prevent the back-pressure of the atmosphere. The condensation of the steam is usually effected either by bringing it into contact with a jet of cold water or by passing it through, or about, a series of tubes, on the other side of which cold water is circulated. In either case the steam is condensed almost instantly and a vacuum, more or less perfect, is formed in the condenser. A perfect vacuum cannot in practice be had—but an average of about 26 inches or 13 pounds is usually obtained by the gauge; diagrams generally show from 3 to 4 pounds less. The approximation to a vacuum, and corresponding diminution of back-pressure, are effected in three ways, namely:

First.—The temperature of the condensing water.

Second.—The pressure of the atmosphere.

Third.—The friction of the exhaust-pipes and ports.

First.—If the temperature should be 32 degrees Fahrenheit, the pressure would be only 0·085 pounds to the square inch, and the vacuum as nearly perfect as is obtainable. The condensing water is, however, usually taken at 40 to 80 degrees and leaves the condenser at from 90 to 120 degrees, making the temperature in the condenser generally about 100 degrees, which would give a back-pressure from this cause alone of about one pound to the square inch.

Second.—If the barometer stands at only 28 inches, 13·7 pounds would be a perfect vacuum; 30 inches of mercury being equivalent to 14·7 pounds; and if the water in the condenser be at a temperature of 130 degrees its vapor will form a resistance of 2·21 pounds; therefore the lowest attainable vacuum would be but 13·7—2·21 = 11·49 pounds. Whereas, if the barometer stood at 31 inches a perfect vacuum would be 15·2; and if the water was but 100 degrees its vapor would give a resistance of only 0·9 pounds, and consequently the highest attainable vacuum would be 15·2—0·9 = 14·3 pounds, making a difference of 2·81, or a gain of *twenty per cent.*

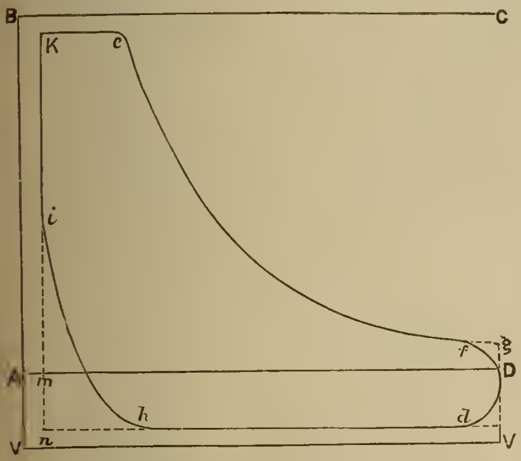
Third.—The friction of the exhaust-pipe and ports will be excessive, if they are too small, to the same extent as in the case of non-condensing engines.

The water used for steam engine purposes invariably contains more or less air, which if allowed to accumulate would gradually destroy the required vacuum. It is necessary, therefore, to draw off this air as well as the water, and this is done by means of an “air pump” worked by the engine; and, of course, the power required to do this although needfully expended, is so much power to be deducted from the given power, reducing the efficient motive power of the engine. The power thus expended is usually equivalent to from one-half to one pound pressure. But it is frequently necessary to raise the condensing water from a lower level to the line of the condenser, and in that case the power required to do this work is also power to be deducted from the gross power, also reducing the efficient motive power of the engine. In all cases it is only the nett motive power, after deducting the power needed to overcome the back-pressure that is represented in the area of the diagram.

The pressure of the atmosphere is usually taken as 15 pounds, which is too high, being correct only when the barometer stands at 30·54 inches—a most unusual occurrence; but the error is unimportant, and it is very convenient to avoid the use of a fraction.

The principal object of knowing the exact pressure of the atmosphere is to ascertain the duty performed by the condenser and the air pump. The temperature of discharge being known, the pressure of vapor inseparable from that temperature is also known (see Nystrom's Pocket Book, page 400), and this being deducted from the actual pressure of the atmosphere, the remainder is the vacuum in which the water would boil. The power of the air pump is shown in the closeness with which the vacuum approaches this point.

The vacuum shown by the indicator will generally vary from that shown by the vacuum gauge, when it is constructed with a glass tube, hermetically sealed at the top; for such gauges are designed to show the variation from a perfect vacuum without reference to the weight of the atmosphere; but the vacuum shown by an indicator is affected by all its variations.



Fig, 12

AN IDEAL DIAGRAM SHOWING THE ACTION OF STEAM.

Some of the disturbing causes on diagrams of a steam-engines which make the real differ from the ideal form of the diagram have already been considered incidentally. In the present article the more important and usual of these deviations are to be classed and considered in detail.

These causes affect the power of the engine, as well as the character and shape of the diagram.

The indicator diagram is, of course, the key to the action of the steam in the cylinder. A part of the work performed by the steam is spent in overcoming the friction of the engine itself, and consequently, the efficiency of the *engine* is most fairly tested by the amount of external work absolutely performed against a brake or otherwise.

Where the efficiency of the *steam* alone is concerned, however, the diagram is the only true criterion; and it will be necessary to deal with its theory carefully to prevent misunderstandings, which are frequent in practice.

THE ACTION OF STEAM IN THE CYLINDER.

The action of steam in any steam-engine cylinder is best understood from a diagram representing the varying pressures and volumes through the stroke.

Such a diagram is usually obtained by an indicator applied to the cylinder, and in such case the pressures shown are actually those of the steam in use. For purposes of comparison and calculation, however, it is more convenient to construct an ideal diagram, as nearly as possible such as would be given by an indicator applied to an engine as nearly perfect as practical, working under the same conditions. Such a diagram is shown at figure 12, where horizontal distances represent volume, and vertical distance pressure.

The several lines on the ideal diagram will be designated in this article, reference being had to the diagram below.

The base lines of the theoretical diagrams are as follows:

THE ATMOSPHERIC LINE.

When the atmosphere has free access to both sides of the piston of the indicator before steam is admitted, a straight line, *A D*, will be drawn by applying the pencil to the moving paper; this line is called the line of atmospheric pressure, or zero, on the steam gauge. From this line we measure pressure for non-condensing, or "high pressure" engines.

THE LINE OF PERFECT VACUUM.

The line *V V*, represents it. This line cannot be drawn by the indicator, but must be drawn by hand, parallel with the atmospheric line, and at the proper distance below it to represent the pressure of the atmosphere, as shown by the barometer, according to the scale of the indicator diagram. When the actual pressure is not known, it is to be assumed at 14.7 pounds on the square inch, corresponding almost exactly with 30 inches of mercury, which is about the average pressure at the level of the sea. The barometric column falls one one-hundredth of its height for every two hundred and sixty-two feet of elevation above the sea level.

THE LINE OF BOILER PRESSURE.

This line is represented by the letters *B C*, and is also drawn by hand, parallel with the atmospheric line, and at the proper distance above it to indicate the steam pressure per square inch, as shown by a correct steam gauge, measured off by the scale of the indicator diagram. It can be drawn by the indicator attached to the cylinder only when the engine is at rest, and while an equilibrium of pressure is established between the boiler and cylinder. It is generally somewhat higher than the initial pressure in the cylinder.

THE CLEARANCE LINE.

This line is represented by *B V*, and is at at right angles to the atmospheric line *A D*, and at such distance from *k i m* and *n*, that the included space, *B A V. n m i* and *k*, correctly represents the clearance.

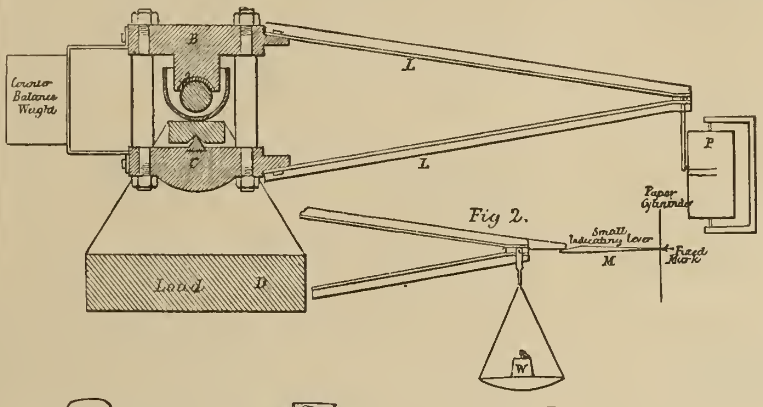


Fig 2.

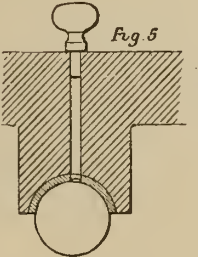


Fig. 5

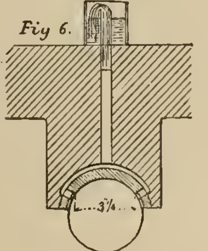


Fig 6.

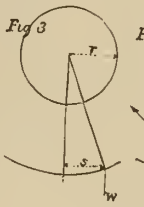


Fig 3

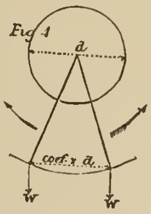


Fig 4

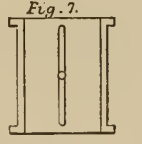


Fig. 7.

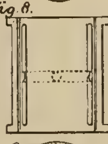


Fig. 8.

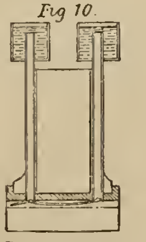


Fig 10.

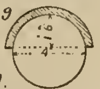


Fig 9

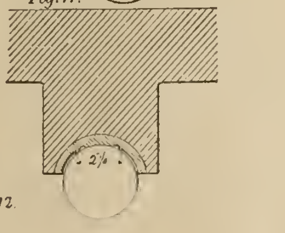


Fig. 11.

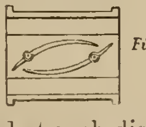


Fig 12.

This clearance is the cubical contents of the steam-port passages and the space between the piston and the end of the cylinder, or head, to which it is nearest at the end or beginning of a stroke, supposing them, when added together to be at each end one-twelfth of the whole cubical contents of the cylinder for one stroke of the piston, then the distance *A m*, would be made one-twelfth ($\frac{1}{12}$) of *m D*. In the diagram, figure 12, one-twentieth ($\frac{1}{20}$) has been taken, so that the line *A m*, is one-twentieth ($\frac{1}{20}$) of the length of *m D*. It is necessary to take these cubical contents into account, for the passages and clearance must always be filled with steam at each stroke, which is compressed and expands just precisely the same as the rest of the steam in the cylinder does after the steam has been cut-off. It is necessary to draw this line and to add this space to the indicator diagram, whenever the theoretical curve is constructed to compare with the actual curve traced by the indicator, and must be reckoned as part of the diagram in calculating the average pressure, and in producing the theoretic curve, or line of perfect expansion. The clearance is, however, rarely given, and it varies in different engines from one to twenty per cent of the space swept through by the piston in one stroke. If we have the drawings of the engine we can calculate it: if we know the style of engine we can approximate it.

The best method, providing the piston is tight, is as follows:—

Put the engine on the center, remove the valve chest cover, uncover the steam-port on the end where the piston is, fill the steam passage and piston clearance with water level with the valve seat; allow it to remain a few minutes, and if it maintains its level it is evident it is tight; then draw off the water, measure or weigh it, reduce it to cubic inches, and we have it exactly. The number of cubic inches of clearance divided by the cubic inches of space swept through by the piston in one stroke gives the ratio of cylinder capacity to clearance. (This matter will be more fully illustrated in a separate article.)

FRICTION EXPERIMENTS.

BY

MR. BEAUCHAMP TOWER,
of London.

Adopted by the Committee on Friction, and Presented to the Council of the Institution of Mechanical Engineers, September 28, 1883.

I. DESCRIPTION OF MACHINE

In experimenting on the friction of lubricated bearings, and on the value of different lubricants, one of the difficulties which is first met with is the want of a method of applying the lubricant, which can be relied upon as sufficiently uniform in its action. All the common methods of lubrication are so irregular in their action that the friction of a bearing often varies considerably. This variation, though small enough to be of no practical importance, and to pass unnoticed in the working of an ordinary machine, would be large enough utterly to destroy the value of a set of experiments, say, on the relative values of various lubricants, for it would be impossible to know whether an observed variation was due to a difference in the quality of the oil, or in its rate of application. The first problem, therefore, which presented itself, in the present experiments, was to devise a method of lubrication such as would be perfectly uniform in its action, and would form an easily reproducible standard with which to compare other methods. These conditions were best fulfilled by making the bearing run immersed in a bath of oil. By this method the bearing is always supplied with as much oil as it can possibly take, so that it represents the most perfect lubrication possible, and it is a good standard with which to compare other methods. It is at all times perfectly uniform in its action. It is very easily defined and reproduced; and it also has the advantage that the temperature of the bearing can be easily regulated by gas jets under the bath. Experiments showed that the bath need not be full; the results obtained were the same when it was so nearly empty that the bottom of the journal only just touched the oil.

The journal experimented on (Fig. 1.) was of steel, 4 in. in diameter and 6 in. long, with its axis horizontal. A gun-metal brass, *A*, embracing somewhat less than half the circumference of the journal, rested on its upper side.

The exact arc of contact of this brass was varied in the different experiments. Resting on this brass was a cast-iron cap, *B*, from which was hung by two bolts a cast-iron crossbar, *C*, carrying a knife-edge. The exact distance from the edge of this knife-edge to the center of the journal was 5 in. On this knife-edge was suspended the cradle, *D*, which carried the weight applied to the bearing. The cap, bolts, and crossbar were put together in such a manner as to form a rigid frame, connecting the brass with the knife-edge. If there had been no friction between the brass and the journal, the weight would have caused the knife-edge to hang perpendicularly below the axis of the journal. Friction, however, caused the journal to tend to carry the brass, and the frame to which it was attached, round with it, until the line through the center of the journal and the knife-edge made such an angle with the perpendicular that the weight multiplied by the distance from the knife-edge to that perpendicular, offered an opposing moment just equal to the moment of friction.

Suppose r=radius of the journal (Fig 3.)
s=distance of the knife-edge from the perpendicular.
w=the weight.

Then $s \times w$=the moment of friction.

Now the friction at the surface of the journal.

$$=\frac{\text{The moment}}{r}=\frac{w\times s}{r}$$

Hence the co-efficient of friction

$$=\frac{\text{Friction at surface of journal}}{w}.$$

$$=\frac{\dfrac{w\times s}{r}}{w}=\frac{w\times s}{w\times r}=\frac{s}{r}$$

So that the co-efficient of friction is indicated by s in terms of r, no matter what the weight is. As an example, suppose s was equal to r; the co-efficient of friction would obviously be 1; or if s was $\frac{1}{10}$ of r, then the co-efficient of friction would be $\frac{1}{10}$.

In order to avoid the difficulty of determining accurately when the knife-edge was perpendicularly under the center of the journal, (a knowledge which was necessary in order to obtain a measurement of s, and which was very difficult to obtain owing to the considerable friction between the brass and the journal when at rest), each experiment was tried with the journal revolving in both directions, and the sum of the values of s on both sides was measured; and then the co-efficient of friction was indicated by the chord of the whole angle, included between the two lines of inclination caused by the friction, with the rotation in the two directions, expressed in terms of the diameter of the journal (see Fig. 4.) Each result was thus a mean of two experiments, one with the axle running in one direction, and the other with it running in the other direction. In order to read the value of the co-efficients thus obtained, a light horizontal lever, *L*, was attached (as shown in Fig. 1) to the frame connecting the brass to the knife-edge. It was 62½ in. long, or 12½ times the distance between the center of the journal and the knife-edge; so that at the end of the lever the chord indicating the co-efficient of friction was magnified 12½ times. As a chord of 4 in. at the knife-edge represents a co-efficient of 1, a chord of 50 in. at the end of the lever also represents a co-efficient of 1, while 5 in. represents a co-efficient of $\frac{1}{10}$, $\frac{1}{2}$ in. of $\frac{1}{100}$, and $\frac{1}{20}$ in. of $\frac{1}{1000}$. The position of the end of the lever during each experiment was recorded by a tracing point attached to the end of the lever, and marking on metallic paper fixed on a paper cylinder, *P*. The distance between the two lines obtained by running the machine both ways, when measured on the above scale, indicated the value of the co-efficient.

II. METHOD OF EXPERIMENTING.

Early in the experiments it was found that immediately after the motion of the shaft was reversed, the friction was greater than it was when the shaft had been running in the same direction some time. This increase of friction, due to reversal, varied considerably. It was greatest with a new brass, and diminished as the brass became worn, so as to fit the journal more perfectly. Its greatest observed amount was about twice the normal friction at starting, and it gradually diminished until the normal friction was reached after about ten minutes continuous running. This increase of friction was accompanied by a strong tendency to heat and seize, even under a moderate load. In the case of one brass, which had worked for a considerable time without accident, and had consequently become worn so as to fit the journal very accurately, this tendency to increase of friction after reversal almost entirely disappeared; and it could be reversed under a full load without appreciable increase of friction or a tendency to heat or seize. The phenomenon must be due to the surface fibers of the metal, which have been for some time stroked in one direction, meeting point to point, and interlocking when the motion is reversed. The very perfectly fitting brass was probably entirely separated from the journal by a film of oil; and there being no metallic contact the phenomenon did not show itself. In consequence of the above facts, it was found necessary to proceed with the experiments in the following order. A complete series of experiments, with a gradually increasing load, was taken with the journal running in one direction; the load was then diminished by the same steps as it had been increased, and the experiments thus repeated, the shaft still running in the same direction, until the load had thus been reduced to 100 lb. per square inch, which was the load due to the unweighted cradle. The direction of motion was then reversed, and the shaft run for half an hour, so as to get it thoroughly used to going the other way; after this the load could be increased and the experiments taken without any difficulty. The experiments, as before, were taken at each step of both increasing and decreasing the load; so that each recorded result is really the mean of four experiments, which have in many instances been taken several hours apart.

This method of obtaining a direct indication of the co-efficient or friction, by the angular displacement of the frame connecting the brass and knife-edge, would have undoubtedly been the best had the co-efficient of friction been nearly as constant as it has hitherto been supposed to be. But as shown by the tables of results, the co-efficient of friction was found, instead of being constant, to vary nearly inversely as the load, and also to be much smaller in quantity than was expected; the consequence was that with high loads the height of the diagram was very small. In the cases where with the greatest loads a co-efficient of $\frac{1}{1000}$ was observed, the distance between the two lines was only $\frac{1}{20}$ in.

The results regarding olive oil, lard oil, mineral grease, and sperm oil as applied by baths, were obtained in this way.

Owing to these experiments showing that the moment of friction was much more nearly constant than the co-efficient, it was resolved to alter the method of observation, and to measure the moment directly instead of the co-efficient. For this purpose the paper cylinder was removed and a small lever, *M*, Fig. 2, was connected to the main indicating lever, in such a manner that the motion of the end of the main lever was magnified five times at the end of the small lever. The end of the small lever was pointed; and when the machine was working this point was brought exactly opposite a fixed mark by putting weights into a scale-pan on the end of the main lever. The main lever was so overbalanced that under all circumstances some weight was required to be added to the scale-pan, in order to bring the end of the small lever to the mark, even when, the friction being greatest, the direction of motion of the journal tended most to depress it. The method of running in both directions, and loading and unloading, was followed, as before. The weights in the scale-pan being noted, the moment of friction was given by half the difference between the weight in the scale-pan when running in one direction and the other.

Experiment showed that the friction varied considerably with temperature. All the oil-bath experiments were therefore taken at a nearly uniform temperature of 90 deg.; the variation above or below this temperature was never allowed to be more than 1½ deg.

(*To be Continued.*)

MACHINE TOOLS.

BY J. RICHARDS.

The general features of machine tools are of necessity familiar to engineers and mechanics, and it is only variations of practice that can have much interest to them. In English practice engine lathes have settled down into a tolerably uniform type, respecting arrangement, proportions, and even details. There seems to be at the present time a tendency to greater uniformity still, except in the quality of workmanship, which is varied even more than formerly. This arises from the different requirements of a home and foreign market, the former demanding generally high-class work, the latter all requiring all grades, from the best to the worst. To construct machines for a given low price is often more difficult than to produce first-class work, and a varied production as to quality, does not indicate a want of skill, but the opposite.

In America there has been a tolerably close adherence to one type of lathes, and that type far from being the best; there has, however, been much more done than in England in the way of modifications and special lathes. Among these latter are what are commonly called "axle lathes," designed for turning railway axles and similar work. The arrangement is shown in the drawing, Fig. 55. It has much to recommend it for the purpose intended, and is one of the most carefully worked out machine tools that can be referred to. The headstock, so to call it, is cast solid with the main frame, and is geared as indicated by the dotted lines, the wheels and pulleys overhanging. The tool slide *a* and the feed screw *e* are placed as near the center *c* as possible, and are mounted on broad flat surfaces as shown. The sliding head goes on at *n*, the frame being of the inclosed box pattern, and is the only example of the kind that can at present be referred to in American practice.

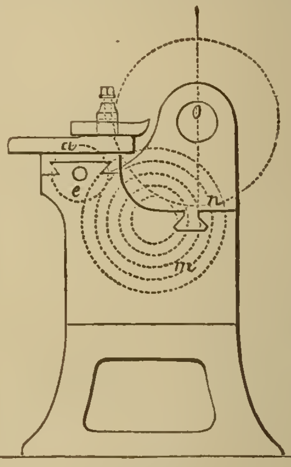


Fig. 55.

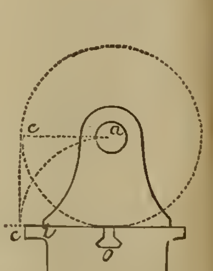


Fig. 56.

The superior rigidity of this arrangement and the adaptation for heavy cutting on pieces of small diameter will be obvious to tool-makers. The design is in many respects of the English type. The box frame, manner of mounting the tool slide, and the solid spindle bushes are characteristics of English lathes, and vary in a marked degree from what may be called the common American type. This modification is employed for turning shafts, making screws, and so on, and has been continually gaining in favor since first adopted, about twelve years ago. One feature of this design deserves particular notice—the position of the spindles behind the

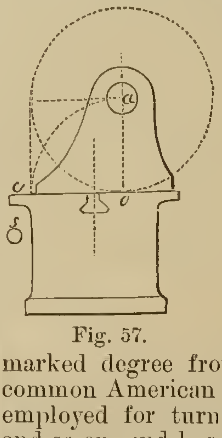


Fig. 57.

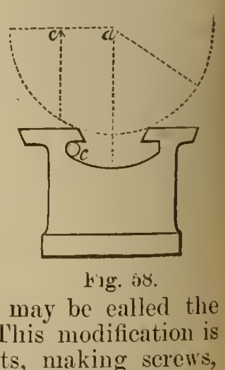


Fig. 58.

center of the main frame. I incline to the opinion that the spindles of all lathes intended for heavy work should be so placed; not perhaps so far back as in the drawing, but so as to avoid strain upon the overhang of carriages. This is illustrated in Fig. 56. When the spindle *a* is placed over the center of the frame, the thrust, in turning pieces as large as the lathe will receive, falls on the line *e c*. The upward thrust on the line *a o* is equal to the downward thrust on the line *e c*, and the center of these forces, in so far as communicated from the headstock to the frame. is on the outside of the frame. The ledge *i* and the overhanging carriage furnish a yielding support for the tools. If the same spindles are placed as in Fig. 57 the strains are brought within the frame, so to speak.

The conditions of use and convenience are not much, if any, impaired by such an arrangement. The spindles do not require to be set over to the extent shown in Fig. 57; one-fourth the distance from *a* to *o* will in most cases secure the required stability for tool support at *c*. As remarked, there are no inconveniences arising from arranging a lathe in this way. The accessibility of the work is the same if the distance from the front of the carriage to the spindle is not increased. There is the mechanical objection of a greater distance between the spindle and feeding mechanism when a screw or rack is placed in front of the frame at *s*, Fig. 57. The position of feeding-screws is a matter of some importance in the construction of lathes for heavy duty.

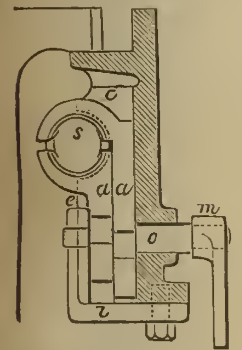


Fig. 59.

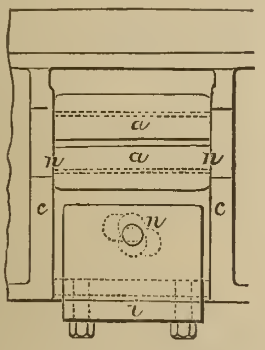


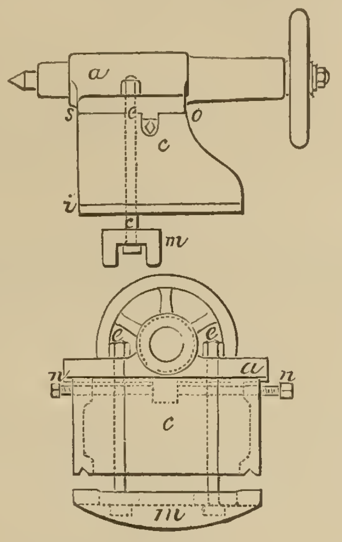
Fig. 60.

In the arrangement shown, Fig. 55, the screw is well placed, but not quite so favorably as in the lathes made by Messrs. Wm. Sellers & Co., of Philadelphia. The strains and working conditions demand the leading screws be situated as near the cutting point as possible. Assuming this to be, for the heaviest cutting, between *a* and *e*, Fig. 58, the nearest protected position for the screw would be at *c*, where it is placed by the firm before named. Mr. Bodmer patented a somewhat similar arrangement, when two screws were employed. A worm-wheel on the carriage meshed into both screws, and the rate of feeding was governed by the relative speeds of the two screws. The plan was more ingenious than practical, and never came into use. In respect to the present and other problems of the kind, it is often useless to search after and comment upon all the various conditions of construction and operation. A few questions so treated would compass the whole space intended for these articles. Suggestion in such cases is often of more use than exhaustive explanation.

The nuts for leading screws of lathes are commonly made of brass, and sometimes of softer metal. Regarded as bearings of journals, which such nuts are, they should be treated the same; with respect to the kind of material, amount of surface, and so on. There is the disadvantage of greater exposure to dirt, and the advantage of a continual change of the surfaces in contact. The remarks respecting bearings in a former place apply to such nuts ; cast iron is thought preferable to softer material. If made three diameters long and carefully "chased" out of hard cast-iron, they will wear for several years under constant and severe duty, and will not much wear a screw if the latter is kept reasonably clean.

Among the various methods of operating screw nuts, the one shown in Figs. 59 and 60 is thought to be as good as any known to modern practice. The objects to be attained are positive movement, rigidity when closed, resistance to side thrust, easy movement under pressure, economy of space, and the height at which the nut can be set in an apron. To these may be added cheapness and simplicity of construction.

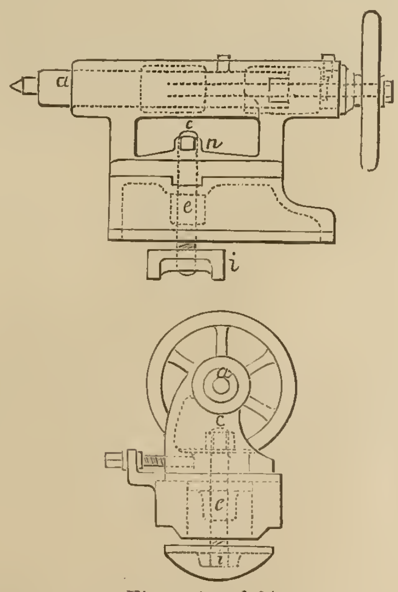
Referring to Fig. 60, the nut *a a* is mounted between two solid ledges or cheeks *c c*, cast in the apron, deep enough to embrace the nuts to the center *e*, Fig. 59 ; *o* is a cam spindle operating in two oblong holes as shown by dotted lines at *n* in Fig. 60. By turning the handle *m* a half revolution, the half nuts *a a* are opened or closed on the screw at *s*, and when closed as shown in the drawings are locked firmly. The thrust falls on ample flat faces at *n n*, so the nuts are easily moved under pressure. They are kept in position by the angle piece *i*, and may be easily removed by loosening this piece.



Figs. 61 and 62

The sliding heads of lathes have undergone more modification than any other part ; for the reason, no doubt, that such modification could be made without risk. In America sliding heads are always made with lateral adjustment, the purpose being to turn tapering pieces by setting the centers diagonally to the tool motion, and also to avoid the care and expense of securing alignment in two planes.

When a still spindle is made adjustable in a horizontal plane there is of course no care required to secure vertical alignment. This method of turning tapering work is one that has nothing but cheapness to recommend it, and will no doubt be abandoned when tapers become uniform enough to be produced by a few positive guides, or when lathes are arranged with compound rests having automatic feed.



Figs. 63 and 64.

At present the adjustable sliding heads are almost indispensable in American practice, and the fact is by no means a credit to that practice, showing as it does a lack of system respecting tapers, or else a want of proper machinery to produce them. Work turned with the centers set out of line is always imperfect, and the centers are soon destroyed. If a tool is set above or below the centers a curved form is produced. It is useless, however, to comment upon the matter, it is well enough understood. Two or three different degrees of taper will meet all ordinary requirements of engineering work, and such tapers can be, and are made, without setting pieces diagonally in lathes. At present the purpose is to notice some of the methods of making these adjustable sliding heads.

Figs. 61 and 62 show one of the most common forms for such heads. The top part *a* is arranged to slide on the box frame *c* ; the clamping screws *e e* moving in slots in the clamp *m*. The screws *n n* are to set the spindle frame *a* and hold it in position. This makes a tolerably stiff sliding head, where the proportions are heavy enough, notwithstanding the loose piece *a*. It is far from convenient for moving, however, two screws have to be loosened and the bridge *m* generally refuses to slide free unless dropped down some distance out of contact with the frame. The weakness of such heads is in the distance from *s* to *o*, or from the bolt *e* to *o*, which is the base for resisting upward thrust at the front. Another fault that may be mentioned in connection with these heads is, the spindle support does not project much beyond the front face of the head at *i*. This increases the distance the spindle must project beyond its supports, and is an element of weakness in working. Anything added to the sliding head beyond the face at *i*, reduces proportionately the extreme length a lathe will receive, or to state it another way, the frame must be made that much longer, but this is a saving in the right direction.

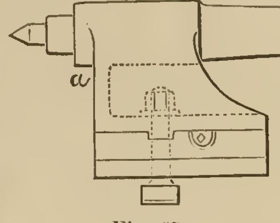


Fig. 65.

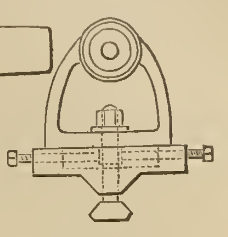


Fig. 66.

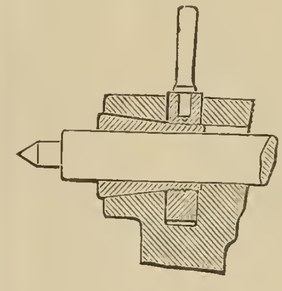


Fig. 67.

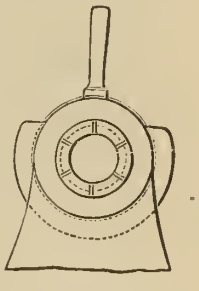


Fig. 68.

Figs. 63 and 64 show another form of sliding head having a spindle support beyond the front face, and fastened with one instead of two screws. The spindle *a* has two bearings, as shown by the dotted lines, and in that respect is much more rigid than when a single bearing is employed. The bolt *c* passes through a boss shown by dotted lines at *e*, so the clamp *i* is moved positively, and for that reason a partial turn of the nut *n* allows the head to be quickly moved or fastened. There have been quite a number of inventions looking to this same purpose, that is loosening or fastening sliding heads with one motion, but none of them possessing any advantage over a common screw bolt as shown.

Figs. 65 and 66 show another modification of adjustable sliding heads held by a single screw as in the former case, but open at the back, and with a thinner base piece. The want of projection at *a* is a common fault with all the heads noticed.

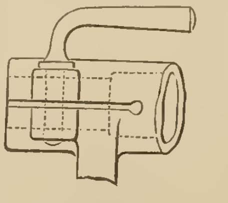


Fig 69.

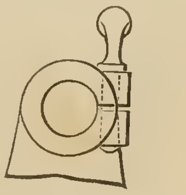


Fig. 70.

In Figs. 67 and 68 is shown in section a form of gripping collar for fixed spindles employed by a number of American machine tool makers. Considered mechanically it certainly answers the purpose of nipping a spindle, and if the range of adjustment required so elaborate a contrivance there could be no objection to it ; as it is, however, it is hard to see a necessity for so expensive a method of nipping a spindle when a split link, as shown in Figs. 69 and 70, will answer quite as well and not cost a fifth as much. Taking into account the awkward form of the casting required to receive the collar nut, Figs. 67 and 68, and the fact that the spindle is too loose when not clamped, it is questionable whether a split bearing is not preferable to any of the more complicated and expensive methods. The very slight movement required to nip a spindle that is well fitted prevents any dangerous strain or danger to a casting, and in respect to the "concentricity" of adjustment, it is certainly as good in Fig. 69 as in Fig. 67. Split conical bushes are perhaps the worst form of constructing compensating bearings for spindles, and the difference between revolving and sliding is not enough to make the method right in one case and wrong in the other.

I am well aware of how far these and many other opinions expressed in these articles, may differ from views held by others, and disclaim in the fullest manner any intent to disparage methods of practice that have been fairly accepted. The purpose is to arrive at the truth, as nearly as possible, irrespective of customs, opinions, or even precedents. This is the best way, or, as we commonly say, a "true" way, to construct all things, and that way when discovered is only confirmed by fair criticism. —*Engineering.*

AN ENGLISH HIGH-SPEED ROLLING-MILL ENGINE.

Our engraving represents a pair of English high-speed engines for rolling-mill service which present many points of interest to engineers. The *London Engineer,* from which we take the engraving, says:

"The maximum speed will be about 150 revolutions, and the piston speed about 1,200 feet per minute. With this object all the bearings have large wearing surfaces, and the momentum of the working parts is carefully counterpoised by balance weights secured by straps to the webs of the cranks. The cylinders are 36 inches diameter, and have a stroke of 4 feet; they are fitted with slide valves having the pressure partially removed from the back by a balance piston, and are worked by eccentrics in connection with a link of the Allan type. The reversing is effected by moving by hand the valve of a small auxiliary cylinder, so arranged that the piston cannot overrun, but follows exactly the movement of the hand lever. As will be seen from the engraving, the reversing lever, the steam valve lever, and the screw for opening the drain cocks are all arranged on a platform elevated to a convenient height to allow the driver a good sight of the rolls. These engines have recently been erected at the Blaenavon Steel Works, Monmouthshire. Messrs, Davy Brothers have done a good deal to promote the adoption of high-speed engines in rolling-mills by the excellence of their workmanship, design and material, and the engine we illustrate is a fair example of their work."

IRON GALLOWS-FRAMES FOR BEAM-ENGINES.

Iron gallows-frames for beam-engines have the singular disadvantage of conveying sound, so that it is difficult for the engineer to locate troubles when they arise. Where the pillow-blocks set iron and iron, any squeak resulting from cutting or abrasion of the journals is scattered through the frame, so that it is impossible to tell by the ear which bearing needs attention. The tubular construction of the legs and the sonorous nature of the metal composing it, or its susceptibility to vibration, all contribute to the evil mentioned. Sometimes a slack rivet will annoy the engineer for hours by squeaking, until, as a remedy, he feels like oiling the whole interior of the frame.

The pillow-blocks on iron gallows-frames should have a thickness of wood interposed between them and the frame, so that any sounds proceeding from the journals will be broken up, and in many boats recently built we believe this has been done.

A LOSS TO THE PROFESSION.

Mr. M. N. Forney announces in the last issue of *The Railroad Gazette,* that he has retired from its editorial management, but will contribute occasionally to its columns. We regard this as a serious break in the ranks of technical editors; these are already so few in number that no worthy men can be spared.

Mr. Forney has never allowed pecuniary interests to direct his opinions, and has been singularly fearless in his opposition to error wherever found. While we regret the necessity we commend his judgment in retiring when he found the strain beginning to tell upon his general health. No one has earned a better right to relaxation than he. Although personally strangers, Mr. Forney will, perhaps, permit us to wish him "surcrease from care" for all future time.

* * *

W. T. Comstock, 6 Astor Place, N. Y., has two new books in press which will be of considerable interest to builders. The first, *Hints on Drainage and Sewerage* is probably more freely illustrated than any other work on the same subject, as it contains over 300 cuts. The second is a new edition of *Powell's Foundations.* This work has been before the public for years, and has been very favorably received. In its new form it will contain double the original amount of matter and gives all the latest points on the subject, together with uses of cements, etc.

* * *

This is a Pretty Sentiment.—"Many establishments in prominent branches of trade, knowing the value of skilled workmen, seize on all they can get, pay good wages, and charge their customers accordingly. The average American is willing to pay so liberally for prompt service and good work that it is a wonder there is not more of it."—*Boston Commercial Bulletin.*

There is plenty of it. When a man wants a job to run your engine and press, and asks a price 25 per cent. higher than you would pay for some one who does not know his business, do you hire the good man or try to cut him down to the bad man's price? You do the last thing every time, because you know the worst is the cheapest. What a big thing common sense is!

* * *

We recently requested friends not to send postage stamps *except* for fractional sums, but by an error we were made to say, in one place, that we did not want them at all. We are always willing to receive stamps for small sums, but in many instances parties send one or two dollars worth, so that we accumulate large quantities in a short time.

* * *

An exchange says: "A boiler exploded in the saw-mill of Shipley Brothers, at Claypool, Ind., the supposed cause being low water. John Haddo was instantly killed, his head and one arm being torn off."

"Supposed cause" is refreshing. Maybe the supposition is that a man was killed! Supposition blows up lots of boilers.

* * *

How much do you make by postal notes for even sums? You spend time going after them, pay a premium for them, when you might quite as well put the bills in the letter at once. They betray their presence at once by the color and crispness of the letter, where old bills are not so easily discovered. They are stolen quite as readily, and are, in short, of very little use.

THE MECHANICAL ENGINEER FOR 1884.

In return for the many favors accorded us in the past by the trades we represent, we put forth renewed energy to merit a continuance of the good will shown. To this end we announce the following serials, which will appear in all of 1884

HOW I SERVED MY APPRENTICESHIP.

This will run through many issues, and is an account of an actual service by a mechanical engineer now in charge of work It deals with such matters as will be of interest to all in similar positions—not merely beginners, but others who have not had the fullest opportunities for informing themselves. The opening chapter takes a common wheel-press such as is in use in every locomotive shop of any size, explains its principles and construction, the action and how to calculate its power. The problems are all in simple arithmetic and quite within the reach of mechanics. The style is easy and in narrative, so that, aside from its intrinsic worth, it is very entertaining.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks, of the University of Pennsylvania, will, in a series of papers, touch upon various points in the construction of steam engines, rendering the principles involved in their action clear to all. These papers will be as useful to designers and constructors as to working engineers, for the author will not follow others and expound text books already published, but reason from his own deductions and observation.

BOILER MANAGEMENT.

Under this head, Mr. A. H. Goff, a practical engineer of St. Louis, Mo., will give his experience with boilers of various kinds, as to the care and course to be pursued to insure the best results. The author will consider the subject from a practical standpoint, so that persons in similar situations can apply the instruction conveyed if it seems good to them.

A SERIES BY H. L. STELLWAGEN, ESQ.

These papers cannot be announced definitely as to the title, but we have made an engagement with the author, who is an engineer of ability, to give our readers the benefit of his experience, and from his previous contributions we know that the writer will both interest and instruct us.

In addition to these positive announcements, we shall have many other short papers through the year, which will be of permanent value. The Indicator Series, now publishing, will be continued well into 1884, and all who wish to know what their engines are doing as well as inform themselves upon the use of an instrument indispensable in every engine-room, should not fail to renew for 1884.

Locomotive work will have special attention in construction and management on the road. The success which has attended the efforts of the publishers during the past year is evidence to them that their enterprise will be supported, and the very considerable outlay involved in the serial papers announced above—all of which are paid for—is some evidence of an intention to deserve the reputation for practical value to workers in its line The Mechanical Engineer has won.

Club Rates of
THE MECHANICAL ENGINEER.

Single Subscriptions	$2 00
Five Subscriptions, (each)	1 70
Ten Subscriptions, "	1 60
Fifteen and upward, "	1 50

(Payable invariably in advance.)

One copy free to the party who organizes a club of ten or more names.

Egbert P. Watson & Son, 150 Nassau St., N. Y.

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which, without exception, make a reduction in their rates in connection with us. All complaints of irregularity in receiving other papers must be made directly to the publishers of them, not to us.

	Publication Price per Year.	With The Mechanical Engineer.
Railroad Gazette	$4.20	$5.25
Scientific American	3.20	4.40
North-Western Miller	2.00	3.50
American Miller	1.00	2.75
Modern Miller	1.00	2.75
Builder and Wood-Worker,	1.00	2.60
Manufacturer and Builder,	2.00	3.50
American Machinist	2.50	4.20
Trade Review	3.00	4.50
North-Western Lumberman,	4.00	4.80
Mechanics	2,50	3.87
Cotton, Wool and Iron	3 00	4.25

Special Notice.—The rates on the *American Machinist* will not be accepted for old names. We have no arrangement with that paper, and can send it only to those who have never taken The Mechanical Engineer.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
W. Barnet Le Van, 3607 Baring Street, Phila,, Pa.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. John Becker, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering. Send for catalogue before purchasing. F. Keppy, Publisher, Bridgeport, Conn.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets. New York. Send for price list and catalogue.

New York : Weekes & Melville, Printers, 25 Beekman St.

THE MECHANICAL ENGINEER.

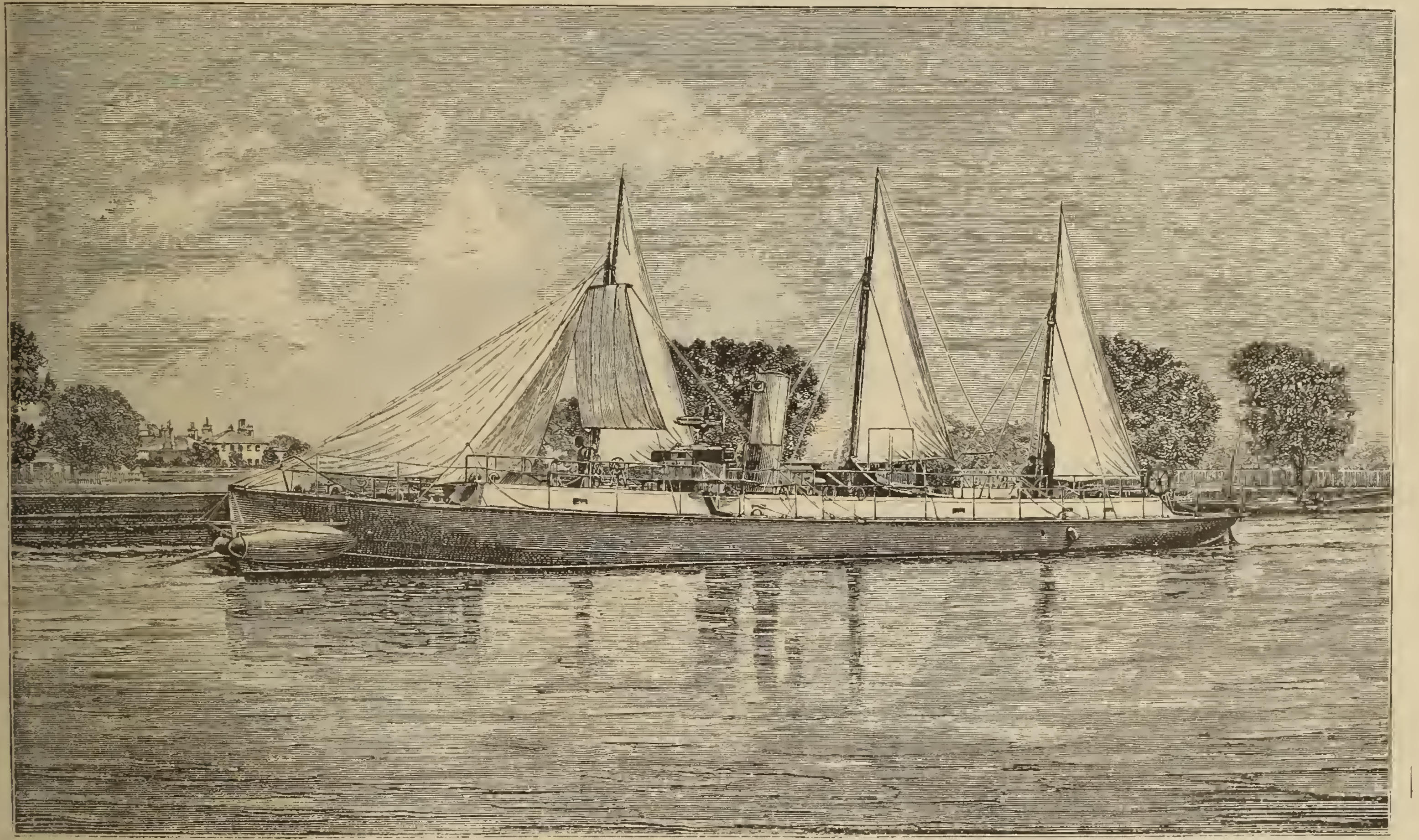
New Series. Vol. VII.—No 2.
Enlarged 1883.

New York, January 26, 1884.

Single Copies 8 Cents.
$2.00 per Annum.

NEW TORPEDO BOATS.

Our illustration shows a new torpedo boat, recently constructed abroad for the Danish Government, by the Messrs. Thorneycroft. While capable of very high speed, these vessels are also able to steam in almost any weather, and keep the sea under conditions quite unsuited, apparently, to boats of their dimensions and construction. The length is 113 feet, and the beam 12 feet 6 inches; the depth is 6 feet 6 inches: draught forward, 2 feet 6 inches; aft, 6 feet; displacement 60 tons. The hull is built of Bessemer steel, galvanized, and is divided into eleven water-tight compartments, the boat will float, with any one of these filled.



The engines are compound, 14″ and 24″, by 15″ stroke, guaranteed to develop 750 indicated horse-power. They drive a three-bladed propeller of forged steel, 5′ 7″ diameter, by 5 9″ pitch. Allowance is made for the "squatting" of the stern at high speeds, so the blade of the wheel shows above water when the boat is at rest; even at slow velocities the boat settles by the stern enough to immerse the wheel. The boiler is of the locomotive pattern, and has 1,119 square feet of heating surface; grate area is 30 square feet.

On trial, the boat made 19·506 knots per hour, with a boiler pressure of 130 pounds, revolutions 413 per minute; slip of screw 17·13 per cent. of the speed. It also made 104 knots, at 11 knots speed, on one ton of coal. These boats are guaranteed to run 1,000 miles, at 11 knot speed, on the coal they can carry.

The sail area is 1,000 square yards.

The armament of these boats is four 19 feet Whitehead torpedoes, 15″ diameter, and two single-barrel, 35 m m Hotchkiss machine-guns. The vessel is steered by steam, and was satisfactory in all respects to the contractors.

These details and the illustration are taken from *Engineering*.

⋈

THE ANNUAL MEETING of the American Institute of Mining Engineers will be held in Cincinnati, on February 20th, 1884. Dr. T. M. Drown, the efficient Secretary for many years, has resigned, and a successor is to be elected by the time of the annual meeting. There are several candidates in the field, but the most popular, and the one best deserving of election, owing to his fitness for the place, the time and energy at his disposal, and his excellent character, is Mr. Charles Kirchoff, M. E., formerly of the *Iron Age*, and now one of the editors of the *Engineering and Mining Journal*. Mr. Kirchoff has our good wishes in advance for the honor of the Secretaryship, which, we hope, will be his.

⋈

TWENTY-FIVE CENTS each will be paid for clean copies of No. 1, Vol. 5, if sent at once.

⋈

HOW CLOSELY CONTRACTS ARE CONTESTED in in England may be seen from the appended paragraph from the *London Engineer*. It says that a heavy contract for cutlery was out, and an old-established company, determined to see if price would carry the work, cut their quotations down to a merely nominal profit, in fact no profit at all. They lost the contract by 1s. per dozen. It was a big thing, being for ten steamers, but cheapness, even with the reputation of a great house against it, carried the day by the mere feather-weight of 1s. per dozen.

⋈

THE EXPERIMENTS OF WESTINGHOUSE with his well-known automatic brake disclosed the fact that friction between solid bodies at high velocities is not constant, as the experiments of Morin have been supposed to imply, but diminishes rapidly as the speed increases, which other observations serve to confirm.

⋈

HERE IS A SUGGESTIVE INQUIRY which carries its own moral. We quote from a contemporary:

> "C. Bros write: We use a tubular boiler, the flues of which are rather thin and weak; which method of cleaning the flues would be preferable—with steam from dome or with an iron cleaner? We wish to favor the flues as much as possible Carry about 20 lb. steam A. Clean with steam from the dome."

What a mysterious thing it will be when an accident happens!

⋈

A COMPLETE SET OF THE MECHANICAL ENGINEER in good order for binding can be had from No. 1, Vol. 2, to date.

PRESS DISPATCHES say that at a recent meeting of sorghum cane growers at Des Moines, all were very enthusiastic, agreeing that the day of cheap and good sugar from sorghum is near at hand. A dozen leading growers made exhibits of syrup and sugar, and stated that they had found the business pleasant, staple, and remunerative. They discussed freely the best methods of growing the plant and handling the product.

⋈

THE *Northwestern Miller* is to be credited with a handsome holiday issue of the first number of the year, containing all manner of good things for its friends. This is the best kind of a premium to induce subscribers to renew and to come in, better than the gaudy chromo or the seductive, seven dollar, silver Jurgensen chronometer.

LOCK NUTS.

The multiplicity of patents on lock nuts (jam nuts) is astonishing. Scarcely a week passes that some one does not invent one; the complication attending them is also remarkable. There are as many pieces—springs, triggers, dogs, etc.—in some of them as in a gun-lock, and they would be almost as costly. A recent device of this kind has a circumferential slot cut in the bottom of the nut for a quarter of the diameter; from the end of this slot is a radial one extending down to the bolt. In the circumferential slot is a spring and in the radial slot is a dog, and a little pin about one-sixteenth of an inch in diameter projects through the side of the nut where the wrench goes on, the whole forming a pleasing exhibition of mechanical sagacity and ingenuity. Meanwhile one nut on top of another performs the same office.

⋈

SOME MEN do many things, but none of them are done well, thereby earning the title of accomplished men. It is better to know one thing only, and know it thoroughly, than to compass many things superficially.

⋈

MUCH OF THE BLOTTING-PAPER in the market is well named, since it blots everything it is applied to; instead of an absorbent it is a diffuser of ink.

EXPLANATORY.

During the last volume we published rates at which we would receive subscriptions for various papers, among them the *American Machinist*. In those rates we discriminated between old and new subscribers, making a rate in favor of the latter which offended a great many old friends, who fancied we had given them the cold shoulder. Simply as a matter of policy this would have been a very silly thing for us to do, and, it is needless to say, we had no such thought. Our wish and intention was to introduce The Mechanical Engineer in quarters where it was unknown, and we therefore reduced its price to new subscribers with a view to their taking it on trial as it might be. Those who already knew The Mechanical Engineer, its objects and character, did not require it on trial and we could not afford any reduction of our regular price to them. If we had made such reduction it would simply have been a premium to the *American Machinist* Publishing Company, a concern we connot afford to give premiums to.

We regret that any one should have cause to complain of this action of ours, and beg those who consider that they have been slighted to charge us with a blunder rather than an intentional discourtesy. The rates are now alike to all, and those who are of a mild and forgiving disposition can still obtain the *American Machinist* at 30 cents less than the publisher's price by uniting with ours. This 30 cents is simply the *American Machinist* Publishing Co.'s commission to us, as their agents, which we present to our subscribers.

CAUSTIC POTASH AS A RE-EVAPORATOR.

In an interesting article on "Science and Engineering," *Nature* instances a recent discovery as follows:

"This invention rests on the curious fact that caustic soda, or potash, will absorb steam, forming a compound which has a much higher temperature than the steam absorbed. If, therefore, exhaust steam be discharged into the bottom of a vessel containing caustic alkali, not only will it become condensed, but this condensation will raise the temperature of the mass so high that it may be employed in the generation of fresh steam. It is needless to observe how important will be the bearing of this invention upon the working of steam engines for many purposes, if only it can be established as a practical success. If it is so established, there can be no doubt that the experience acquired will reveal valuable facts with regard to the conditions of chemical combination and absorption in the elements thus brought together."

We hope inventors will not impoverish themselves in making feed-water heaters on this principle.—Eds.

* * *

A faithful friend of The Mechanical Engineer in California is also an inventor of merit, and has succeeded so well in his efforts that he writes he is about to order a marble palace, steam yacht, and several diamond pins. He has proselyted to the extent of two hundred copies for The Mechanical Engineer, all "without fee or hope of reward," and this leads us to regard him as the central figure on the Pacific coast.

DIAGRAMS FROM A SLIDE VALVE ENGINE COMPOUNDED WITH AN AUTOMATIC ENGINE.

Editors Mechanical Engineer:

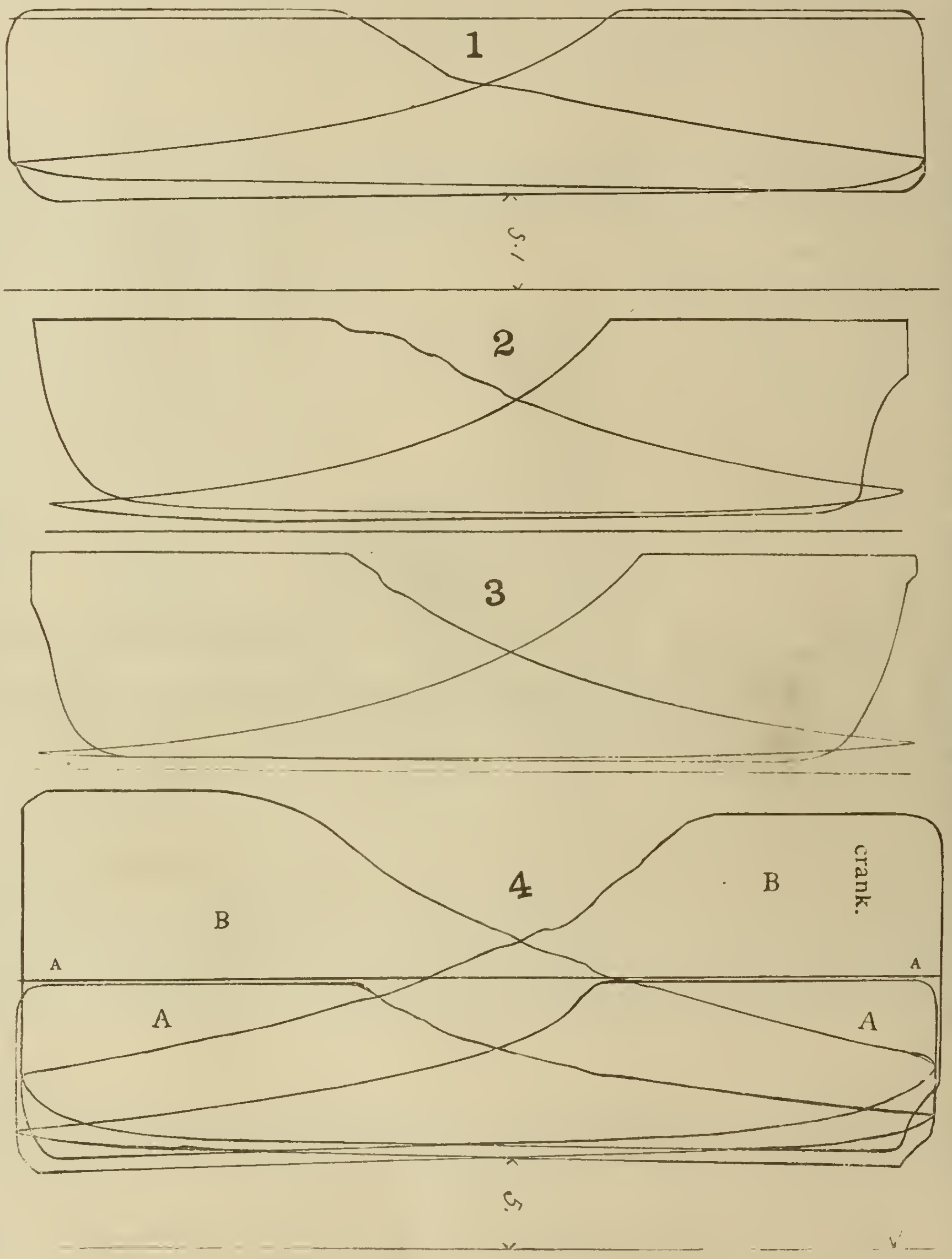
I send you diagrams from a pair of automatic engines recently compounded by the addition of a slide valve engine, which takes the exhaust from the former. Diagrams 1, 2 and 3 were taken within three minutes of each other, and when the load was nearly uniform. Diagram Number 4, *A A*, was taken just previous to putting on the dynamo machines which drive the electric lights. Number 4, *B B*, was taken just after the dynamos were put on, with an interval of scarcely five minutes between them.

From the low-pressure cylinder the steam passes into a heater and thence to a Knowles independent vacuum pump about 50′ from the engine.

Data of Diagrams Nos 1 and 4. Cylinder, 40×42·5; cut-off at 15″; revolutions, 88; boiler pressure, 40; vacuum per gauge, 20″; scale, 10.

Diagrams Nos. 2 and 3. Cylinder, 18″×42″; revolutions, 83; boiler pressure, 40; scale, 30.

The low-pressure engine, or the whole as compounded, was started on January 2d, and performance is acknowledged to be entirely satisfactory to all concerned. The compounding was done by William Coutie & Sons, Troy, N. Y., for the Renfrew Mill, Adams, Mass.



The Professor in the Machine Shop, in the last issue, I have read over and over again, for I perfectly agree with him, and have said the same thing in No. 3, Vol. 6, only in different words Another correspondent says—No. 2, Vol 6—"*compression can only be effected at the expense of power for in the act of compressing, power is taken from the fly wheel or moving parts.*"

I am satisfied that some engine builders make a mis take by using high compression and claiming a gain, for we have no proof of gain in any direction.

The "Professor" struck the nail on the head, and I wish he would do the same every time for the benefit of the craft

Troy, N. Y. Jacob H. Weller (*Caution*).

* * *

It is claimed that a process has been introduced in Australia for annealing iron castings by the use of a fluid bath; even chilled castings are softened by this process, and the tensile strength of the material improved.

AMERICAN CHILLED ROLLS.

In our last issue we mentioned an English chilled roll, recently made, which was very large, weighing no less than 14 tons We have the pleasure of recording in this issue an American chilled roll which is larger in diameter by two inches, and is cored out. From a friend we have an account of one just made by the Farrel Foundry and Machine Co. of Ansonia, who have successfully poured what is probably the largest hollow chilled roll in this country. It is 13 feet long on the face, 17 feet over all, and 30 inches in diameter, requiring about fourteen tons of iron to cast it. The effort required no little pluck, as a cored chilled roll is something new, and the Farrel foundry was the only one in this country that would undertake it.

* * *

Says *The Lumber World*: A want of correct knowledge of the natural figure and properties of the structure of wood, such as the oak, is constantly shown by the imperfect painting to resemble that wood, as exhibited on doors and shutters of houses. If we cannot afford to have genuine wainscot doors, but desire an imitation, it would be worth the trouble to have a block cut from the quarter of an oak tree, and have each of its six sides planed and polished, in order to exhibit their several features. The house painter would then see what nature really is, and thus save us from ridicule when we mix up "sliver grains" and all the other natural features upon one side of a board or panel.

The immense cost of machine patterns, and the care of them is well shown in the following paragraph from *The Northwestern Lumberman*: "A move recently inaugurated by E. P. Allis & Co. is a careful assortment and listed by number, of the patterns that have accumulated in the lofts of the establishment since its inauguration. These patterns number about 15,000, and may be said to represent a cost of fully $300,000. The task is a gigantic one for the reason that the patterns have been tossed about in the utmost confusion. The design of the company is to erect a building 200 feet long, 60 feet wide and two or three stories high, for the manufacture and store of patterns.

In what is known as the Arlberg tunnel, France, a singular obstacle has been encountered The tunnel pierces a mountain, and has been successfully driven for nearly three-fourths of the distance. In the remaining portion the engineers struck a sort of quicksand, which is renewed as fast as removed, and against which no shoring avails, the heaviest metal columns being bent out of shape under the enormous pressures. In the opinion of eminent European engineers who have visited it, the tunnel is an impossibility.

* * *

A complete set of The Mechanical Engineer in good order for binding can be had from No. 1, Vol. 2, to date.

* * *

Sorghum cane growers continue to hold meetings "out west" to discuss the prospects of the future, these being very bright in anticipation.

WHERE A REFORM WOULD BE SALUTARY.

A matter which needs reforming is the practice, too prevalent in some quarters, of giving three or more columns of fulsome praise to private schemes, under the pretence that they are new discoveries of great importance to the world at large. Some papers do this, and make the projectors of such enterprises pay roundly for the space occupied. We consider it an imposition to publish such matters at all. Persons who are not capable of forming opinions for themselves on technical subjects are often led to invest, to their ultimate loss.

Not long since, a prominent city paper published an article about a new sort of boiler which, upon the face of it, was a humbug to any one who had the slightest acquaintance with steam boilers. This article was copied all over the country, by editors who eagerly snap up everything that has a big head line over it and seems fruitful of future advertising.

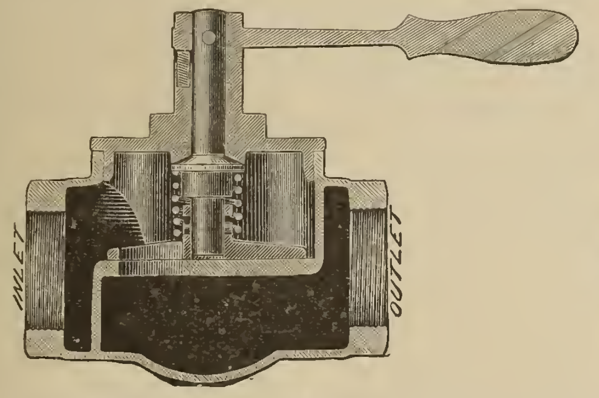
◆

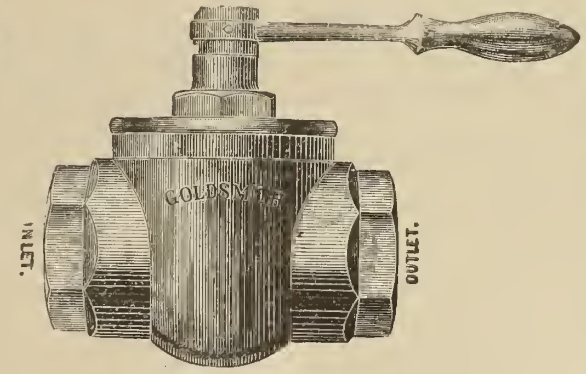
TWENTY-FIVE CENTS each will be paid for clean copies of No. 1, Vol. 5, if sent at once.

PHILOSOPHY OF SEPARATING CREAM BY CENTRIFUGAL ACTION.

There are few mechanical principles more widely known than that of so-called centrifugal force; an action which, though still a puzzle to students, has long been thoroughly understood. It is, however, comparatively recently that it has been applied in practice. The separation of cream from milk is an example.

In this arrangement the milk is charged into a vessel something of the shape and size of a Gloucester cheese, which stands on a vertical spindle, and is made to rotate with a velocity of 7,000 revolutions per minute. At this enormous speed the milk, which is the heavier, flies to the outside, while the cream remains behind and stands up as a thin layer on the inside of the rotating cylinder of fluid. So completely does this immense speed produce in the liquid the characteristics of a solid, that if the rotating shell of cream be touched by a knife it emits a harsh, grating sound, and gives the sensation experienced in attempting to cut a stone. The separation is almost immediately complete, but the difficult point is to draw off the two liquids separately and continuously without stopping the machine. This has been simply accomplished by taking advantage of another principle of hydro-mechanics. A small pipe opening just inside the shell of the cylinder is brought back to near the center, where it rises through a sort of neck and opens into an exterior casing. The pressure due to the velocity causes the skim-milk to rise in this pipe and flow continuously out at the inner end. The cream is at the same time drawn off by a similar orifice made in the same neck and leading into a different chamber.





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SOME FACTS CONCERNING INDIA INK.

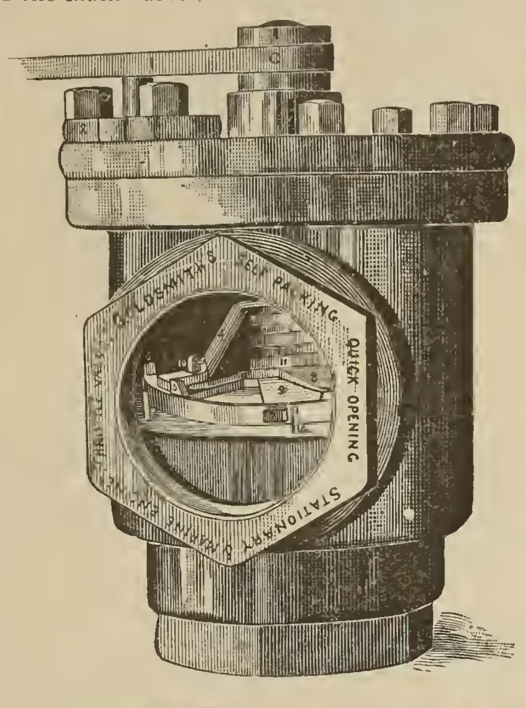
India ink is used the world over by engineers and draughtsmen, and but little is generally known concerning it. As to its ingredients it is composed of carbon, in one form or another, either animal or vegetable, very finely pulverized. This base, so to call it, is bound together with a soluble gum or glue. The best ink is made from pork-fat carbon, and the quality of the ink depends greatly upon the fineness of the carbon. This is added to the glue until it is a soft paste. A very little pea-oil is then mixed with it, and the whole thoroughly kneaded by hand. After being left to stand several days, it is pressed into cakes in wooden dies. The best India ink is slightly brown in tint; when jet-black, it is stated to be of inferior quality.

Good India ink improves with age, and should not be used for a few years after it is made. It is not easy to keep it, as it must be protected from moisture. Some persons, in rubbing it up, make circular movements that soon ruin it. It is better to rub it in straight lines back and forth with the least possible pressure.

◆

GOLDSMITH'S STATIONARY AND MARINE ENGINE THROTTLE-VALVE AND STOP-VALVE.

Our engravings represent a new form of throttle and stop-valve for use on all engines, whereby the labor of handling them and the engines is very much reduced. This end is secured by having a small auxiliary valve on top of the main valve; the first motion of the lever operates this and lets steam in under the main valve, thereby balancing the pressure and rendering the subsequent opening very easy. These valves are also self-packed, as shown in the section of the stop-valve above. This also has the same general arrangement and principle; one movement of the handle gives any amount of valve opening desired, from the least to the full area.



We believe the advantages claimed to be fully realized; the manufacturers offer to send valves on trial to responsible persons.

Manufactured by the Ashton Valve Co., 271 Franklin Street, Boston, Mass.

◆

WE ARE OF THE SAME OPINION.

An English contemporary, unknown, says, in relation to high speeds on railways, that some roads are fit for any practicable speed, except in some few places. At these bad spots high speed, if continued, is dangerous and accidents arise from such causes. It adds:

> "If a railway were perfectly smooth, even and straight, and if the line of draught of carriages passed directly through their centers of gravity, there would be no derailments. Indeed, with perfectly cylindrical tires, and a perfect equality of resistance at every point, flanged wheels would not be required except to provide against the action of the wind; because there would be no reason why a train once set fairly on the rails should be induced to leave them. In practice, however, there is no such thing as a perfectly even and smooth line of rails. The center of tractive effort does not coincide with the center of gravity. There are plenty of curves to be run over, and, in short, the road and rolling stock are both far removed from perfection."

All of which is singularly in consonance with what we have said on the same subject editorially.

◆

THOSE WHO HAVE SEEN a locomotive plunging through snow drifts, or driving through the open prairie with the mercury below zero, must have been struck with its exposed condition and loss of heat by radiation. Concerning this the *Railway Review* says: "The locomotive being in motion, coming in violent contact with fresh supplies of air, the loss of heat by radiation is necessarily greater than in any other class of steam engine, and a method of covering, by non-conducting materials which can prevent this loss, and present the least practical difficulties for removal, is a desideratum. The expense of a durable and easily-removable covering would be a matter of minor importance as compared to the saving of steam, especially when the great difference in temperature between high-pressure steam and the external atmosphere, a difference averaging some 300°, is taken into account.

◆

TRIPP'S METALLIC PACKING, recently illustrated in this paper, has received the formal indorsement of United States Naval authorities. A report says: "It required no adjustment after it was first fitted into position; it prevented any leakage; it automatically accommodated itself to any irregular motion of the rod; it required no lubrication; it kept the rod well polished, and after five months' use we find this packing in as good a condition as when it was first applied.

◆

WATER-LEG BOILERS of both marine and locomotive types are the least economical of steam generators. A few years ago, in Austria, an experiment was made of taking out the water-leg sides of locomotives and replacing them with fire-brick lining; the result was a saving of 25 per cent. Boats on the Mississippi, Ohio, and Missouri rivers use cylinder boilers set with fire-brick furnaces.

THE MARINE Engineers' Beneficial Association, Number 3, of Detroit, Mich., elected the following officers for 1884: President, Charles E. Solean, Esq.; Vice-Pres., W. F. Cullen, Esq.; Rec. Sec., Jas. S. Sargeant; Treas., Robert Stage; Financial Sec., Frank Kenyon; Corresponding Sec., John Galway; Chaplain, N. Johnson; Conductor, R. C. Ludlow; Door-keeper, A. Whitmore.

Delegates to the National Convention are W. F. Cullen and Jas. H. Reid.

◆

THE *Trade Review*, in commenting upon the many divisions of engineering and the improper application of the word, says:

> "Last, but not least, the most mysterious title of 'Traveling Engineer,' is applied to a gentleman connected with a Western railroad—though what that means nobody has yet been able to find out."

A traveling engineer on a railroad is one who goes from division to division, and exercises a general supervision of the runners. He gets on and off of locomotives all along the roads, listens to the drivers' complaints of defects, and sees whether they are just or not. He is generally one of the oldest men on the road, and his word is law in his province.

◆

HARPER'S MAGAZINE for January has an article descriptive of the old clipper ships, which were the pride of the country twenty-five years ago. It is an exceedingly interesting article, and those who would like to know what Americans did when they had an opportunity to show their skill as shipbuilders should read it.

ALIEN OFFICERS ON AMERICAN VESSELS.

A matter which is very prejudicial to the interests of American engineers and steamboat officers on the Lakes is that of licensing persons who are not citizens to perform the duties above named.

On the line of the United States bordering on Canada, and the Atlantic and Pacific coasts, a large proportion of aliens get their licenses as pilots and engineers by declaring their intention, but never becoming *bona fide* citizens; neither do they get full naturalization papers, for, as the law is now construed, any alien who may serve for six months in any capacity on board an American vessel (sail or steam) is entitled to declare his intention, and get his license as engineer or pilot: and his only residence in the United States is during the season of navigation, when he draws American money, and at the close of navigation goes to pay taxes to a foreign power. The Marine Engineers' Association is looking into this matter, and under the bill aliens will be granted licenses on announcing an intention of becoming citizens, but if this intention is not carried out on the fourth renewal, the license will not be allowed.

◆

WHAT MAY BE TERMED a singular accident recently happened in St. Louis when, according to a contemporary, "the back connecting rod strap gave way, causing the engine to run through itself;" jumped down its own throat so to speak.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

WOODEN VALVES FOR AIR PUMP BUCKETS, ETC.

Editors MECHANICAL ENGINEER:

In a former communication to you respecting the removal of grease from steam boilers I failed to mention that I had been using zinc in mine for over a year. I suspended plates in the water above and below the tubes, in order to destroy the galvanic action. I am now trying the remedy you have suggested, and will inform you of the results obtained.

I am obliged to keep the water in my boiler six weeks without changing, and of course it gets quite salt. I carry it from about two, to two and one-half density, and blow from the surface occasionally.

I have just had my boiler inspected and it was found all right. The repairs consisted of two rivets in the middle furnace, which for a year's outlay is not so very expensive.

My air pump valves have been giving me so much trouble, never lasting for more than a month or six weeks, that I substituted walnut wood for the gum, as the latter burned out. I have been using three wooden valves in the bucket six months, and they are as good now as the first day they were put in.

Bro. J. H. Reid states that he is not troubled with grease in his boilers, but he fails to say what kind of a condenser he is using. He may have a jet condenser, and be running in fresh water, in which case he would not have any grease. I use less than a quart of oil in twenty-four hours, all of which, except a small portion, finds its way into the boiler. What I want to do is to keep it out of there.

Thanking both you and Bro. Reid for your replies, I am, etc.,

MARION BELL,
OLD POINT, VA. *C. E., St. Pilot.*

[Zinc suspended in the water of a boiler remains neutral and availeth nothing. Bro. Bell must carry his injection pretty warm to burn out gum valves in the buckets in six months. It is a good failing, for india rubber is cheaper than coal, and the hotter the injection water is (and maintain the proper vacuum) the larger the coal-bunkers are. We hope others will favor us with their experiences aboard ship.—ED.]

◆

FROM ATCHISON ASSOCIATION, No. 1.

Editors MECHANICAL ENGINEER:

Being of a progressive nature, and seeing the benefit an association would be to engineers, I went to work and got up an association in this place, which, I am proud to say, is No. 1 of this State. Our title is "Atchison Association, No. 1, of Kansas."

We have thirteen members who are well pleased with its workings. Below is a list of officers:

Past President, Richard Hurd; President, R. G. Cheney; Vice-President, George Fishwick; Treasurer, Oscar Verden; Secretary, T. C. Logan; Conductor, John Stannard: Door-Keeper, Joseph Gilkinson.

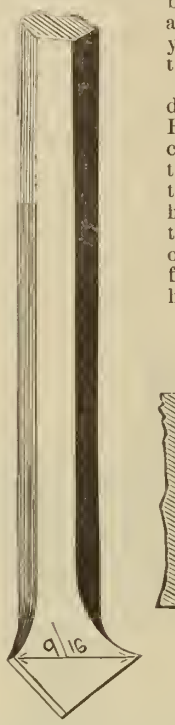
T. C. LOGAN, *Sec.*
604 T St., ATCHISON, KANSAS.

[We are glad to hear such an encouraging report from the West, and hope that Atchison No. 1 will double its membership in a short time.—EDS.]

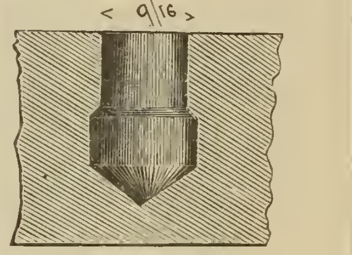
WABBLE DRILLS FOR CHAMBERING HOLES.

Editors MECHANICAL ENGINEER:

I notice in the *American Machinist* of Dec. 8th an article by John E. Sweet, on a "Wabble drill for chambering holes to be tapped," and also on tapping them. I send you a sketch of a tool I use for that purpose.



Drill the first hole the size and depth wanted, say 1 1-16 inch. Have a drill bit forged, as for a common drill, $\frac{1}{4}$ inch smaller than the hole wanted. Then flatten out the point for cutting, having one side a little fuller than the side of shank. The other side to be enough to allow for grinding to the size of the hole when finished.



I make the starting tap point $\frac{3}{8}$" blank, the size of the hole below the threads, with the grooves running clear through to allow the oil and chips to lead in. This acts as a guide, and if the holes have been carefully drilled, as they should be, the studs or bolts will stand straight with the face of the work; at least I have never found any trouble.

NEW YORK. WM. H. BUTLER.

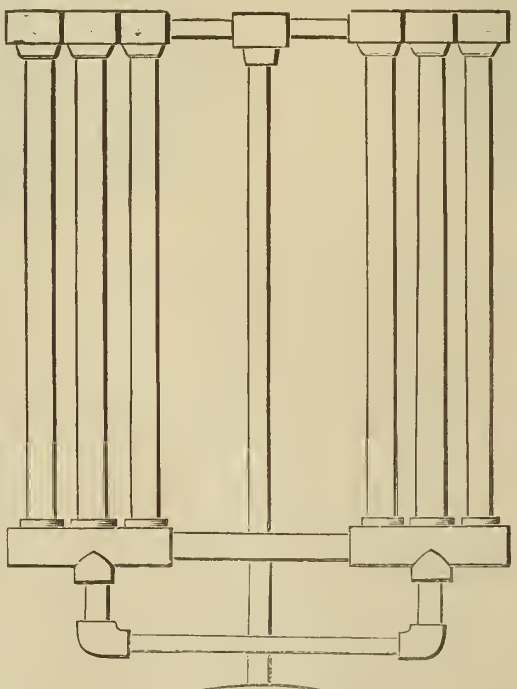
◆

A QUESTION ABOUT HEATERS.

Editors MECHANICAL ENGINEER:

Will you be kind enough to answer me a question about steam heating, and help me out of a difficulty. I have set a boiler for the above purpose, and it backs water in the return-pipe, above the water-line. The return is eighteen inches above the water-line in the boiler. The main pipe is two and one-half inches diameter, and the separate drips are one inch diameter. The main return is one inch and one-quarter.

The rig works passably well at one pound pressure, but if the steam goes over that it backs up in the return. I would like to know how to rig this arrangement to carry five pounds. There are no openings anywhere to the atmosphere except the usual air-valves.



The arrangement is shown in the sketch. It lies horizontally, and the boiler is supposed to be eighteen inches below it.

I like THE MECHANICAL ENGINEER very much. It answers questions right to the point. I have probably received more instruction from it than any other paper.

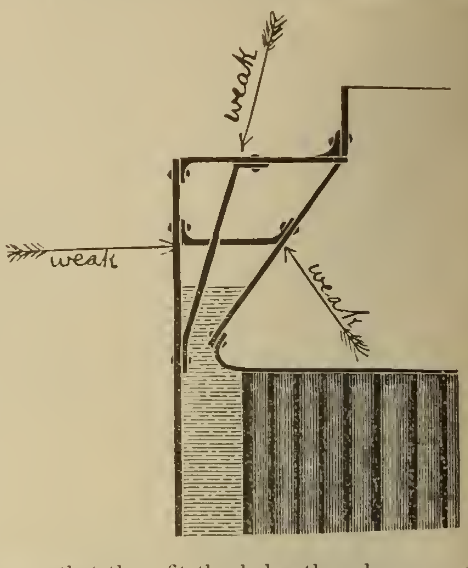
PHILADELPHIA, PA. HEATER.

◆

BOILER BRACES.

Editors MECHANICAL ENGINEER.

The vertical boiler in your issue of December 29th, Vol. VI. is no doubt a very good one, but I do not like the shape of the braces. I cannot see where the strength comes in. It looks hinge-like to me. I think it better to put braces in with a crow-foot and yoke. Some boiler makers are not careful to have the braces draw properly: if they only get the pin entered it must go in. One brace may draw up, and the next the reverse way. I would prefer to put in braces with bolts and nuts; see that they fit the holes, then draw up, and you will not come far out of a good pulling brace.



Driving sharp-pointed pins in a bad-fitting brace, then splitting the pin, is like peaning out holes for $\frac{3}{4}$ inch rivets; they squeeze to $\frac{5}{8}$ths. Splendid job (to look at) after being finished and pointed.

H. G HILL, *Chief Engineer,*
NEW YORK. Old Dominion S. S. Co.

◆

THE MARINE BOILER OF THE FUTURE, WHAT IS IT TO BE?

Some time since the writer read in your journal with much interest an article by Richard Sennett, Chief Engineer of the Royal Navy, England, upon the weight and difficulties with the present type of marine boilers as used in most of the transatlantic steamships. In the article referred to many of the disadvantages of internally fired Scotch boilers are pointed out, but little or nothing is said of the source to which we are to look for relief, in this difficult problem, which resolves itself into this—how are we to get a marine boiler that will carry 150 to 200 pounds of steam, with a factor of safety not less than six, and not weigh more than forty pounds per foot of heating surface ready for use? To do this we require a large furnace area, utilizing the entire width of the boiler front, and to insure economy the heat of the furnace should be transmitted through as thin sheets of metal as a factor of safety of six will justify, and with no joints or riveted seams in the fire or heating surfaces. With such a boiler, carrying 150 to 200 pounds of steam, the greatest economy ever obtained commercially on the sea would be assured.

The great weight of the present type of Scotch boiler is due to the thickness of the shell and furnaces, which have to be constantly increased in thickness in direct proportion to the enlargement of the shell and the increased pressure it is intended to carry. These conditions have made it necessary to increase the thickness of the outside shell until many of the boilers now in use are an inch and an inch and a quarter thick, which requires the riveting to be done by power or hydraulic riveting-machines. These, from the concentration of pressure between the dies forming the rivet-head, too frequently causes bulges or cracks in the edges of the plates.

As early as 1876 the iron shipbuilding firms of Denny & Company, of Dumbarton, Caird & Co., of Greenock, R. Napier & Son, D. W. Henderson & Co., David Rowan, of Glasgow, J. Scott Rowan, of Greenock, and John Elder & Co., of Glasgow, petitioned the Right Honorable Sir Charles B. Adderly, President of the Board of Trade of London, for a modification of the rules for the construction of marine boilers by reducing the factors of safety from six to five or even less in certain instances. The petition also set forth that "while the rules of the Board of Trade are adapted to insure the safety of the public, they should not unnecessarily harass trade, and thus impede the progress which might be naturally expected from the unfettered action of individual enterprise and ability." The receipt of this petition was acknowledged by the Board of Trade and some suggestions made in reply, but there the matter was allowed to rest from that time—June, 1876. We suppose the reason to be in the fact that the standard steam pressure then in use was about 60 pounds, and English engineers found relief by constructing the shells of their boilers of steel, which reduced the thickness from about 1", when made of iron, to about $\frac{13}{16}$" when made of steel. The constant tendency to increase the pressure of steam and the size of the boiler as well, to meet the increased size of the ships built, has finally brought the weight of marine boilers, per square foot of heating surface, up to a point which seems to be alarmingly heavy, unless some other type of steam generator is adopted that will carry greater pressures upon less weight of material. We quote from *Engineering*, Nov. 9th, referring to the recently adopted or new rules of the English Board of Trade:

> "Soon after the new rules had been issued, it became apparent that still higher pressures would shortly be required, and to obtain accurate data on which to found any further alterations of the rules, the Board of Trade had carried out, at the suggestion of Mr. Traill, a series of valuable experiments on large examples of riveted joints suitable for employment in high pressure marine boilers. The series of tests were made by David Kirkaldy, and an examination of the data they affor led led to conclusions which are given by Mr. Traill as follows:
>
> "'The average strength of iron boiler plates in the direction of, and across the fiber, is about 21 tons and 18 tons per square inch respectively; thick plates are as strong as thin plates, but less ductile. Thick lapped joints are very much weaker than thin ones, owing to the severe cross-bending action which is set up when in tension; thick joints of every description are proportionately weaker than similar thin joints. The strength of the plate between the rivet-holes of both thick and thin joints is less than an equal section of the solid plates. Joints with wide pitched rivets are not so strong in proportion to the quantity of metal left between the rivet-holes as joints with closer pitched rivets. The strength of punched single riveted joints was only about 13 tons per square inch of the metal left between the rivet-holes. Double-riveted drilled joints, in which the rivets were arranged zig-zag, fractured in the zig-zag line unless when the net plate-section in that line was at least six-fifths of the net joint-section in the direct line.'
>
> "As soon as these conclusions had been definitely arrived at the Board of Trade rules were again altered, the tensile strength of 21 tons and 18 tons (in the direction of and across the fiber respectively) being taken for the boiler-plates instead of the former assumed strength of 23 tons per square inch; the factor of safety for first-class shells being reduced from 6 to 5. The effect of these alterations was to increase the highest working stress allowed in the net section of the plates from 8,586 lbs. to 9,400 lbs. per square inch. The Board of Trade rules as thus amended are still in force."

In view of the foregoing facts it now seems to be a matter for consideration among English engineers (outside of the Board of Trade and the Scottish shipbuilders), whether the factor of safety—5—is not too small for use in any marine boiler—since engineers are constantly confronted with the danger which is likely to result from retaining such immense volumes of steam and hot water in one envelope composed of a single sheet of metal, which is the case in all Scotch or cylindrical boilers, the weakest part of which determines the factor of safety. The volume of water and steam thus carried within a single shell of the boilers of ocean-going steamers is sufficient, if once liberated by accident or otherwise, to produce the most serious results, and some missing steamers have undoubtedly gone to the bottom from this cause. Recognizing these facts it is now a matter of great concern among engineers in America, [and judging from the recent thorough discussion to which we refer as emanating from the greatest of English mechanical journals, viz., *Engineering* in Europe also, that some type of marine boiler be introduced that will enable engineers to increase the pressures of steam to 150 lbs. with safety, upon a reduced weight of material, with increased economy of fuel and greater carrying capacity for freight.

The method clearly open to the accomplishment of this desirable result is in the direction of a water-tube or sectional boilers set in furnaces *lined with brick, or other refractory material*, for these have been shown advantageous and highly economical on coast steamers during the past years. This class of boiler has another advantage of prime consideration over all forms of shell-generators, viz., in positive water circulation or a current that insures the keeping of all parts of the boiler at an even temperature. In using steam at high pressures on shipboard, where the boilers are all massed together, it is essential for safety that those of a sectional type should be used, for they are the easiest to repair, not only under ordinary conditions of wear but under circumstances of abuse and neglect.

The heating surfaces of sectional tubular boilers, being made to lie transversly to the currents of the heated gases of the furnaces, are more efficient than an equal amount of heating surface in the ordinary cylindrical or tubular-boiler. These conditions, coupled with positive circulation, tend to make water-tube boilers most rapid generators. Evaporation depends not only on the quantity of heat applied to the surfaces of a boiler, but on the quantity taken from them; the amount of evaporation consequently depends upon the rapidity with which the cooler atoms of water obtain access to the heated plates. At the same time they insure larger factors of safety than can be obtained in boilers of the shell type, which must ultimately give engineers and steam users more ease of mind than they enjoy when using boilers of the shell pattern.

THREE STARS.

"DETROIT" ANSWERS "THREE STARS."

Editors MECHANICAL ENGINEER:

In answer to the communication of "*Three Stars*," in your issue of January 12th, concerning the boilers of the new cruiser, *Chicago*, I wish to say that since writing the criticism on the engines of that vessel (which criticism you did me the honor to publish), I have taken a little trouble to satisfy myself concerning the class of boilers to be used in her. I reach a different conclusion from your correspondent, *Three Stars*, and do not hesitate to put myself on record as in favor of them and being certain of their success.

Seeing in your paper that the steamer *Louisiana*, of the Cromwell Line, had boilers similar to those proposed for the *Chicago*, I came down to New York on purpose to look at her, and was fortunate enough to find her at the dock. Mr. Huckins, the Chief Engineer, gave me every opportunity to make a thorough investigation. When I went aboard it was eight o'clock in the morning, the boilers having been blown out at six on the previous evening. I saw five out of the eight in the ship opened at the lower man-holes, and I must say they were as clean as any boilers I ever saw, the tubes being scarcely whitened with scale and the iron over the furnaces quite clean.

I own to having had a slight feeling of doubt as regards the brick furnaces, expecting to find them more or less damaged and injured by slice-bars or fire-irons, but I will own that I was wrong. Mr. Huckins told me that the newest one of the furnaces was a year old, but there are no signs of the oldest ones having been rebuilt or renewed, except when it became necessary to repair the boiler itself, a socket-bolt, for instance, or such a matter. These fire-bricks are set simply on the grate-bars, not upon good foundations, and it is surprising that they could withstand the pitching and rolling and handling of the fire as well as they have. As nearly as I could observe on hasty inspection, these boilers had originally about 16,000 feet of heating surface in all. Now, by taking out the water-legs, nearly 2,000 feet were lost. The original grate surface was 376 square feet; it is now only 312 square feet. Yet, with the lessened heating and grate surfaces, the same work is done upon eight tons less of coal per day, and I think I am safe in attributing this saving to the brick furnaces. Mr. Huckins, and the firemen as well, assured me that they had no trouble whatever with the boilers or furnaces, and had no instructions or directions from the owners or from the resident engineer of the line respecting them.

Mr. Editor, you have my name and know something of my record, and can testify that I have no object in writing this except to bear honest testimony to the value of brick furnaces, the *London Engineer* "to the contrary notwithstanding." I would be willing to go anywhere on the face of the globe with this arrangement, and I am sorry to see a sensible American engineer agree with a mere opinion formed abroad, as *Three Stars* says he does.

Looking at the matter from the same aspect as *Three Stars*, and in reply to some of his points, I would say that Mr. Huckins told me the boilers had been in the ship four years. During this time heat has been applied to the outer shells of them, and there is neither "blister nor buckle;" they are quite free from anything of the kind.

The shells are $\frac{9}{16}$ths of an inch thick, and there are three girth-seams in each of the furnaces where there is one in the *Chicago's* furnaces. Four years' experience shows that they are as good as when first put in. So they cannot "burn out in a remarkably short space of time." Aside from these facts concerning the *Louisiana's* boilers, there are thousands of furnaces in use $\frac{5}{8}$ths of an inch thick, joining tube-plates $\frac{3}{4}$ths of an inch thick, where the products of combustion are discharged through the contracted openings over the bridge-walls, which must naturally intensify the heat, locally, far more than the arrangement of the *Chicago's* boilers. These having much freer exits in this respect, are easier on the iron.

Let me say that so far as I can gather from reading the specifications of the *Chicago's* boilers, as published in the *Proceedings of the Naval Institute Magazine*, that they seem to hold about eight tons less water for the same grate and heating surface than the average boiler of the same class in steam vessels; the destructive effect would therefore be less, not greater, as *Three Stars* claims, in case of an accident.

Now, in reference to the quotation from Mr. Richard Sennett, I understand him to mean that the difference in expansion between the hot furnaces and comparatively cooler shell wears the boiler out. In his own words:

> "When the boilers are under steam, unequal and unknown strains are brought on material by the expansion resulting from the heating of the furnaces."

Has *Three Stars* not observed that this quotation is singularly inapplicable to the *Chicago's* boilers, from the simple fact that the furnaces have no connection with the boiler, and one cause of anxiety is removed? I consider this is one of the best features of the *Chicago's* boilers.

As to circulation and the dangers likely to arise from it, all that *Three Stars* says certainly arises from want of experience. Boilers exactly similar in type are in use all over this country, particularly out west, where we use very small domes. There is no trouble from wet steam. As to his "two direct rising currents," that sounds like the arguments of sectional boiler advocates—of this type there is not one afloat.

What *Three Stars* says about superheaters may or may not apply. I see no special reason to condemn or approve of this detail. It perhaps serves to distribute or carry the products of combustion safely through the ship. Mr. Huckins, of the *Louisiana*, told me that the steam fell about one pound between the boilers and the engines, which would imply some superheating as the pipes are not very well protected.

In conclusion, I must, as an unbiased judge, say that *Three Stars* has not made a point, though perhaps he was "guided by the light of the (his?) best practical experience." I would rather have the actual experience of working engineers and shipowners than all the cut and dried opinions that could be carried in the *Great Eastern*. One may sit in a chair and be chock full of the spirit of prophecy, but log-books and account-books will show the fallacy of them every time. Neither do I care two straws for the designers of the *Chicago's* boilers, or the *Louisiana's* boilers, except in so far as the principle is concerned. These gentlemen are strangers to me and are likely to remain so. Seeing the opportunity to get a little information at my own expense, I have taken advantage of it and do not regret it.

DETROIT.

A COMPLETE SET OF THE MECHANICAL ENGINEER in good order for binding can be had from No. I, Vol. 2, to date.

THE

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No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required until Jan. 1st, 1884, but should be in our hands by December 1st, 1883. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

FICKLENESS OF PUBLIC OPINION.

Formerly, when the Government had need of new vessels for any purpose, their designs and construction were made, and in many instances carried out, in Government yards. Whenever these plans miscarried, if the ships were slow, and the engines expensive and inadequate, the great and general public set up a hue and cry through the press, and said it might have been expected. Government officials—the public said—had had but little experience, comparatively; were reckless of cost, and from the nature of their positions, autocratic and unfit to make navies. The argument advanced was that the Government should call in outside talent, and avail itself of men of practical business ability in the designing of new ships and machinery. In this event success would be certain.

Precisely this thing has been done in the construction of the new cruisers and dispatch boats ordered by Congress. A naval advisory board was created, the members being selected in part, from civilians who had carried on their several professions as a business, and who had mercantile reputations—perhaps professional is a better term—of a high order. Henry Steers is a shipbuilder of life long experience, whose hulls float on every sea. No one has ever questioned his ability from any aspect. Miers Coryell (both of these gentlemen are members of the board), is a mechanical engineer of high standing, as we stated in our last issue. Mr. Alexander Henderson is a Chief Engineer of the Navy, with an unimpeachable record. Admiral Shufeldt and others need no shoring at our hands. It is safe to infer that the two first named gentlemen still retain possession of their faculties, and that the same skill upon which they have won reputations, and for which merchants pay them at this day, has not suddenly taken the wings of the morning and flown to the uttermost parts of the earth.

Judging from the tenor of criticisms published, this is the case. The Naval Advisory Board have chosen the time when they stand before the world—in a great measure—to introduce "pet schemes," and ride hobbies of a refractory and vicious character. Instead of seeing that the opportunity is a great one to add further luster to their reputations, they are accused of foolishly risking all they have taken a life-time to acquire, on some perilous scheme of more than doubtful possibility. We submit that this is not human nature, and that the criticisms passed upon their performance, so far as it has gone, are premature and ill-timed. Curiously enough, the adverse opinions have all come from foreign sources. An expression of disapproval in a foreign contemporary has been caught up by home journals, and made much of. No newspaper published in this country has criticised the ships or engines adversely from their own knowledge of details, but the opportunity has been seized by some to retail ready made opinions at second hand.

We have no more interest in the Naval Advisory Board than any other citizen has, but we have as much of the spirit of fair play as most men, and we would like to see an exhibition of it in this instance.

MARINE BOILERS.

The attention of marine engineers is directed to the inadequacy of the present marine boiler for the increased duty demanded of it, and they are endeavoring to adapt other types to the service in question. The able discussion of this matter in another column of this issue will be read with interest by all concerned, and it may be, hasten the change, which, sooner or later, will be made.

Briefly summarized the immense weight entailed by the thickness of iron necessary for the large shells, has become a serious evil, and practically bars the way to higher pressures, for the shells are as heavy now as they should be. Also, the thickness of the fire-boxes or furnace-flues is another existing evil, for by reason of it, the transmission of heat to the water is impeded.

The problem presented for solution is by no means simple and the most experienced engineers do not hazard predictions as to what the marine boiler of the future will be. Their ideal takes the form of small tubes or shells, made of ordinary boiler iron or steel without large furnace-flues, and with no shells of great diameter, but the disposition of these for the purpose in view demands the very best engineering ability. We shall be glad to hear from all who have had experience in this line; discussion may aid the solution materially.

ROBERT MACFARLANE.

There died recently in Brooklyn a man of singular gentleness and moral worth; his name adorns the caption of this article. Robert MacFarlane was for many years the editor of the *Scientific American*, and it was our good fortune to be associated with him upon that paper twenty-three years ago.

To him more than any other one person is due the prominence it enjoys in the patent business, for in its earlier years it was he who drew the specifications and urged upon its proprietors the growing importance and great business to be realized by prosecuting it. His predictions were realized, but of the vast business which he helped to create he never received aught above a very meagre salary.

Robert MacFarlane was a Scotchman, quiet and unobtrusive, without a personal enemy, and for one not brought up to mechanical pursuits, of singularly correct and clear insight as regards new inventions and industrial schemes He predicted the failure of the caloric engine as applied to marine purposes, and his opinions were verified; in many other discussions of lesser note he came off victorious. In his later years, after his resignation of the editorship of the *Scientific American*, he traveled some and wrote for a weekly paper in this city.

Robert MacFarlane was a man of singular probity and sweetness of disposition. No man that ever lived was less aggressive in manner or speech. In view of this, the peroration to an article in the *Scientific American* is ungenerous and uncalled for. To wit:

> "Mr. MacFarlane was a man of exalted moral character, and his integrity was probably never suspected by any one who was acqainted with him."

Why "probably?"

He certainly never wrote any anonymous letters, but always expressed his opinions in an open, manly way. To write an obituary notice of a former associate and then asperse his memory by saying that his integrity was "probably" never suspected, is a novelty in remembrances of of this character.

> "Green be the grass above thee,
> Friend of my earlier days;
> None knew thee but to love thee,
> None named thee but to praise."

If some one would write an article on the mutations of paragraphs and their ultimate destiny, it might be interesting. Some twelve months ago we copied a few lines from a foreign contemporary upon the matter of wetting coal before firing. This showed a loss of useful effect. In the new dress we gave the paragraph our foreign contemporary immediately reprinted it, considering possibly, that our version added a new interest to it. Since that time this same trifle has been printed almost from Maine to Georgia, and from the Atlantic to the Pacific. It bids fair to become a tramp paragraph, handed about from press to press, but popping up ever fresh and new in the places least expected. One can scarcely have too much of a good thing.

RESPECTING HIGH SPEEDS ON RAILROADS.

An impression prevails widely that the demand for higher speed on railways arises chiefly from the peculiar recklessness of our people rather than from any legitimate need. We think this is a mistaken view, and that high speeds are a necessity of the time. The telegraph and the telephone fill their places in the business of the country, and the fast passenger train is as much of a necessity as either. The sharp competition for first place, the ambition to lead, to stand in the front, which characterizes Americans demands that every available moment be utilized. "Time is money" in the fullest sense of the word, and while electricity can convey the spirit and the letter of transactions, weightier ones require the actual presence of individuals. This can only be brought about by some system of transportation, railway or steamboat, hence the demand for higher speeds on both.

As a matter of fact speeds are not high in this country and it is not to be wondered at that travelers demand greater dispatch on trunk lines. For short distances rapid runs are made, and knowing this the average traveler frets and fumes when he is delayed, or when he is not carried two thousand miles at the same rate that he is conveyed one hundred miles. The modern traveler is an autocrat. Topographical, or mechanical difficulties are nothing to him; he simply clamors for higher velocities regardless of risk, expense, or anything that may stand in the way of his desire. We believe that if trains were announced to leave for Chicago tomorrow, guaranteed to make the time over present roads at 100 miles an hour, at double the usual fare, passengers would flock to them in crowds.

Engineers know full well what stands in the way of satisfying the demand discussed, and they know, also, that the speeds at present attained are as high as can be expected without some radical changes in the character of the roads themselves. These have not been built with reference to any higher velocities than forty miles an hour, and very many are not adapted to that. The locomotive engineer of the day simply makes a series of spurts over any given road when running at a high velocity. He rushes down grade at breakneck pace only to be brought up standing by a hill to be climbed at half the speed, and the measure of his lineal advance, in time, is exactly the average of these velocities, with the disadvantage that it has cost far more in money to accomplish it than a higher speed on a level road would have. Thirty miles an hour up grade and sixty miles an hour down grade is equal to only forty-five miles an hour on a level for given distances, but the straight forty-five miles would be much cheaper than the crooked forty-five.

If rapid transit is a necessity of modern times then to attain it a beginning must be made at the bottom, and railway managers must give railway engineers straight and level surfaces to run upon. Then the power now existent would be ample to *average* sixty miles an hour, and even higher, with less expense than lower average speeds now cost. If it is urged that this is costly work to undertake, that filling grades, straightening curves, and building solid stone bridges where they are needed, practically dismisses the subject, we may answer that attempting high speeds with the present railways is simply spending money without attaining the object.

THE BUSINESS ASPECT.

In all communities, great and small, there are individuals who from temperament or mental constitution, are prone to look upon the dark side of things; who so soon as the springs of their prosperity cease flowing abundantly, sit down and declare that the world has come to an end; that darkness is over the face of the earth. Such persons are known by the general title of pessimists, and they are not pleasant company. Aside from this aspect, pessimists are injurious to the general welfare of communities, for they imbue many others with their own views, and timorous persons are apt to feel that hereafter seed time and harvest will both fail. So they would, if the pessimist's philosophy prevailed. There would be neither corn nor wine in the land, for these things come not spontaneously, but only abundantly when the earth has been made to yield them.

Our own trades are not free from this class of the community, and it is certain that they do injury when they proclaim that the springs of industry are dried up, and that there will be neither buyers or sellers abroad this year, for the facts are to the contrary.

Our commercial contemporaries, whose lines of trade lead them to investigate such subjects carefully, and without bias, for or against, have discovered that the condition of trade is quite as satisfactory as could be desired or expected. There is no tremendous inflation or rush for goods of any kind, but in every quarter there are schemes of greater or less magnitude on foot, and orders are by no means wanting. Especially is the iron industry in a healthy condition, and as this is a staple, and indicative of the state of trade, it is a most encouraging sign.

The coming summer will doubtless witness a great advance in one direction, and that is in the cultivation of sorghum for the production of domestic sugars. The feasibility of making sugar from sorghum is so well attested that it is a settled fact. In time it will unquestionably become a staple industry, and add another source of trade to all connected with our line of business.

A moderate and temperate view of the situation as regards business for 1884, even at this early period, shows that there is abundant reason for believing that it will not fall behind average years. If all will go to work and endeavor to prosecute their several interests with energy and intelligent effort, January 1st, 1885, will show satisfactory balances.

TALKS ABOUT THE STEAM ENGINE.—No. VII.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

Steel is growing into more general use among engine builders. As used for machinery it has a different significance from tool-steel.

The steel used by English mechanical engineers is very ductile, will stretch from 10 per cent. upwards before rupture, turns off in long thin curls in the lathe, will not harden in water after being heated, and may be welded if skilfully handled. In almost every characteristic, save fracture, it resembles wrought iron of a very superior quality.

Its fracture is granular, however, and when treated with dilute acid, its homogeneity is proved by the absence of fibrous structure.

Steel, which is very hard, and is without ductility, is not safe to use as it is liable to snap at any moment.

With ordinary wrought-iron, piston-rods will fail by either crushing or buckling. With the characteristics mentioned above, steel piston-rods will fail either by pulling apart or buckling, but not by crushing.

TO DEDUCE THE DIAMETER OF A STEEL PISTON ROD.

Take the square root of the initial pressure in lbs. per square inch; multiply this by the diameter of the cylinder in inches. Divide this product by 95·24. The result will be the diameter of the piston rod in inches.

Taking the same example as before we have:

95·24) 202·37 (2·12
19048

11890
9524

23660

A steel piston-rod should have one inch and a half of diameter for every foot of length, or its tendency to rupture by buckling will be greater than its tendency to pull apart.

Since the stroke is four feet, we see at once that we must proportion this rod to resist buckling.

Take the fourth root (the square root of the square root) of the initial pressure in lbs. per square inch. Take the square root of the stroke in inches. Take the square root of the diameter of the cylinder in inches.

Multiply these three quantities together and divide their product by 28·41. The result will be the diameter of the piston-rod in inches.

Taking the same example as before:

28·41) 98·406 (3·47
8523

13176
11364

18120

Therefore the diameter of the steel piston-rod should be 3½ inches.

Since the lengths of the wrought-iron and steel rods are the same, the volumes of the rods will be proportional to the squares of their diameters, and the steel rod will have but 90 per cent. of the weight of the wrought-iron rod, when both are equally strong to resist buckling.

In the case of the rods to resist rupture by tension, or compression, the steel rod will have but 34 per cent. of the weight of the wrought-iron rod.

It will generally be found, however, that wrought-iron rods will have to be calculated to resist crushing, and steel rods to resist buckling, in which case there will be no considerable diminution of weight attained by the use of steel.

Most of the rules given by Bourne and other writers, are blindly copied from the dimensions of existing engines, and frequently result in trouble. The designer should refuse to slavishly copy his antiquated examples.

Bourne never is quite right, or even so with approximation. In newer styles of engines his rules are dangerous, as giving weak members, and in old styles, while he may be on the safe side, one is never sure of it.

A reason why empirical rules, giving the diameter of the piston-rod as a constant fraction of the diameter of the steam cylinder have had some success, is because this fraction is usually so large as to cover the highest steam pressures in use, and because the diameter of the piston-rod increases as the square root, or as the fourth root of the steam pressure, and directly as the diameter of the steam cylinder.

A good many different metnods of fastening the piston-rod to the piston-head are in use. Some make a shoulder on the rod and place lock-nuts on the other side of the piston-head.

A slightly tapered end, with a nut, or nuts, to draw it home makes a solid job. A tapered end, riveted over, so as to hold the piston, makes a solid and permanent job when well done.

When the piston is not in one piece, a key driven through the rod and hub of the spider gives a firm junction and enables the removal of the end when necessary.

Any untruth in the guides or any wear which is not taken up will spring the rod and throw much stress on the gland.

If the crank-pin is not true it may show itself by a regular thump on the guides, which, of course, means spring in the rod.

HOW I SERVED MY APPRENTICESHIP.

BY GEORGE SLOCUM.

NUMBER II.

"This curved arm here enables the operator to lengthen or shorten the stroke of the plunger. When there is great resistance to the ram—as, for instance, in pressing on a driving wheel—this end of the connecting rod is slipped out here nearly to the end of the arm; then the power applied to work this plunger has greater leverage, but the stroke of the plunger is lessened, consequently the ram does not advance as far at each stroke as it would, if the rod were moved close up to the plunger, which would lengthen its stroke and cause it to throw more oil into the barrel at each stroke. This pulley up here is 18 inches in diameter. Here is a safety valve, weighted to—let's see—yes, 100 tons. Now in case that gauge should get out of order, and no one knew it, and the pressure was run up to 100 tons, and the gauge should show only 60 tons, this safety valve would tell on it, by opening. These big castings and rods which go to make up the press, are not made so by guesswork, or because iron was plentiful and cheap, but their sizes and shapes are the result of careful calculations regarding stress and strains, something we won't bother about now, but which you can read up after a while in books on machine construction.

"You understand what I have told you so far?"

"Yes, sir; I think I do."

"Well, now, we'll do a little figuring. Here you see this plunger, it's ¾ths of an inch in diameter; how would you go about finding its cross section area, I mean the area of its lower end?"

"Why I would reduce ¾ to a decimal fraction, that is ·75; then I would square it, that is, multiply it by itself; that would give me ·5625, and this multiplied by ·7854 would give me the required area; that is, ·44178750 of a square inch."

"Very good. What's that ·7854; where did you collar that?"

"Why that's a constant number; that's the area of a circle when its diameter is a unit or one, and I used that to take the corners off the square, produced by multiplying ·75 by ·75, and to change it into a circle."

"Correct!"

"Now, here is this ram, it is 7½ inches in diameter; how would you proceed to find its area?"

"I should change the common fraction, ½, to a decimal; then put down 7·5 and proceed as before."

"I see you are partial to decimals."

"I use them whenever I can, instead of common fractions, because in addition, subtraction, etc., I save time and labor, treating them as I would whole numbers."

"Could you find the area of this ram by any other method?"

"I could multiply half the circumference of the ram by its radius, and get a like result, but the other way is just as accurate, and I don't care to tax my memory with more than one rule for each operation in arithmetic."

"You see this 1,000 pound mark on the gauge is about ⅛th of an inch ahead of the 20 tons mark, and we will call it equal to 22 tons. Now 22 tons are equal to 44,000 pounds, the pressure on the ram when the pointer is at the 22 tons mark—or about where it would be if made. The area of the ram is equal to 7·5 × 7·5 × ·7854 or, 44·178+square inches. Then 44,000 pounds divided by the area gives 1,000 pounds per square inch, nearly.

"Again, if we multiply the area by 1,000 pounds, and divide the product by 2,000 pounds or, 1 ton, we get 22 tons, nearly. So that tons pressure is on the whole area of the ram, and pounds pressure on each square inch of the area. Suppose we were pressing on a truck-wheel and the pointer indicated 22 tons pressure; this would be equivalent to a weight of 22 tons placed upon the wheel were the axle standing upon end. But in this case 22 tons pressure would not have the same effect, as it would be only dead weight, and would lack the "*impact*" given to the ram by the fluid at each stroke of the pump-plunger. In summing up the pressure on the ram, an allowance must be made for friction, the weight of the ram itself, also the weight, or resistance of the counter-weight, which draws the ram back into its chamber.

"What is the secret of the great power of these hydrostatic presses?"

"There is no secret about it, it is perfectly plain, it is owing to the enormous leverage obtained. It is as though you had a very long stout lever, and the fulcrum close up to the load. Not only this but water or oil being only slightly compressible impacts on the end of the ram, as you would spring on the end of a long lever to start a heavy weight. If you want to post up on hydrostatics get Steele's '*Fourteen Weeks in Natural Philosophy*,' which is an elementary work, low priced, and easily understood without the aid of a teacher."

"There is one thing more I want to call your attention to," said Jones, "and that is, the advance of the ram for each down-stroke of the plunger. As the area of the ram is to the area of the pump plunger, so is the distance moved by the plunger to the distance moved by the ram. We found the area of this ram to be 44·178 +square inches; and the area of the plunger ·4417 + square inches—its stroke is 6 inches—now, take this piece of chalk and figure out the advance of ram for each double stroke of plunger, or what is the same thing, for each revolution of this 18 inch pulley."

"I can do it by proportion, this way:—As 44·178 is to ·4417 so is 6 to the answer," said I.

"All right; go ahead; let's have the work," said Jones.

"Well, ·4417 multiplied by 6 equals 2·6502, and this divided by 44·178 gives ·0599 + of an inch."

"How much is ·0599 of an inch; how can you read that on a common two-foot rule?"

"I can't, as it is; but I can find its value in common fractional parts, and then I can read it on a rule."

"Well, let's see you do it."

"How fine do you want it?"

"Make it sixteenths."

"Well, ·0599 multiplied by 16 equals ·9584, so it ain't a sixteenth."

"Try thirty-seconds," said Jones.

"All right, ·0599 multiplied by 32 gives 1·9168; that is one 32d, and $\frac{9168}{10000}$ of a thirty-second; pretty close to a sixteenth of an inch."

"So now you see that when this lower end of the connecting rod is moved close up to the plunger, so as to give a six inch stroke, the ram will move *nearly* a 16th of an inch for each downward stroke of the plunger. Then, of course, according as this rod is moved away from the plunger, its stroke shortens and the power has greater leverage, but the ram advances a less distance for each downward stroke of the plunger."

"Do you understand?" said Jones.

"Yes, sir, I understand that clearly."

"Very well, its getting late; let's go home, and to-morrow evening we'll tackle this press again and be done with it. Good evening."

"Good evening, Mr. Jones."

(*To be continued.*)

THE STEAM ENGINE INDICATOR AND ITS USE.—No. 8.

BY WILLIAM BARNET LE VAN.

DIVISION OF THE OUTLINE DRAWN BY THE INSTRUMENT DURING A REVOLUTION OF THE ENGINE.

The diagram, Fig. 12, published in No. 1, current vol., shows all the lines that would be traced by the pencil of the indicator during one revolution of the engine, assuming the action of the steam to be nearly theoretically correct. In order that the student may better understand the subject matter, the following names have been given to the lines represented as follows:

The line from *i* to *k*, the admission line.
" " *k* to *e*, the steam line.
" " *e* to *f*, the expansion line.
" " *f* to *d*, the exhaust line.
" " *d* to *h*, the back pressure, or line of counter pressure.
" " *h* to *i*, the compression and lead line.

Of these divisions, the first four are drawn during the forward stroke of the piston and until it is at, or very close to, the termination of its stroke, and the last three are drawn during the return stroke.

ADMISSION LINE.

The admission line, *i k*, shows the rise of pressure due to the admission of steam to the cylinder. This line is generally very nearly vertical, and when this is the case it shows that steam of nearly boiler pressure is had at the commencement of the stroke while the piston is nearly stationary. Should this line incline forward and, as shown at *B* in figure 7, or at *k* in diagram 11, curve with the steam line the reverses indicated; or should this line continue vertically beyond, and then suddenly drop to the level of the steam line, it signifies that the steam is wire-drawn, and cannot keep up the full pressure as the piston starts forward; but should this line, after projecting above, be suddenly depressed below the level of the steam line, vibrating back and forth one or more times on the latter line with acute angles of return, it may be attributed to the momentum of the reciprocating parts of the indicator while running at very high speeds, this will be hereafter more fully explained.

THE STEAM LINE.

The steam line, *k e*, is traced while the steam is being admitted to the cylinder, and should be nearly parallel to *B C*, and is invariably several pounds pressure below it; this loss in pressure occurs from radiation and friction in the pipes from the boiler to the cylinder. This line also represents the initial pressure acting on the piston up to the point of cut-off, and should be of unvarying height to show that full boiler pressure is maintained. It also shows at its termination the point at which the valve closes, or steam is cut-off.

To maintain a proper steam pressure in the cylinder depends, of course, in the first place upon the amount of steam port area, it will be noticed in diagram, Fig. 6, taken from a Corliss engine, that the piston obtained nearly the full boiler pressure at the very commencement of the stroke. The initial cylinder pressure was 97 per cent. of the pressure in the boiler; while in the diagram, Fig. 11 (fitted with the ordinary slide-valve and the steam controlled or regulated by a valve in the steam pipe), the maximum cylinder pressure reached but 88 per cent. of the boiler pressure, notwithstanding the slower speed of the engine, the former making ninety, and the latter but forty revolutions per minute.

An important consideration in connection with the admission of steam is that the maximum cylinder pressure be fully maintained until the closing of the valve; in other words, that the steam line traced by the indicator, should, as much as possible, run in a horizontal direction. (See diagrams 6, 8, 10 and 12.) To effect this, it is necessary to have the steam-port fully uncovered early in the stroke, so that the steam can be rapidly introduced into the cylinder. Referring to the above mentioned diagrams, we find that the steam-line is kept well up to the boiler pressure, and this pressure is nearly fully maintained until the point of cut-off is reached. If we take into consideration the small amount of lead obtained in these cases, we must attribute the comparative good results solely to the employment of Corliss and Buckeye valves which permit—with a smaller amount of angular advance of the eccentric—a very rapid and good introduction of steam.

In locomotive engines the diagrams taken with a high rate of expansion, more particularly at high speeds, the steam line generally falls more or less during the period of admission, indicating that the steam-port opening is too small.

THE POINT OF CUT-OFF.

This takes place at *e*. In the theoretical diagram the corner is abrupt, but in practice it is more or less rounded. The diagram does not always show clearly the exact point where the convex curve of the rounded corner changes to the concave curve of the expansion line, but the point of cut-off is properly located at the point where the direction of curvature changes from convex to concave.

THE EXPANSION CURVE.

This is represented by the line *e f g*, and results from a fall of pressure due to the expansion of the steam remaining in the cylinder after cut-off takes place. The actual curve, as drawn by the indicator, will be above the theoretical curve laid down by the law of Boyle and Mariotte's law. That is to say the pressure is inversely as the volume, and the curve which expresses the pressure, for every point of the stroke is an equilateral hyperbola. In all indicator diagrams, a material difference will be noticed between the true ratio of expansion and the corresponding pressures; the amount of departure of the actual pressures from the theoretical curve bearing, however, a certain relation to the degree of expansion, as will be seen hereafter.

There are various causes which produce this action during the period of expansion, but their precise influence is more or less difficult to ascertain. In the first place, leakage at the valves or past the piston is, of course, calculated to alter the actual expansion curve.

The effect of leakage, if such occurs, is generally easily detected by the irregular form of the indicator curves. The main cause of the peculiar action of the expanding steam is due, according to a large number of experiments made, to the heat given off by the cylinder to the contained steam after its communication with the boiler has been cut-off. This condition is facilitated by the presence of a certain quantity of water, which at the commencement of the expansion has the temperature of the live steam, but as the pressure is reduced in the cylinder this water will be instantaneously evaporated, and thus abstract from the cylinder a certain amount of heat. The heat absorbed with such rapidity is sufficient to raise the pressure considerably above that which would have existed had no condensation and re-evaporation taken place. The amount of heat which can be absorbed depends, of course, upon the difference of temperatures between the steam and the metal.

On the other hand the mean temperature of the cylinder is influenced by the amount of protection against radiation and conduction of heat from the cylinder, by the amount of "throttling" from the boiler to the cylinder, by the extent to which expansion has been carried, and by the speed in revolutions per minute.

When the communication between the boiler and the piston is open, the cylinder will acquire a temperature practically the same as that of the boiler pressure, and if the cylinder contained nothing but dry, or superheated steam, this temperature would probably be maintained for the greater part of the stroke; but owing to a certain amount of water which has been deposited in the cylinder, and which is re-evaporated at the expense of heat imparted to the cylinder, this latter will become materially cooled by the time the piston has reached the end of the stroke.

From these considerations the relative effect of the various degrees of expansion and of speed will readily be appreciated. As the degree of expansion is increased the quantity of water converted into steam becomes also greater, necessitating, however, a larger condensation of high pressure steam during admission; and the longer the duration of the stroke. In other words, the slower the engine is running the more heat will be absorbed from the cylinder by the conversion of this water into steam.

* * *

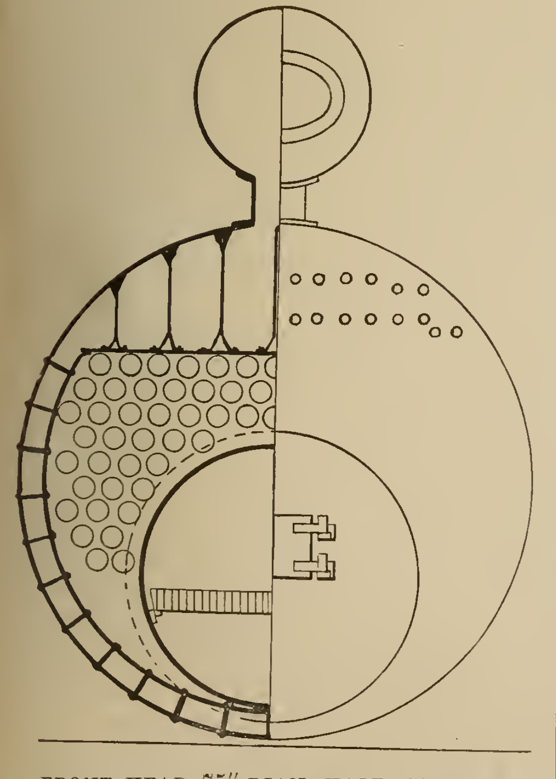
TYPES OF AMERICAN BOILERS.

NO. III.—MARINE BOILERS.

We continue our illustrations of steam boilers and give herewith details of one form of a marine boiler which is much liked in some localities. Concerning it, our correspondent says.

"The end course of shell and back smoke-box sheets, and furnace or main flue, I have laid out. In so doing it is best to have a blackboard and draw a diagram of front, with back smoke-box, braces, tubes and flanges on flue.

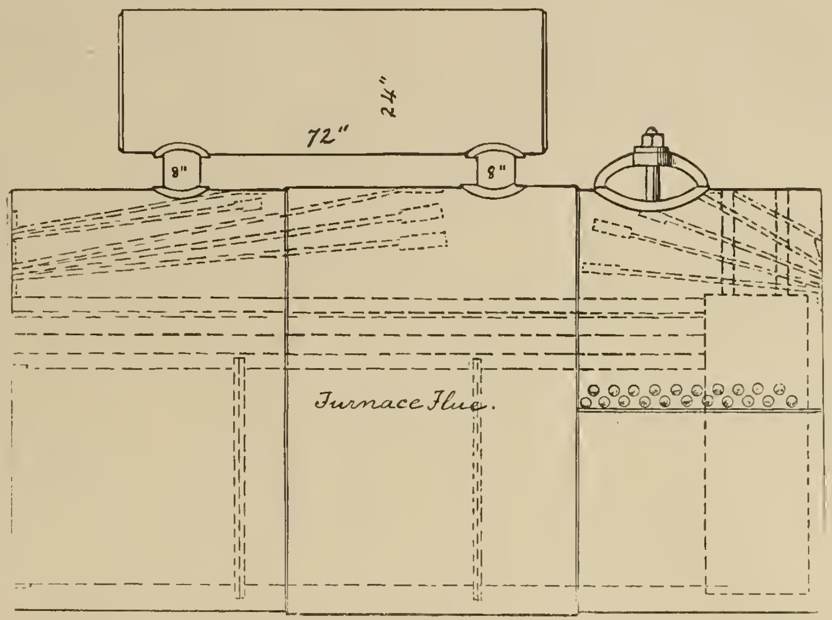
"In laying out the stay-bolt holes, divide the inner circle, or smoke-box, into the distances the stay-bolt holes are to be apart, then strike lines from the center, cutting the shell. Now, by taking a steel rule or a piece of thin hoop-iron and bending it to the curve, the layer-out can get the exact distance of the holes; he can also get the position of the braces by dividing the crown into as many parts as he wants braces, laying the square on and drawing lines cutting the shell, then take the rule or hoop-iron bent to the curve and mark the centers, laying them out on the sheet.

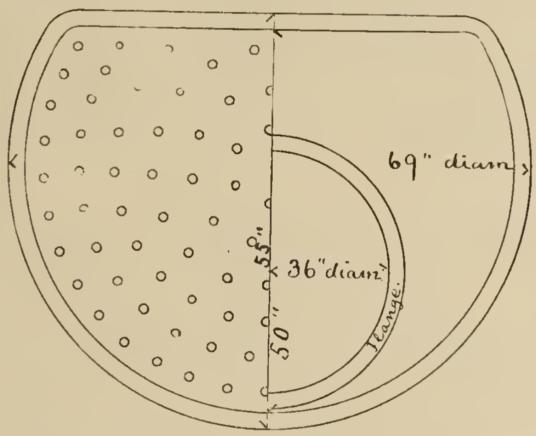


FRONT HEAD 75" DIAM. HALF IN. IRON.

"In making the flue for this boiler the courses are butted together with flanges and a ring $2\frac{1}{4}'' \times \frac{1}{2}''$ between, so that they can be caulked inside the flues. By using a "fuller," it can be fullered out to each course, caulked, and chipped and caulked to ring on the outside, and by keeping the horizontal seam well down below the grates there will be no rivets near the fire except at the smoke-box, or back connection. It is best to have both front head and tube-sheet of the smoke-box flanged for the flue to enter.

"The dome is $24'' \times 72'' \times \frac{3}{8}''$, with two wrought-iron (or boiler-plate) connecting-pipes, 8" diameter.





"The boiler is $72'' \times 144''$. It requires four plates, $117\frac{1}{4}'' \times 49'' \times \frac{7}{16}''$; two plates, $118\frac{1}{2}'' \times 49'' \times \frac{7}{16}''$ for the shell.

"Flue requires one plate $117'' \times 43'' \times \frac{1}{2}''$; two plates, $117'' \times 41'' \times \frac{1}{2}''$; 2" flanges on flue.

"There are 96 tubes, $3'' \times 120''$.

"Back smoke-box sheets are:

"One sheet, $20'' \times 138'' \times \frac{3}{8}''$.

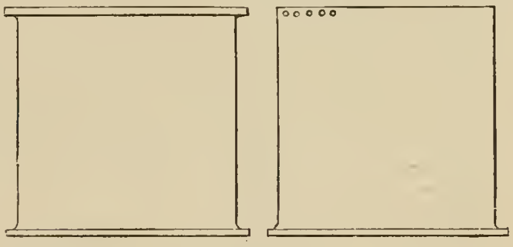
"Crown sheet, $20'' \times 63'' \times \frac{3}{8}''$.

"Two heads, 75" diam. by $\frac{1}{2}''$ for shells; two, $69'' \times 55'' \times \frac{3}{8}''$, half shown on same diagram.

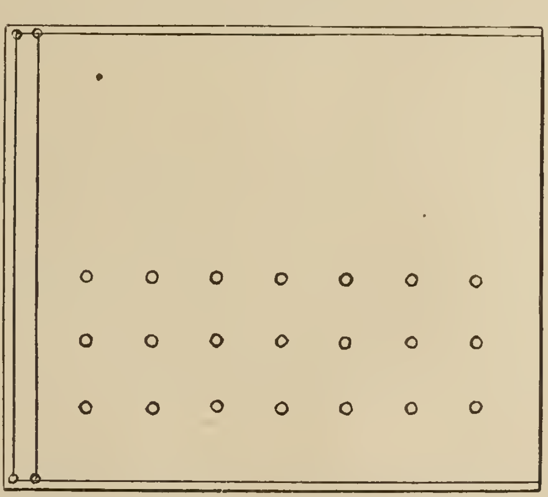
"Two dome-heads, $28\frac{1}{2}''$ diameter.

"The two end-courses of the boiler are 72" inside; large course, $72\frac{7}{8}''$ inside. On iron as heavy as that, I allow $1\frac{1}{4}''$ from edge to center of hole for $\frac{3}{4}$ rivets.

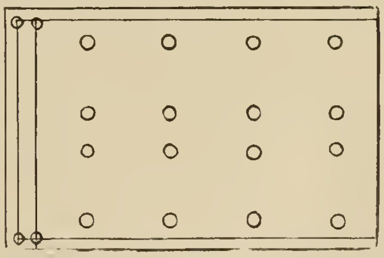
"In getting the distances of stay-bolts and brace-holes on the shell-sheet, lay out the holes on the smoke-box sheet first, and add the water space, thus: From line of edge-holes on smoke-box sheet to line of stay-bolt holes is 3". Then on the shell sheet (as there will be 4" water space) the line of stay-bolt holes will be 7" between stay-bolt holes and edge-holes.



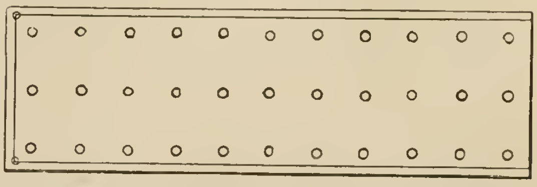
FLUES 38×37 OUTSIDE DIAM., ROLLED AND FLANGED.



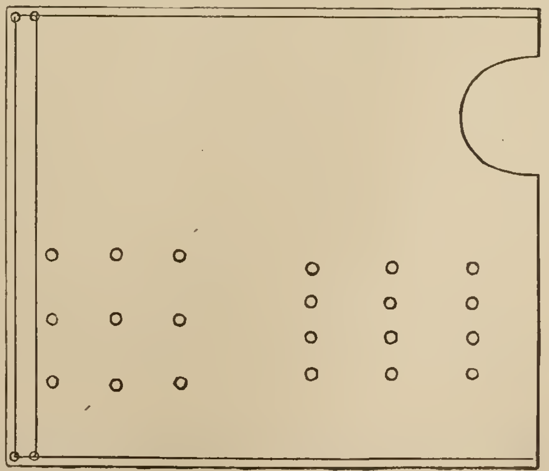
ONLY HALF OF THIS SHEET IS HERE SHOWN. WHOLE LENGTH AND WIDTH IS $117\frac{1}{4} \times 49\frac{7}{16}$THS.



BACK SMOKE BOX CROWN. ONLY HALF OF THIS SHEET IS SHOWN. SIZE OF SHEET IS $63'' \times 20''$.



BACK SMOKE BOX SHEET. ONLY HALF OF THIS SHEET IS HERE SHOWN. WHOLE LENGTH IS $138'' \times 20''$.



ONLY HALF OF THIS SHEET IS HERE SHOWN. WHOLE LENGTH IS $117\frac{3}{4} \times 49\frac{7}{16}$THS.

"The great thing in laying out a boiler is to get, and work from, the center. You may say that this advice is superfluous, but there are lots of so-called boiler-makers that work by guess or have templates made for them by the pattern-maker to work by. Sometimes they fit the boiler up piece by piece, punching their stay-bolt holes or caping them out.

"I do not want any such work done for me, and I do not believe the engineer-readers of your paper do.

* * *

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* * *

WHENEVER YOU SEE A METRE MENTIONED as a measure of length that means, in English dimensions, 3' $3\frac{3}{8}$ths inches. A decimetre is $3\frac{15}{16}$ths inches; a centimetre is $\frac{25}{64}$ths; a millimetre is $\frac{3}{64}$ths.

FRICTION EXPERIMENTS.

III. RESULTS OF EXPERIMENTS.

In the earlier experiments care was taken not to load to the bearing up to seizing, in order that the condition of the brass might not be disturbed.

In the later experiments, the bearing was intentionally loaded up to seizing.

Two sets of experiments were specially made for the purpose of ascertaining the greatest load which could be carried with rape and mineral oil in the oil-bath. The greatest load carried with the rape oil was 573 lbs. per square inch, and the greatest load carried with the mineral oil 625 lbs. In both of these cases the experiment was repeated after the brass had been taken out and scraped up, but with no better result.

The general results of the oil-bath experiments may be described as follows: The absolute friction, that is, the actual tangential force per square inch of bearing, required to resist the tendency of the brass to go round with the journal, is nearly a constant under all loads, within ordinary working limits. Most certainly it does not increase in direct proportion to the load, as it should do according to the ordinary theory of solid friction. The ordinary theory of solid friction is that it varies in direct proportion to the load; that it is independent of the extent of surface; and that it tends to diminish with an increase of velocity beyond a certain limit. The theory of liquid friction, on the other hand, is that it is independent of the pressure per unit of surface, is directly dependent on the extent of surface, and increases as the square of the velocity. The results of these experiments seem to show that the friction of a perfectly lubricated journal follows the laws of liquid friction much more closely than those of solid friction. They show that under these circumstances the friction is nearly independent of the pressure per square inch, and that it increases with the velocity, though at a rate not nearly so rapid as the square of the velocity.

The experiments on friction, at different temperatures, indicate a very great diminution in the friction as the temperature rises. Thus, in the case of lard oil, taking a speed of 450 revolutions per minute, the co-efficient of friction at a temperature of 120 deg. is only one-third of what it was at a temperature of 60 deg.

A very interesting discovery was made when the oil-bath experiments were on the point of completion. The experiments being carried on were those on mineral oil; and the bearing having seized with 625 lb. per square inch, the brass was taken out and examined, and the experiment repeated. While the brass was out the opportunity was taken to drill a ½ in. hole for an ordinary lubricator through the cast-iron cap and the brass. On the machine being put together again, and started with the oil in the bath, oil was observed to rise in the hole which had been drilled for the lubricator. The oil flowing over the top of the cap making a mess, and an attempt was made to plug up the hole, first with a cork and then with a wooden plug. When the machine was started the plug was slowly forced out by the oil in a way which showed that it was acted on by a considerable pressure. A pressure gauge was screwed into the hole, and on the machine being started the pressure, as indicated by the gauge, gradually rose to above 200 lb. per square inch. The gauge was only graduated up to 200 lb., and the pointer went beyond the highest graduation. The mean load on the horizontal section of the journal was only 100 lb. per square inch. This experiment showed conclusively that the brass was actually floating on a film of oil, subject to a pressure due to the load. The pressure in the middle of the brass was more than double the mean pressure. No doubt if there had been a number of pressure gauges connected to various parts of the brass, they would have shown that the pressure was highest in the middle and diminished to nothing towards the edges of the brass.

The experiments with ordinary lubrication were begun with a needle lubricator, the hole from which penetrated to the center of the brass. A groove in the middle of the brass, and parallel to the axis of the journal, extended nearly to the ends of the bearing for distributing the oil, Figs. 6 and 7. It was found that with this arrangement the bearing would not run cool when loaded with only 100 lb. per square inch; and that not a drop of oil would go down, even when the needle lubricator was removed and the hole filled completely with oil, thus giving a head of 7 in. of oil to force it into the brass. It appeared as though the hole and groove, being in the center of pressure of the brass, allowed the supporting oil film to escape. This view was confirmed by the following experiment. The oil-hole being filled up to the top, the weight was eased off the journal for an instant. This allowed the oil to sink down in the hole and lubricate the journal; but immediately the load was again allowed to press on the journal the oil rose in the hole to its former level, and the journal became dry, thus showing that this arrangement of hole and groove, instead of being a means of lubricating the journal, was a most effectual one for collecting and removing all oil from it. It should be mentioned that care was taken to chamfer the edges of the groove, so as to prevent any scraping action between them and the journal

As the center of the brass was obviously the wrong place to introduce the oil, it was resolved to try to introduce it at the sides. Accordingly the center hole and groove were filled up, and two grooves were made. These grooves were parallel to the axis of the journal, extending nearly to the ends of the brass, and were placed at equal distances on either side of the center; they formed boundaries to an arc of contact, the chord of which was 3¼ in., Figs. 6 and 8. With this arrangement of groove, the lubrication appeared to be satisfactory, the oil going down into the journal and the bearing running cool. The bearing, nevertheless, seized with an actual load of only 380 lb. per square inch.—*Engineering.*

(*To be Continued.*)

WEIGHT PER HORSE POWER OF VARIOUS MOTORS.

PROFESSOR OSBORNE REYNOLDS.

The distance which a locomotive body, be it animal or machine, can travel, loaded or free, is limited by the ratio of the power which it carries to its gross weight. The speed which it can attain is limited by the rate at which it can use its energy compared with its weight. Hence there are two particulars in which we can compare the different form of stored energy for locomotive purposes.

Let us take the horse and the locomotive. A full-sized horse weighs, say, 1,500 lbs., and, at a rate of 2½ miles an hour, will go five hours without food, doing about 10,000,000 foot-pounds of work, including the work necessary to move itself; this represents the largest result, or about 150 lbs. per 1,000,000 foot-pounds. If the horse is put to ten miles an hour, it will not do more than 1·5 million foot-pounds in a single journey, besides moving itself. Probably the greatest rate at which a horse can use its energy is about 4,000,000 foot-pounds per hour, or 750 lbs. per horse-power.

A locomotive with its tender, say, weighing 60 tons, exerts 500 horse-power gross, 270 lbs. per horse-power per hour; so that a first-class locomotive with tender is above one-fifth as heavy for its power as the horse; but then the horse cannot go more than ten miles an hour.

Now, in a general way, passenger locomotives carry coal and water for eighty or one hundred miles, *i. e.*, two hours; or the locomotive already mentioned expends at one run about 2,000,000,000 foot-pounds, which means that the gross weight of the locomotive is about 60 lbs. or 70 lbs. per 1,000,000 foot-pounds of power with which the locomotive starts.

In thus taking the gross weight of the horse or locomotive, we must remember that this includes the weight of carriage and machinery, and that in whatever form the energy is carried, this weight must be added. In the locomotive the weight of water and coal in the tender for two hours' journey weighs about one quarter the gross load; and if we add the weight of the boiler, we may consider the carriage and machinery at one-half to one-third the gross load. Taking the latter, and substituting for the boiler, coal and water; energy in either of the above forms, the coal, water, and boiler would be about 40 lbs. per 1,000,000; so that, if we took compressed air instead, we should have one-fourth the power; or the engine would run for thirty minutes instead of two hours, a distance of twenty-five instead of a hundred miles. A fireless locomotive might do more than this, say, thirty-five minutes, or thirty miles, at the same speed as the locomotive. Faure's battery, if it could be made to work at all, would carry the locomotive forty-eight minutes, or thirty-five to forty miles.

These figures seem to show that the locomotive has little to fear from any of these rivals, that is under circumstances where the smoke and steam are no harm, and where a full-sized locomotive is required. But there are already some cases where the locomotive is required and where the burning of coal is impossible. Should the channel tunnel be made, there will be a great field for some form of packed energy; but it does not seem that the promoters have much faith in a smokeless means of working the tunnel being forthcoming. As regards horses, however, there is nothing to show why the horse should not be rivaled by some one of the forms of packed energy. There have been inventors who have constructed carriages to go by clock-work. This has now become possible, substituting hot water compressed air, or a battery for the spring, and such means have already rivaled the horse on tramways. The fact that horses are not at all used for tramcars is a matter of as much surprise as that steam should be used on underground railways. For locomotives driven by compressed air might certainly be made cheaper and better in every way.

WHAT MAY BE FOUND IN THE RAG ROOMS OF PAPER MILLS.

Money and other valuables are often found among rags. A woman working in a mill found a diamond ring valued at $150 inside the lining of an old vest taken from a bale of rags, and there have been instances where bank notes in large sums have been found, also gold, silver and copper coin. In many cases, the money has slipped from holes in the pockets and caught in the linings, and in still others money and diamonds have been found, stitched between linings.

There is no telling of the crimes shrouded in mystery, that might be unraveled by the testimony revealed in the rag-rooms. The boss in the sorting-room of one mill, had an extensive collection of curiosities, obtained in this way. Prominent were foreign coins, books, writings, combs, brushes, rings, bracelets, beads, and other ornaments. The engineer also, in one of the mills, had some books, culled from the rags, including two or three worth almost their weight in bank notes, on account of their rarity.

At one time the prizes found in the rags made such a stir that a boss in one of the sorting-rooms grew crazy over the subject. As whatever was found was taken possession of by the finder, this man was in the habit of going to the mill on Sundays and mornings before work hours, to open and examine the bales of rags by himself. Whether he ever found much of value or not is uncertain, but in one bale he did find a pair of drawers of English make, nearly new. It occurred to him to take off his old ones, and put on those he had found. He did so, and in a few days was taken sick with smallpox in its most malignant form. The disease proved fatal; just before death he confessed the manner in which he had exposed himself and others.

A woman, tearing open clothing in an English paper mill, found between the linings bank notes, amounting to £30. Her employer took possession of the money, despite her protestations, and declared that as he expected its possessions in bulk would do her and her family more harm than good, let her have it gradually, till it was all expended. Another woman, while cutting rags, found secreted in the inside of a large button, which had been hollowed out for its reception, a magnificent emerald and diamond ring, worth £50. Coins and gold chains re secreted so carefully that they escape not only the eye of the dealer, but the rag cutters and dusters themselves. It depends, of course, upon the class of paper made, but when a considerable quantity of cut clothing has been used, it invariably happens, on lifting up the beater roll and taking out the plate, that coins, whole and cut, pieces of chain, etc., are found, sometimes in large quantities. These are considered the perquisites of the beater-man, and there was once a workman who wore a curious-looking chain, composed of bits taken out from the beaters. Often the gold comes down to the machine, and is incorporated in the paper. Some time ago there was observed in a sheet of plate paper several glittering specks, which were extracted from the fibers, and on being tested with acid were found to be pure gold. —*The Paper World*.

TO LINE UP SHAFTING.

To put a shaft in line, or, in other words, to make it straight and in proper relation to other machinery it may be in connection with, the workman should select a point on the shaft to start from that it would be best not to move, in order not to have to move other connecting machinery more than can be helped. If the shaft is overhead, and has gearing and pulleys on it, and there is a floor underneath, fasten a piece of wood to the floor at a point selected to start from, then take a parallel straight-edge, and laying one end on the piece fastened to the floor, put a spirit-level on the straight edge and raise or lower the other end until it is level. Then fit a piece of wood to the floor the proper height for the straight edge to rest on, and moving it along the length, level it; and then fit another piece of wood as before, and so continue on to the end of the shaft. Then placing the straight-edge on the leveled pieces on the floor, at the place of beginning, cut a strip of wood long enough to extend from the straight-edge up to the under side of the shaft, and by trying this strip of wood at different points along the shaft, always getting as close to the bearings as possible, the variations will show how much the shaft will have to be raised or lowered; but if the size of the shaft varies the difference will have to be added or subtracted.

In order to get the shaft in line horizontally, whether it has to be at right angles to another shaft or in connection with a vertical shaft by bevel gears, or has to be parallel with other shafting, draw a fine cotton or grass line under the shaft, on the piece of wood above described, and then square the line from the right-angle shaft, or center it with the vertical shaft, or put it parallel with the other shafting, as the case may require. Then by plumbing down from the shaft at the different points spoken of above, the variation of the shaft from the line will show how much the shaft will have to be moved.

A very good way to line a shaft, where it is not desired to try the level of it, is to measure down at both ends, placing a piece of wood the same distance below the shaft. Then, as near as possible to the intermediate bearings place other pieces of wood, and look across them, and raise or lower the intermediate pieces until they are all in line; then plumb down at the ends of the shaft and mark the points, and drawing a line through from one point to the other, take the measures the same as in the first case.—*American Miller*.

ENGLISH AND AMERICAN FREIGHT CARS COMPARED.

An article in the *London Engineer* contains some interesting details as to the relative merits of English and American freight cars, a portion of it we republish:

"Though the gross weight of the American vehicle is just double that of the English, the average load is three times greater. Excluding wheels and axles in the American vehicle, the weight of the load almost exactly equals the tare of the vehicle; but in England, the weight of body, framing, springs, &c., exceeds the load by 38 per cent. This great difference is probably due to the fact that the materials are so well disposed in an American freight car that great strength is attained with a moderate weight. The sides form a deep truss, the depth being about $\frac{2}{7}$ of the span, and the bottom is also strongly trussed, and, owing to the central buffer system, needs little or no diagonal bracing in a horizontal plane. Two English goods trucks have eight buffers and four draw-hooks, with their accompanying gear, against two central buffers and four "dead blocks" on an American freight car of greater cubic capacity. The saving in wrought iron hinges, knees, corner plates, &c., is also considerable, while the American freight car bogie, with its spiral springs and axle-boxes bolted to the bogie frame, weighs little more than the corresponding axle guards and plate springs of an English wagon. The smaller number of doors, ends and headstocks also reduces the comparative dead weight of the longer vehicle. The comparison is still more unfavorable if the typical English vehicle be represented by a covered wagon instead of an open trunk protected by a tarpaulin. The dead weight, excluding wheels, is then more than double the average paying load, instead of being equal to it, as in American practice. This great discrepancy is not due to weakness, as an examination of the freight cars in traffic and in the repair shop shows that the bodies and frames of American box cars stand shunting and rough usage fully as well as our own. The medium-sided open cars, used almost exclusively for coal, are generally sagged in the middle, showing the value of the trussed sides of the covered cars. The depth of truss possible under the floor is in itself insufficient to support a timber-framed loaded vehicle, with bogie centers 24 ft. apart.

"The wheels and axles of an English vehicle are far heavier in proportion to the load they carry, weighing 29 per cent. of the weight on the journals, instead of only 18 per cent. as in the case of the American vehicle. This can only be partly accounted for by some 3 in. or 4 in. difference in the diameter of the wheels and 6 in. to 8 inches difference in the length of the axles, and is chiefly due to the insufficient strength of the American wheels, as shown by their frequent breakage."

TESTS FOR IMPURITIES IN LUBRICATING OILS.

Carefully compiled statistics of fire among the New England mills, says Charles A. Hexamer, in a communication to the *Textile Record*, have shown the remarkable fact that 37 per cent. in amount of loss by fire in the said mills was caused by hot journals and by spontaneous combustion of oily waste or stock. This alarming fact has induced the making of experiments to discover the cause of this great waste. It has been clearly demonstrated that bad oils, both for lubrication and for use on stock, are largely responsible for this destruction. For the benefit of manufacturers, rules have been compiled to guide them in purchasing lubricating oils, but we have never seen any directions for determining the qualities of the oils under these rules. The object of this paper is to give a few practical tests by which managers can determine for themselves the value of the oils they purchase.

A good lubricating oil should not flash at a temperature lower than 300 deg. Fah. It should not give off more than 5 per cent. of volatile matter at 140 deg. in twelve hours. It should be free from grit. It should contain no free acid or alkaline matter.

We will take up the examination of an oil in the above order. To determine the flash test of the oil, a sample should be placed in a flat dish; this dish should be set in a plate containing dry sand, the heat being supplied to the sand plate or bath, and not to the oil direct. This will cause a gradual heating of the oil. The bulb of a thermometer should be suspended in the oil in such a manner that it does not touch the bottom of the dish containing the oil. As the temperature rises the thermometer must be closely watched, and when the heat of the oil approaches 300 deg. a lighted match or taper should be moved over the surface of the oil, without, however, touching it. When the vapors given off ignite or flash, the state of the thermometer must be accurately noted; the degree indicated is the flash test of the oil. If this test give a temperature of the oil below 300 deg. at the instant of flashing, the oil is not safe as a lubricant.

This method can be used to determine the flash point of burning oils. To determine the amount of volatile matter in a sample of oil, the sample must be carefully weighed and the weight noted. Then the oil must be slowly raised to about 140 deg., and the temperature held at this point for ten or twelve hours. The oil is then allowed to cool, and is again weighed. If the loss in weight is more than 5 per cent. of the original weight of the sample, the oil is not safe to be used on rapidly revolving journals.

The presence of grit in a sample of oil can easily be determined by pouring a small quantity on a perfectly clean plate of glass, and then covering the oil with a second plate. On rapidly rubbing these two plates against each other, any gritty matter can at once be felt. It is well in making this test to obtain a sample of oil from as near the bottom of the cask as possible, since this portion of oil will contain the most grit.

To determine whether oil contains any free acid or alkali, the most simple test is by the aid of litmus paper, a paper dyed blue by the coloring principle of the Rocella. If this blue paper be dipped into a sample of oil containing any acid, it will quickly be changed from blue to red. Should a purely mineral lubricating oil give this reaction, it ought to be condemned; but olive and other vegetable oils acidify spontaneously, especially in hot weather, and hence to them the test will not strictly apply. If the red paper be now dipped into oil containing free alkali, it will again be changed to blue. But if an alkali has been added to vegetable and animal oils, so as partially to saponify them, they will blue reddened litmus without being necessarily injurious to the journal box.

In the process of manufacturing some of the mineral lubricating oils sulphuric acid is used. This acid is then neutralized by the addition of the oil of caustic soda. Should the amount of soda be too small to act on the acid contained in the oil, an excess of acid will remain. Too much soda will cause an excess of that substance. Both acid and alkali in excess are detrimental to a good lubricant, on account of their action on the metal of the bearing.

Sulphuric acid is the only acid likely to be found in mineral oil. We will, therefore, give a simple test for the determination of its presence. A sample of oil should be mixed with a quantity of water, and then well shaken. The mixture should then be allowed to stand. When the water has again separated from the oil, it should be poured off. Owing to its affinity for water, any free sulphuric acid contained in the oil will have been absorbed by the water, and we have now only to test the water for sulphuric acid. Chloride of barium being added to water containing the smallest quantity of sulphuric acid, will at once cause a white sediment to form in the water.

But as there are three other acids which, either free or in their soluble compounds, throw down a white sediment, it must be treated with strong and pure nitric or hydrochloric acid, when, if it remains unchanged, it indicates the presence of sulphuric acid in the oil. Should the litmus paper test give indication of the presence of alkali in excess, the nature of the alkali can readily be determined by treating the oil with water in the manner above described, then boiling down the water to evaporation, and testing the sediment in a colorless flame. If an intense yellow flame results, the presence of soda is assured.

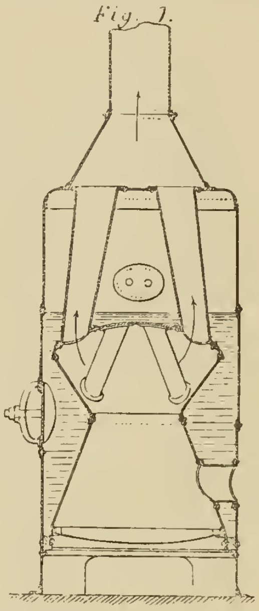
Animal oil can be detected in a mixed oil by the addition of concentrated sulphuric acid to the sample. If animal oil is present it will be quickly charred, forming a black ring in the oil. It is well to have the sample experimented upon as cold as possible, since in that state the union of the two oils is not so perfect. Animal oil can also be detected by the saponification method. On adding some alkali, such as caustic soda, or potash, or ammonia, to a sample of oil containing animal oil, the latter will be saponified and separated from the petroleum.

Of late, irresponsible oil men have been adding cottonseed oil to their lubricating oils. There is no very certain test by which the presence of cottonseed oil can be detected. We have never experimented to determine the presence of this adulteration, but we are informed that a sample of oil containing cottonseed oil will turn red if some acetate of lead be added to it, and the mixture be allowed to stand for ten or twelve hours.—*Oil, Paint and Drug Reporter.*

ENGLISH VERTICAL BOILERS.

We illustrate herewith an English boiler which has been recently patented. It is intended to combine large-heating surface with improved circulation, and consequently better evaporation. It is stated that these ends are attained, and that the boiler shown on the right evaporates nearly ten pounds of water for one pound of coal. A great deal of water can be passed through the steam pipe of a boiler of this class, from the proximity of it to the water line. This latter, it will be seen, is, in the engraving, below the surface of the main flue leading to the uptake, or back connection. It would seem from the shortness of the passages that the flue would become very hot, and that to carry water below it would not only lose the surface it has, but also superheat the steam to a high degree. If the water line was at *A*, better results would be obtained.

Fig. 1.



Also, the expense of constructing, to say nothing of the vertical shell being cut in two by the horizontal shell, does not compensate for the heating surface gained. This is a simple vertical boiler compared to some that have recently appeared in England.

One of them is a common vertical boiler, the tubes having a twist in them, just as if after they were set in the fire-box and upper head, the latter was turned quarter the way round. The idea of this is to expose more surface to the ascending flame, or have the heat strike at an angle !

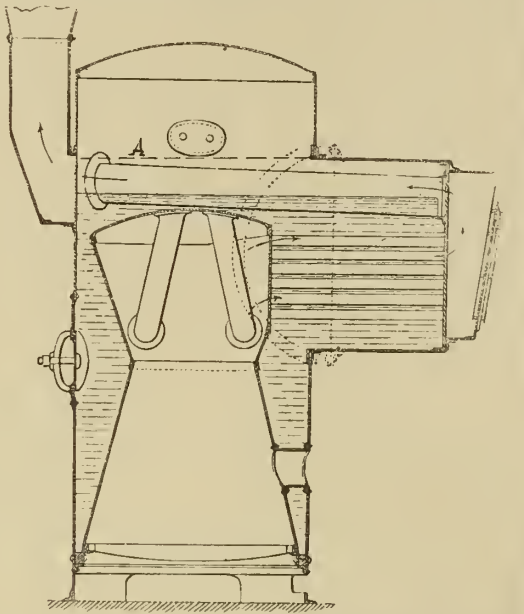
WHY BRASS CASTINGS ARE NOT UNIFORM.

Mechanical engineers and machine constructors have frequently noted a want of uniformity in brass castings, and have assigned various reasons for it. A recent writer, Mr. P. M. Parsons, in *Iron*, gives the causes as follows:

"In the manufacture of iron and steel an amount of scientific knowledge has been brought to bear, which elevates these industries into scientific processes, but I can discover nothing of the kind in bronze and brass founding—everything is there done by the rule of thumb, and that in a most clumsy manner. The idea of combining the various metals to form the alloys required in atomic proportions, does not seem to have been ever entertained, and the books written for the practical guidance of brass founders, ignore this important principle altogether. I allude to handbooks, and the like, which contain instruction of the most clumsy and unscientific character, for making different alloys. Thus for gun metal the proportions given are 1 lb. of copper to 2 ozs. of tin, or if required to be harder 2¼ ozs., or 2½ ozs., and so on ; then, as regards brass, it may be 70 lb. of copper and 30 lb. of zinc, or 60 lb. of copper and 30 lb. of zinc, or 60 lb. of copper and 40 lb. of zinc, for yellow metals. Now, not one of these alloys or others described are in atomic proportions, and that is the reason why unsatisfactory results are constantly occurring in ordinary brass founding ; not only are the copper alloys thus produced weak, soft, spongy, and porous, but it is a constant occurrence that the constituents vary in different parts of the casting.

This is the case principally in the gun metal and bronze alloys. The surplus tin above that forming a definite alloy in atomic proportions, seems to be held in mechanical suspension, which separates by liquation, and collects at the top of the casting as it cools and solidifies, causing the well-known tin spots, sponginess, etc. The only remedy the ordinary brass founder has for this, is to use as large a proportion of scrap metal as he can get—he does not know why, he only knows that he gets better castings by using it, but the true reason is that the scrap metal has adjusted its constituents in atomic proportions during the several re-meltings it has undergone, any surplus tin or zinc being got rid of by liquation and oxydation, but if in the original manufacture of the alloy the metals are combined in atomic proportions, nothing of this kind happens, the castings are sound and the alloys homogeneous."

TWENTY-FIVE cents will be paid for copies of No. 1, Vol. 5, in good order.



FOURTEENTH ANNUAL CONVENTION OF THE MARINE ENGINEERS' ASSOCIATION.

The late convention of the Marine Engineers' Association, held at Pittsburgh, Pa., was very harmonious throughout, and the attendance of delegates was large and from all parts of the country. The following officers were chosen : President, W. E. Russell, of Pittsburg; Vice-President, Charles Rensford, of Detroit ; Secretary, James K. Harris, of St. Louis ; Treasurer, Reuben Doty, of Cleveland.

As some of the members felt that the Association should consider the subject of wages, the question was discussed, and the Committee on Constitution made its report. The instrument was adopted as submitted without change. One of its clauses stated that no association has any right to fix a standard of wages for its members, but each man can act as his own free agent. There are now 42 lodges and nearly 4,000 members in the Association.

THE NUMBER OF STEEL BOILERS built is increasing yearly. This is owing to the low price of steel as compared with iron, it being only 15 or 20 per cent. higher than that material, while the wages paid for labor remain the same. The cost of construction is, we fancy, somewhat greater than for iron.

THE MECHANICAL ENGINEER FOR 1884.

In return for the many favors accorded us in the past by the trades we represent, we put forth renewed energy to merit a continuance of the good will shown. To this end we announce the following serials, which will appear in all of 1884

HOW I SERVED MY APPRENTICESHIP.

This will run through many issues, and is an account of an actual service by a mechanical engineer now in charge of work. It deals with such matters as will be of interest to all in similar positions—not merely beginners, but others who have not had the fullest opportunities for informing themselves. The opening chapter takes a common wheel-press, such as is in use in every locomotive shop of any size, explains its principles and construction, the action and how to calculate its power. The problems are all in simple arithmetic and quite within the reach of mechanics. The style is easy and in narrative, so that, aside from its intrinsic worth, it is very entertaining.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks, of the University of Pennsylvania, will, in a series of papers, touch upon various points in the construction of steam engines, rendering the principles involved in their action clear to all. These papers will be as useful to designers and constructors as to working engineers, for the author will not follow others and expound text-books already published, but reason from his own deductions and observation.

BOILER MANAGEMENT.

Under this head, Mr. A. H. Goff, a practical engineer of St. Louis, Mo., will give his experience with boilers of various kinds, as to the care and course to be pursued to insure the best results. The author will consider the subject from a practical standpoint, so that persons in similar situations can apply the instruction conveyed if it seems good to them.

A SERIES BY H. L. STELLWAGEN, ESQ.

These papers cannot be announced definitely as to the title, but we have made an engagement with the author, who is an engineer of ability, to give our readers the benefit of his experience, and from his previous contributions we know that the writer will both interest and instruct us.

In addition to these positive announcements, we shall have many other short papers through the year, which will be of permanent value. The Indicator Series, now publishing, will be continued well into 1884, and all who wish to know what their engines are doing as well as inform themselves upon the use of an instrument indispensable in every engine-room, should not fail to renew for 1884.

Locomotive work will have special attention in construction and management on the road. The success which has attended the efforts of the publishers during the past year is evidence to them that their enterprise will be supported, and the very considerable outlay involved in the serial papers announced above—all of which are paid for—is some evidence of an intention to deserve the reputation for practical value to workers in its line THE MECHANICAL ENGINEER has won.

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Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

USEFUL INFORMATION AND TABLES ON STEAM and Water for Engineers and others, will be found in Blake's new illustrated catalogue of steam pumping engines, just published. Copies sent free. Address Geo. F. Blake Manfg. Co., 95 & 97 Liberty Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
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PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

New York : Weekes & Melville, Printers, 25 Beekman St.

THE MECHANICAL ENGINEER.

New Series. Vol. VII.—No. 3.
Enlarged 1883.

New York, February 9, 1884.

Single Copies 8 Cents.
$2.00 per Annum.

DAVIS' NEW KEY-SEAT CUTTER.

In former issues of this paper we have published a view of this machine as it was first designed. It was, at that time, the same in principle as it now is, but experienced gained in manufacturing large numbers of them has led the inventor to improvements, so that it now comprises all that is essential to accuracy, rapidity, and convenience.

In its new form the entire frame and bed of the machine, together with the guides, are one casting, so that it is impossible for anything to get out of line. The gearing is all cased in (not shown in the engraving) and many facilities for adjustment of the cutter-bar, or saw as it is called, have been added. These render the improved key-seat cutter much more desirable than the old pattern.

A tool of this class is indispensable in all shops where key-seats in quantity are cut. The capacity ranges from seats one-fourth of an inch wide to one inch. W. P. Davis, North Bloomfield Foundry and Machine Tool Works, North Bloomfield, N. Y., is the manufacturer, and will furnish price lists to those desiring them.

STORAGE OF ENERGY FOR SMALL POWERS.

The greatest amount of energy that can be stored in a given weight of steel is very small, compared with other means. To take a familiar unit, to store the energy necessary to maintain one horse-power for one hour would require no less than fifty tons of steel—that is to say, fifty tons of steel in the form of watch springs, all freshly wound-up, would not supply one horse-power for one hour; and yet this is the commonest form in which energy is carried about.

It is the adaptability of the spring, and the readiness with which energy can be put in and taken out, which recommend the steel spring.

India rubber will store much more energy than the same weight of any other material, say, eight or ten times as much as steel; but with this, several tons would be required to store the horse-power for one hour. A much more capacious reservoir, according to its weight, is compressed air. There are certain difficulties in getting the energy in and out without loss; but with air, compressed to four times the pressure of the atmosphere, we should only require about 20 lbs. of air to yield the amount of one horse-power for one hour. Of course, if we were going to carry this air about, to the weight of the air would have to be added the weight of a case to contain it, and such a case, in the form of steel tubes, would weigh something like 230 lbs.; so that, in any form in which we can carry compressed air about, we shall have about 300 lbs. to carry for each horse-power per hour.—*Prof. Osborne Reynolds.*

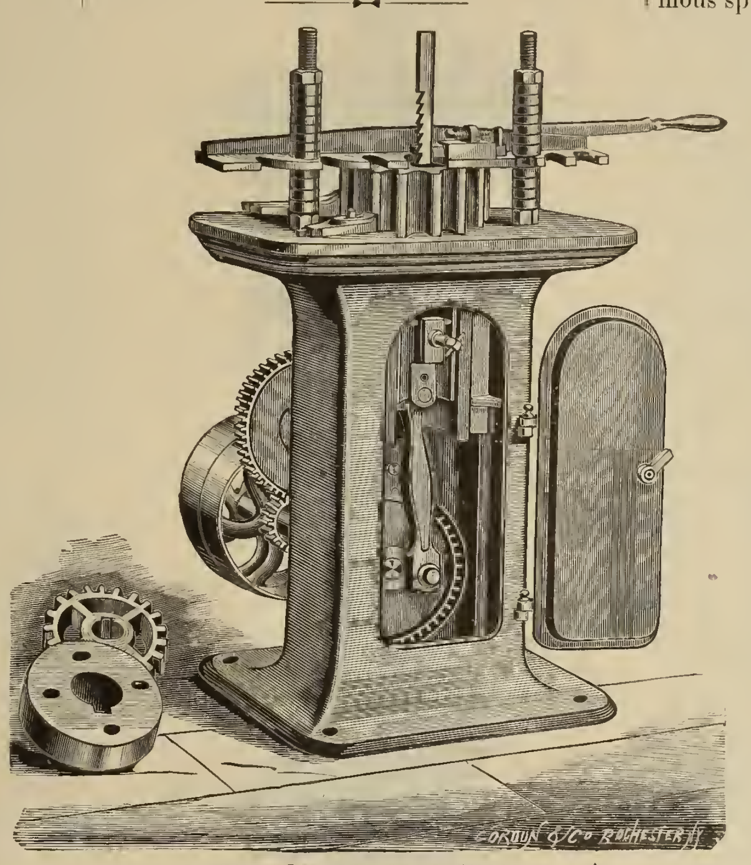
THE BEAUTIFUL TRANSPARENT COLORS seen on tin boxes are obtained from copper varnishes that is varnish with a copper base—aided by heat. According to the time exposed, the shades vary, running from dark green, green-gold, to orange and red-brown. If a good copal varnish is used as a vehicle to carry the copper, the tin can be pressed, and even hammered, without destroying the lacquer.

* * *

GOOD ADVICE.

Never contradict a customer or tell him that such an article is just what he wants, for if he reserves to himself a certain amount of independence, and does not care to have a salesman pretend to know more about his business than he does himself. Do not allow any one to interrupt you when you have the sale nearly completed, for then is the time, above all others, to clinch the sale by short sentences.—*Unknown Sage.*

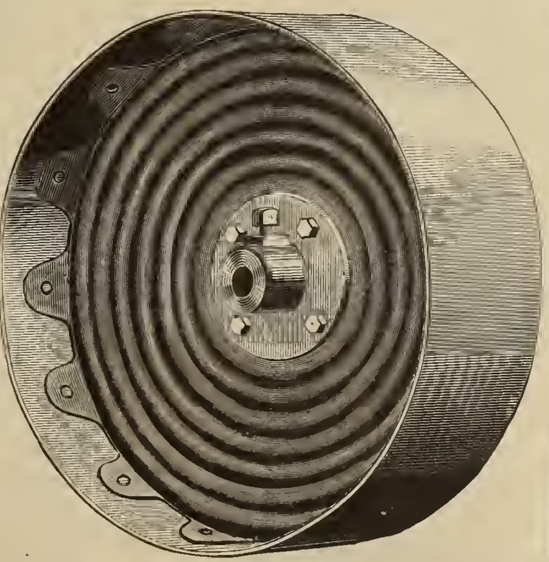
* * *

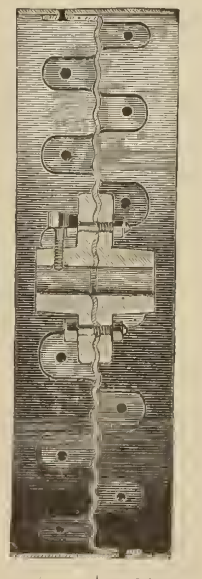

GORDON & Co ROCHESTER N.Y.

DAVIS NEW KEY-SEAT CUTTER.

A NEW CORRUGATED DISK PULLEY.

The engraving represents a new pulley of ingenious design which is now being manufactured in large quantities. Anything that tends to relieve the dead load on driving, or driven, shafts is greatly to be desired, since it is the non-paying load which is a constant item of expense. The end in question is attained by this pulley, as it is much lighter than the standard pulley and stiffer for given diameters.





The illustration explains the invention fully, as regards the principle involved. The material is either wrought-iron or steel, with concentric corrugations like those here shown; or it can be corrugated readily if desired. The corrugations and ears, or lugs, are struck up at one operation, and the rim is then forced on and riveted. It is the invention of Messrs. Fulton and Ohlsen, of Indianapolis, Ind., and is now being put on the market by three firms—John T. Noye Mf'g Co., Buffalo, N. Y.; Indianapolis Bolt Works, Ind., and The Falls Rivet Co., Cuyahoga Falls, O. These parties will furnish information as to prices.

* * *

ENORMOUS SPUR WHEELS.

The Dickson Manufacturing Company of Scranton, Pa., have recently completed an enormous spur-wheel, it being the second of its kind made by them. The wheel is 43 feet in diameter at pitch-line, is $4\frac{5}{8}$ inches pitch by 12 inch face, and has 352 teeth. The total weight is 62 tons.

This is a cut-gear, the teeth being all milled to exact templates. The machine for cutting it was devised by the Superintendent of the Dickson Works, Mr. Sidney Broadbent. The wheel itself was laid out by E. D. Leavitt, Jr., Cambridgeport, Mass. The time occupied in cutting the teeth was 215 working hours, say $21\frac{1}{2}$ days.

THE COMPOUND ENGINE.

The non-compound engine bids fair to become extinct, because the compound engine is all round a better machine. That it is more economical to use high pressure steam than low is certain, and the compound engine provides a better way of using high steam than the simple engine does. This is entirely apart, however, from the consumption of fuel. If theory and practice alike are good for anything, then it is certain that a non-compound engine may be made which will burn as little coal as the compound engine; but when it is made it is not as good as its rival. Its valve gear must be more complex, its turning more irregular, and the strains set up in its parts greater. All these things have to be taken into consideration. A glance at the history of the compound engine will suffice to show that if it could not be turned out for about the same price as the engine which it superseded, there would have been no supercession.

The first compound engines used at sea were complex; but they were perhaps as economical in fuel as anything since produced, but the ship owners would not have them. Nothing worth mentioning was really done in compound engines until the happy thought struck some one to build a compound engine, like any other two cylinder engine, only with one cylinder smaller than the other, the smaller exhausting into the valve-chest of the larger. This solved the whole problem in a moment. It is a curious fact that the name of the man who first did this is not known. The compound engine has grown up in some mysterious way, but the author of really the greatest improvement made in marine engineering for many years remains, so far as the world at large is concerned, in obscurity.—*London Engineer.*

THE MECHANICAL ENGINEER refers to our paragraph regarding some trivial accidents in our shops as "a difficulty, which attends students in technical colleges.—*The Tech.*

Well, you said "the tendency was to turn the shops into dissecting rooms." We are glad to know that this is trivial, merely incidental, and not compulsory in the course.

* * *

OUR CORRESPONDENTS have favored us to such an extent, this week, that we are unable to get all their favors in, although set in the smallest type that is legible. Several letters must stand over until the next issue.

THE INDUSTRIAL SITUATION.

Bradstreets, a paper which takes a moderate and temperate view of business matters at all times, has an article on this subject and as it contains some hints of value to our friends, both employer and employed, we make no apology for its presentation here. We have never discussed the question of wages in any way and do not intend to do so, considering that to be a matter in which we have no right to interfere. The fact that our storehouses are overloaded, either through diminished demand or temporary over supply, causes the manufacturer to contemplate one of two courses—either to shut down his works or to run on short time, which amounts to the same thing, or to cut down wages. If he shuts down his works or runs on short time the employee claims that wages are thereby cut down, but the employee prefers this course to reduction of rates, for he holds that if rates remain the same, when the market becomes more active he is on a good footing, and there is logic in his reasoning. The manufacturer sees that if he shuts down or runs on short time he accomplishes what he claims is necessary to accomplish, that is, reduces the stock on hand; he see, also, that if he should cut down wages to keep his works on full time he harms himself as well as his employee, because he does not reduce his stock, but by reducing wages he inevitably reduces the price of the stock that he has on hand; it would, therefore, seem to be the best policy for the interest of the two great forces to run on short time, for certainly this course would reduce the supply and avoid the always annoying result of readjusting rates of wages. Wages, since 1879–80, have been quite steady, while the margins in profit to the manufacturer have been growing narrower.

It was shown by Mr. Wright, of the Massachusetts Bureau of Statistics of Labor, in his fourteenth annual report, that the net loss to employers and employees in profits on production as between 1775–80 was 11·54 per cent., and that of these losses labor bore 4·35 per cent. and capital 7·19 per cent. We are convinced that the data since 1880, if obtainable, would show a still greater decrease in the margin of profit, and that the proportion of loss falling to capital would be larger relatively than that falling to labor in the period from 1875 to 1880; and yet, viewing the industrial situation from all sides, we cannot see how labor can bear much reduction in wages. It is probably true that, so far as this country is concerned, they have reached their highest limit for a long period. What we mean is that while fluctuations will will take place by reduction and subsequent increase, wages will not for many years be much higher than they have been since 1879–80. Believing this to be true, and for the other economical reasons stated, probably the best interests of all concerned and the community at large would be better protected by a temporary reduction in working time rather than a temporary reduction of wages. The moral effects of this course are apparent.

⁂

How BENEFICENT THE WORKINGS of engineers' aid societies are may be seen from an incident related by ex-President Jas. H. Reid, of the Marine Engineers' Association, at his annual report. A member of the association in Chicago had allowed his subscription to expire and shortly after was lost; his family were left destitute and depended on the charity of the friends of the order. The assistant of this brother was also lost, but having kept up his standing the money received from the aid society enabled the widow to pay off her indebtness on two small houses, and placed her above want.

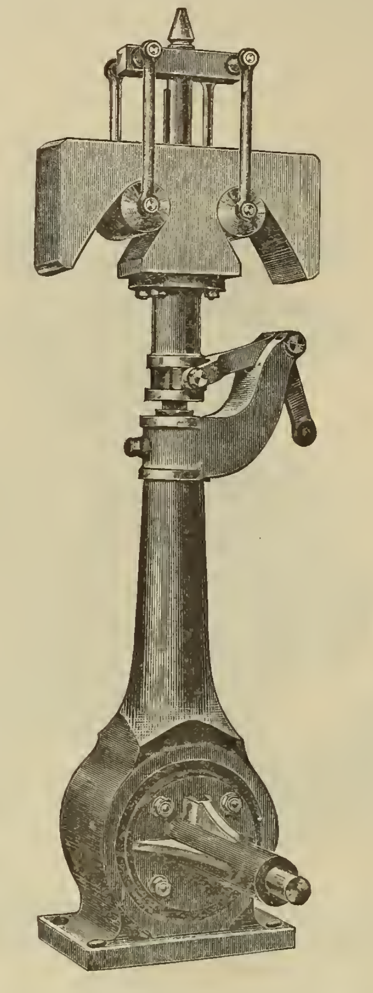
⁂

How MANY SPUR GEARS are set to run on their pitch lines? Not many. Oftener than otherwise the wheel and pinion bottom, where the bearings are not fixed so that they cannot be changed by persons erecting them or the machines they drive. Unless the pitch-lines coincide, the system by which the teeth are cut, or formed if cast, is rendered useless for noiseless action. Pitch lines should split each other; neither overrun nor fall short.

A NEW ENGLISH GOVERNOR.

Our engraving represents a new governor recently introduced in England, which is novel in action and not unattractive in appearance. It is made by the Messrs. Galloway, and is thus described in *Engineering:*

"A heavy counterpoise is formed at each side to a parabolic curve, and is free to slide on a central spindle. Two rollers take the place of the balls in an ordinary governor, and work freely on links, which are attached to a cross-head fixed on the spindle. The rollers rise and fall in the slots of the counterpoise with the quicker or slower speed of the engine, and a means is thus provided for governing the flow of steam. In the arrangement shown a grooved collar and a bell-crank form the connection between the counterweight and the throttle valve or expansion gear.

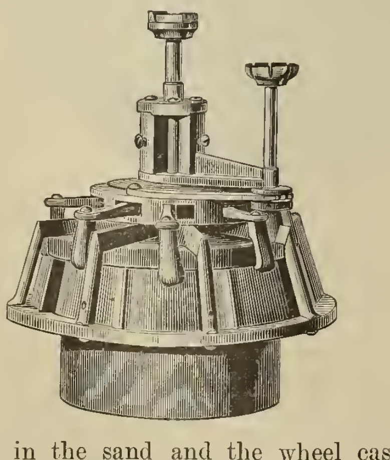


"It is claimed by the inventors that this governor gives the maximum of power in the minimum of space, together with practically absolute regularity, and that it can be run at any height with a variation in speed of not more than 1·5 to 2 per cent.

⁂

THOMPSON'S TURBINE.

Our engraving represents a wheel which has given good results where introduced, and is now used in very many States. In construction it is of the best material and the workmanship unsurpassed. The buckets are of wrought-iron or steel, set in the sand and the wheel cast on them, making it solid and very strong. The gates are nearly balanced, and are straight surfaces as far as they control the water, thus making perfect chutes and conveying the water to the wheel in straight lines, and in the shortest possible distance. It is not restricted to any particular number of gates or buckets, but uses from eight to sixteen gates and from twenty to thirty-six buckets, applying the water on a large acting surface.



The attention of persons using water-power is requested by the inventor, W. J. Thompson, Meadville, Pa., who will also furnish circulars and price lists.

⁂

HOW GALVANIZED IRON IS MADE.

The iron to be covered is deprived of its coating of oxide by an acid bath composed of sulphuric acid and water, or of hydrochloric acid, in which it is immersed for a short time. It is then scrubbed with sand until the surface is cleansed; after which it is immersed in a concentrated solution of chloride of ammonium, taken out, and subsequently put into a bath of melted zinc, covered with fatty matter, or colophony, to prevent oxidation, and stirred in it till the zinc forms an alloy at its surface. The coated metal is then, in some instances, introduced into a second bath consisting of melted tin, such as is used for tinning thin sheet-iron, when a slight coating of tin is formed on the exterior of the plate or bar. Of late years this second bath is generally dispensed with, a few pounds of tin being added to the zinc bath to produce the same effect.

⁂

ASLEEP ON POST.

So seldom do we print light reading that we hope our readers will not accuse us of unseemly levity if we present to them an account of what befell an unfortunate telegraph operator who slept on his post. He was at a country station and received a dispatch from headquarters to hold "No. 7" for orders. He fully intended to do this and hung out a red light in the usual place to notify the engineer. Then he sat down and fell asleep. Also, the red lamp went out. Meanwhile "No. 7" came along and went by, and still the operator slept in his chair. Let the *Laramie Boomerang*, where the story originated, tell the rest:

For the last hour the chair on which Allen sat had been throwing out distress signals. The sleeper had tilted it back until his whole weight rested on the rear legs, which, after sundry squeaks and groans, gave way. Allen gives way at the same time. He gathers himself up and becomes conscious that the instrument on the table is sounding his "call" with startling rapidity. He grasps the keys and replies "I."

"Where is No. 7?"

"Hasn't arrived yet," replied Allen.

"Are you sure?"

"Yes; don't think it could get by without my hearing it, do you?"

"Have you been asleep?"

"No."

"Got a red light out?"

"Yes."

"How does it happen, then, that the operator at Fort Steele reports the arrival of No. 7 at that place?"

Allen was paralyzed—partially. He rushed to the door and found no red light—only a lantern.

He took in the whole situation in a second, and seizing the key, once more replied:

"—— if I know. No. 7 hasn't passed here to-night. If she's at Steele she must have gone around by the overland stage road; it runs within a few miles of here, you know." * *

There had been no accident. No. 10 had orders to meet No. 7 at St. Mary's, but had been delayed at Fort Steele by a hot box until after the arrival of that train.

Allen packed his grip, and every time a train from the East hove in sight, got ready to turn over the office to his successor, who, however, did not put in an appearance. One day the chief dispatcher came along. He took Allen to one side very confidentially, and said:

"Don't go to sleep again while on duty, and for goodness sake don't let any more trains go around over the old stage road. The alkali mud eats the paint off of the locomotive wheels, and the amount of coal required to pull up some of those hills is simply awful. The next time an engineer tries to give you the slip by taking that road, just take a horse and follow him up. You can catch him because the road-bed is so uneven that he can't make very good time. When you catch him, kill him. The company will pay all the bills. Eh?"

Allen said he would.

LOCOMOTIVE ENGINEERS MAKING THREE HUNDRED MILE TRIPS.

On a Southern road, according to a Savannah paper, a train makes an eleven hour run with, presumably, the same crew; though the paper does not say so it follows by inference, as witness this paragraph:

"A railroad engineer complained that engineers are subjected to too great a strain in a 300-mile run. The fast mail train which collided with the freight on Thursday morning makes an 11-hour run between Atlanta and Savannah, leaving Atlanta at 9 o'clock P. M., and reaching Savannah at 8 o'clock the next morning.

"'The strain is just here,' said the engineer: 'When the train rolls out of Atlanta at night, the engine plunges into the darkness. The engineer strains his eyes to see as far as the rays of the headlight will extend. The first care on his mind is the safety of his train, for he knows not what minute the headlight will flash a tie or tree across the track, a washout, or, what is more dangerous still, a coming train. Then he is subjected to a thousand little annoyances that the public, and very few of the officials, ever know or dream of. He may have a new fireman, may have to stop now and then to cool off a hot box, the conductor may ring him down at a cross road, his pumps may not work right, his engine may have a thump in it, the air brakes may not act, he may have to wait for a belated train to pass, and the Lord only knows what else. All these things bear heavily on his mind, and yet no matter how many happen, he must keep his mind on the schedule and remember 15 or 20 other trains to meet or pass. As to his home troubles, he is expected to forget kith and kin. He must forget them while is hand is upon the lever and his eye upon the illuminated section of the track. These constitute the mental strain on an engineer.'"—*Savannah News.*

AN ESSAYIST says:

"It is interesting to note that a loaf of bread contains about the same quantity of alcohol as a glass of ale."

This is not interesting. If a glass of ale contained as much bread as a loaf, many persons would never be hungry.

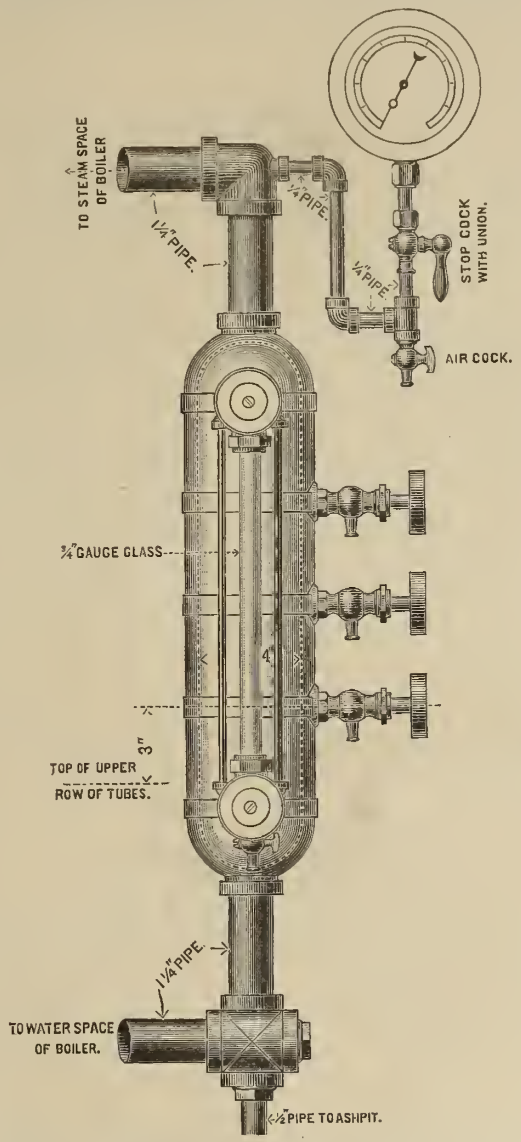
WATER-GAUGE CONNECTIONS.

We give in this issue an engraving showing what we have found by long experience to be the most satisfactory arrangement for water columns, or "combinations," as they are usually called, for the ordinary horizontal tubular boiler. The body of the column is round, a form to be preferred because it is the cheapest, strongest and the best looking that can be made. We don't believe in fancy shapes for this purpose.

The diameter of the chamber inside is four inches in the clear. This insures an ample body of water, and also leaves a good space for sediment to deposit without choking the connections, or the body of the column itself. The thickness of the shell of the column should not be less than three-eighths of an inch, and one-half inch is to be preferred. The latter will insure ample strength and a sounder casting than the former. The size of connections to boiler is one and one-fourth inches. Experience has shown that this is the smallest that should be used for this purpose. The practice of using one-half or three-quarter inch pipes for these connections cannot be too strongly condemned. There is always more or less trouble resulting from small pipes fouling with scale or sediment. Even when one and one-quarter inch pipes are used, it is better to connect the nipple at the lower end of the column with the pipe entering the water-room of the boiler, by means of a cross instead of the usual T, so that by simply removing the plug the pipe may be thoroughly cleaned out. Where the pipe turns in the smoke connection to enter the tube-sheet, a T should be used with the outlet looking out, and plugged. By removing these plugs the entire length of the pipe may be thoroughly scraped out without disconnecting a pipe or breaking a single joint.

A half-inch pipe should be led from the lower outlet of the cross, as shown in the engraving, to the ash-pit. This pipe should be provided with a valve a few inches below the cross, by opening which all sediment may be blown out of the water column. By leading this pipe into the ash-pit, we can not only blow out the column without filling the boiler-room with steam, but we have also a convenient means of filling the water cavity in the ash-pit with water. The extent to which this pipe will naturally be used for this purpose, will be sufficient, under ordinary circumstances, to keep the connections to water column thoroughly cleaned out.

A three-quarter inch gauge-glass should always be used. For a boiler five feet in diameter this should be twelve inches long and the gauge-cocks may be four inches apart from center to center. For smaller boilers the glass may be somewhat shorter, and the cocks may be say three, or three and one-half inches apart. For all sizes of boilers the lower cock should set three inches above the top of the upper row of tubes. Then, when two gauges of water are carried, there will be a depth of six to eight inches over the tubes. The boiler should be set one inch lower at the back end than at the front so that all water will be drained out of it when the blow-off valve is opened.



Some engineers object to the lower connection to water column being made so far below the top of tubes as that shown for the reason that if a gauge-glass breaks during the night, or when no one is about, the boiler will be more quickly emptied of water than it would be if the lower connection were above the tubes. This objection has little force, for we do not think many engineers are foolish enough to leave a boiler over night, or even for an hour, without shutting off the connection to the glass by means of the small valves always provided for that purpose. A great risk is incurred, whatever the position of the connection, if this precaution is neglected.—*The Locomotive.*

THE COMPARATIVE VALUE of heating surfaces in boilers is thus stated by an experimenter: Area exposed to flame equals 1; that is, it takes all presented to it. Horizontal area above flame, 1; surfaces inclined towards flame, 1; vertical surfaces, $\frac{50}{100}$ths; surface inclined from flame, no value; horizontal surface below flame, no value; internal flues, $\frac{50}{100}$ths, and small tubes, $\frac{66}{100}$ths.

FACTS ABOUT GLASS.

The quality of the glass used in making bottles for aerated and other beverages is of much greater importance than might be supposed. Most bottlers are more particular about the color than they are about the quality of the glass, and yet the exact color is of little consequence, provided that the glass is bright and clear. What is required is solid glass, from "oats," or bubbles. A "seedy" or spongy glass is to be avoided, for it is invariably weak. Each "oat" is a bubble which materially diminishes the strength of the glass.

"Winds" on the surface of the glass are also an indication of weakness, and should be avoided. These "winds" are generally evidence that "cullet," or old glass, has been remelted with a portion of new glass, and has not been thoroughly assimilated. Glass made in pots is more apt to contain "winds" than that made in tanks, from the fact less "cullet" is used in making the latter. This will be readily understood when the two processes of manufacture are explained.

Pot glass is made as follows: The batch is placed in the pot and melted through the night, being fed as often as required with the batch by the shearer. When melted the glass will sometimes froth considerably, when it requires some time to settle. Sometimes, in the eagerness to commence blowing, the glass is not allowed sufficient time to thoroughly subside, and the result is "seedy" glass. At other times a large amount of salt water will appear over the glass, considerably retarding the melt. In such cases it is usual to fill the pots with broken glass until the salt water has all run over, leaving only glass in the pots. If the original batch had much "cullet" in it already, the addition of more generally causes the "winds" above referred to.

The other method of making glass is to melt the batch in a furnace, feeding it at intervals. The melted glass is carried off in a trough to a tank, and is taken from this tank to be blown. The glass in the tank is fined, and at all times ready to work. It need not, therefore, be "windy."

Of these two processes of making glass, the latter produces the better quality, and, provided the annealing is equally good in both cases, it is safe to say that a bottle made with tank glass will prove more satisfactory than one composed of pot glass.

The hammered look that some bottles present is not a sign of weakness, and is of no consequence except as far as the appearance is concerned. The cause of this "hammered" appearance is that the glass was put into a mould which had not been made sufficiently hot, and the steam from the surface of the mould has imprinted itself on the bottle.

Much could be said about workmanship that would be applicable to all factories. The workmen are not all skillful in a glass factory any more than they are in a machine shop or in any other trade. It often happens that apprentices are allowed to blow bottles when an order has been taken at too low a figure to allow it to be filled profitably by skilled workmen.—*Earthenware and Glass Trades Chronicle.*

THE *Millwright and Engineer* is the title of a new monthly paper issued by E. P. Allis & Co., the well-known engine builders of Milwaukee. Mr. Albert Hoppin is the editor, and we have no doubt but that, under his direction, it will be prosperous and popular. Our wish is that it may be both.

THE STEAM SPACE in a boiler should not be less than fifteen times the capacity of the cylinder to be driven by it.

A RECENT INVENTION in the line of high-speed engines is that brought out by M. Jaeomy, a French engineer. In appearance it resembles closely the numerous class of rotary engines, though the internal construction is on the reciprocating plan, one piston working inside of the other and at right angles to it, the resultant motion of the crank being circular. Although the inventor claims many advantages for it, the numerous joints and intricate mechanism argue against its ever coming into extensive use.—*Exchange.*

This sounds like Roots' square-piston engine of twenty years ago; it is the same in design.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

IN FAVOR OF COMPRESSION.

Editors Mechanical Engineer:

A friend has called my attention to an article in your excellent paper of Jan. 12, and has asked me to answer it, knowing me to be a practitioner and strong advocate of compression. The article referred to is under the heading of "*The Professor in the Machine Shop.*"

My ideas are quite the reverse of the Professor's. I believe compression to be economical in the use of steam under most all conditions, and that it is essential in a greater or less degree to the smoothness of the engine's performance. I am sorry the Professor did not show more of the process of reasoning which has led him to his present conclusions. I shall, however, take up the argument he has presented and answer it, rather than to present my own argument, as that would take more space than I will be allowed here, and more time than I can at present spare on the subject.

After admitting that compression, by the act of compressing steam from a low to a high pressure, fills the clearance space with steam that would otherwise have been wasted, and that it will save just so much live steam from the boiler, he then asks, "What has done this work?" and answers by saying:

> "Is it not live steam, originally on the other side of the piston?" "Have I not taken something from the useful effect and banked it on the other end?"

Most assuredly, Professor. But you will have its equivalent every time in the steam compressed; and, provided that steam is allowed to expand again to the pressure from which it was originally compressed, it will give back in full measure the power stored in it, and the clearance will have been filled without cost. Yes, and under strictly theoretical conditions there should be a slight gain in power by each compression, on account of the difference between theoretical expansion and compression curves there should be a slight surplus in favor of the expanding steam.

But the Professor says there is always a loss in such an operation. "Whether I compress steam with a piston or grind corn with it, I have done work, and I cannot get back as much as I put in." His intended similes here are so widely different that I will have to take two situations as widely dissimilar in order to correct the error, and assert that jumping into a pool of mud has a widely different effect from jumping on a spring mattress. In the former, the energy stored in the body is lost from the body and stored in the mud; and takes form as heat, in part, and is in part, expended in elevating the surrounding mud. While in the latter operation the energy of the body is stored in the springs, which will rebound, throwing the body back again. The mud is inelastic, while the springs are elastic. Steam is highly elastic, while corn is inelastic. Besides, the corn is torn into fragments and cannot react on the piston again, producing power as the steam. The power of the engine in grinding corn is by friction mainly converted into heat and lost as power. Take up some of the meal just as it leaves the buhrs and you will find it hot. If the buhrs are very close it is very hot. The heat thus produced is quickly dissipated and lost from our observation. When steam is compressed heat is also developed, and that heat is given to the compressed steam, giving it life and power, so *that* heat, instead of being dissipated and lost, is used again to urge the piston forward. The heat-gain by compression is not that, however, which is derived from the mechanical act of compressing the steam, but it is that which is gathered from the exhaust and which would otherwise have been wasted. The Professor goes on to say:

> "Non-compressionists can also cite card areas, and say that where the piston works close up to the cylinder head the corner is as square as this page, and consequently shows a greater percentage o. useful effect than the compression card," etc.

The trouble with that logic seems to be that the piston won't work up close to the cylinder-head just to accommodate the non-compression theory. It is a fact that all engines have clearance. It is something which cannot be avoided. And compression, we claim, prevents more or less the loss of steam arising from its presence. If there were no clearance there could be no compression, and we would be left without an argument.

I will not dwell longer at present on this part of the subject, but at some future time, if called to do so in defense of the theory, will show the most substantial reasons for the use of compression on grounds of economy.

With a few words, now, in regard to the other part of the subject, I will close.

When high rotative speeds are employed, compression is a practical necessity. It prevents sudden change of pressures on or near the end of the stroke, and consequently the violent shock the reciprocating parts must sustain and transmit to their bearings, causing pounding.

If the compression is sufficient, it will set all the parts over by a more gradual movement before the steam enters from the steam-chest, and in that position they can receive initial pressures without causing noise. If the compression is not sufficient to set the parts entirely over before the steam enters from the steam-chest, it is still of use in counteracting, in part, the bent spring condition of crank and crank-shaft, and in so doing prevent, in part, the force of rebound. Consequently smoother-running is obtained. Engines of long stroke and slow rotative speeds do in many cases run noiselessly (or somewhere near it) without compression. Yet E. D. Leavitt, Jr., uses compression on his largest, slowest moving engines, saying it is essential to smoothness of running. E. D. Leavitt, Jr., is a successful engineer. George H. Corliss built about three years ago a pair of — thousand horse-power engines for a corporation in Lowell. The eccentrics were keyed on and the valve gear non-adjustable, so that nothing could be changed. The engines having no compression pounded so badly that the agent required Mr. Corliss to send a man there, and he was several weeks making the change. The eccentrics were moved ahead, compression introduced and the pounding ceased. A pair of 500 horse-power Corliss engines at another place in Lowell had compression introduced with the most satisfactory results.

When running at a lively, or high speed, compression is positively essential. The writer speaks advisedly, having had a great deal of experience with engines of medium and high speeds.

The locomotive owes its success as a high-speed engine mainly to that feature of the link-motion which gives greater compression on the shorter cut-off. When the locomotive is running at a high rate of speed, it is always hooked up on a cut-off less than one-half, and the compression is great. The Armington & Simms engine owes its success in a very great measure to that peculiar valve action which gives great compression. I was watching one of these engines started at Edison's electric illuminating station the other day. After its speed went up above 200 it began to pound, and when it had reached 350 it pounded bad. Then the governor left its inner stops, increasing the effect of compression, and the engine quieted down. An engine will pound when running with condensation that will run quietly without it, simply because vacuum takes away the compression.

A Porter-Allen engine down in Maine (20″×36″) was made noiseless by the use of compression. At Dover, N. H., a finely built Porter-Allen pounded fearfully until compression was introduced, when it ran noiseless. Near Philadelphia, an engine, 28″×48″, of finest build, pounded so badly when first started (almost entirely without compression), that it could not be run longer than a few hours at a time. It would squeeze or pound the babbitt out of the crank brasses. Afterward proper compression was introduced, and the engine was quiet and satisfactory. I could cite a great number of these cases which have come under the writer's immediate supervision, both in the West and in the East. In each individual case has compression benefited the running and, when sufficient, has caused smoothness of action, unless the conditions of speed and steam pressure were so severe as not to admit of smooth running under any arrangement whatever.

Brooklyn, N. Y. E. F. Williams.

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DOES SCALE AFFECT THE EVAPORATIVE EFFICIENCY OF A BOILER.

Editors Mechanical Engineer:

Experiments recently made abroad to determine the relative economy of foul and clean boilers, do not agree in any respect with results obtained by other experimenters and engineers. It is stated that boilers with the fire surfaces covered with a stratum of scale proved fully as effective in evaporation as when the boiler was internally clean. Engineers will doubt this, as it conflicts both with practice and common sense. I refer to the experiments recently made and, (it is stated) very carefully conducted in Bavaria with scale ¼″ to ⅜″ on the fire-sheets, the water used being impregnated with gypsum, which produces the worst scale. A trade-paper states that a wrong impression exists as to the effects of scale in boilers. This is undoubtedly true, but I do not believe that scale does not diminish the steaming power of a boiler. We want no better proof that it does than over-heated fire-sheets, which shows that part of the heat is stored up in them. It needs no expert tests to convince the intelligent engineer that this is true. The bad effects of incrustation (when present to any extent) in a steam-boiler is so well known that even if it did not detract from economy its accumulation would be guarded against as far as possible. To convince the average steam user that scale does not interfere with the economy of a boiler will require more than one experiment in Bavaria, or elsewhere. If nothing is lost by the presence of a stratum of scale on the fire-sheets then nothing is gained by putting non-conducting material on the exterior of a boiler.

The result of the test mentioned (if true) is contrary to previous tests made by scientific and practical men. If the Bavarian experiment had demonstrated that scale ¼″ or ⅜″ detracted 75 per cent. from the efficacy of a boiler it would not have made engineers more particular as to the condition of their boilers, for, as a rule, engineers examine and clean out boilers as *frequently as circumstances will permit.*

There are many advocates of petroleum for removing scale; some tell us to use the refined, others say use the crude oil only. My experience however says use neither, as oil will eventually help to form a dangerous scale. The oil will also form a crust on the sheets at the water line. Oil introduced into a steam boiler has a tendency to combine with other matter held in suspension and the lightness of it holds the foreign matter a longer time than it would remain without the assistance of the oil, but both finally settle and form scale. It is a very easy matter to remove the surface impurities held in suspension by surface blowing, but it is an extremely difficult matter to remove deposit after it has settled and hardened on the sheets. Great care will be necessary, and frequent examination to prevent the formation of a dangerous scale if the feed water contains salts or lime. If a surface blow is attached it should be opened in the morning as soon as the water is disturbed by ebullition and continued at intervals during the day. I have also found it a good plan to set open way-valves between the gauge-cocks and boiler of the feed water was uncommonly impure, or if oil from the cylinder found its way into the boiler; this would stop up the gauge-cocks if it should occur. The cocks can be removed and the pipes cleaned at any time when steam is on. The bottom-blow should be opened at least once a day to make sure it is operative when needed, and to keep the pipe clear. I also think it a good plan to speed up the pump while the blow-off cock is open if the feed pipe is attached to the front end, and the blow-off at the back end.

Engineers do not have the time allotted them which they should have in order to do the work of examination and repairs as thoroughly as they would wish. In fact, they have frequently to break the Sabbath to do work that cannot be done when steam is on. A boiler covered with several tons of hot masonry is not a very inviting place to enter, even if the fire was hauled and the water let out the preceding day, consequently there are details often neglected that should, and would have received attention if sufficient time had been accorded.

Beverly, Mass. "Smoke Arch."

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SOME REMARKS ABOUT SCALE AND WHAT IT WILL DO.

Editors Mechanical Engineer:

A battery of 50 inch boilers was dumped in front of a boiler shop in the city recently and the mud-drum came with them. It was half full of coarse, yellow mud. One of the boilers had soft patches on every seam in the bottom, four in all, and inside was an inch of deposit. I call that fossil engineering; working in the interests of graveyards, coal yards, and the insolvent courts.

They cut out the lower halves of these boilers and put new bottoms in them. "New wine in old bottles." I have heard say that the fools are not all dead yet and begin to suspect that it is true. The boiler maker is not to blame, for a steam user has a right to repair his boiler as best suits his pocket; brains have nothing to do with it.

Some years ago I had charge of a thrashing-machine engine and boiler. Before starting up—(I had just arrived and had no chance to examine for myself)—I asked the proprietors if the boiler was clean. They assured me that it was. The feed was self-acting; that is, when the water fell an inch in the boiler it connected with the pump and put on the feed so that, in a certain sense, it was self-acting. I observed that the hand of the gauge vibrated a good deal, and, not being able to get more than 70 lbs. of steam came to the conclusion that the boiler was not so clean as it might be. This view was sustained by what soon transpired. While watching the gauge, as a man will do when the steam lags, the hand suddenly went from 70 lbs. to 120 lbs., and by the time I had my hand under the lever to ease it off, the pressure had risen to 140 lbs. My first impulse was to run, but the pressure fell almost as fast as it rose, and the boiler began to foam. On opening the furnace door all the tubes were leaking so as to put the fire out. I ran the water out as quickly as I could, and on taking off the man-hole and hand-hole plates found scale half an inch thick, covered with rust where it had parted by cracking off the fire surface. This was the cause of the suddenly rising pressures as well as the hard firing to make steam.

San Francisco, Cal. J. M.

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A NON-COMMITTAL PERSON.

Editors Mechanical Engineer:

Please to inform me how to organize an Association of Stationary Engineers. This place needs one badly. It seems to be the idea about here to get men who will work for the least money, no matter whether they know anything about the business or not. The town I live in is going to build a flour-mill, and they have hired a man to put up the machinery for $20 per month, who says he is "a machine shop engineer," but when I ask him any questions about the business he either makes no reply or else says: "You bet," or words to that effect. I own an engine and boiler at this place, but do not want any "you bet" engineers in charge of them.

Which is the most efficient of the two boilers: One 16 feet long with 45 three-inch tubes, or one 22 feet long with 12 six-inch tubes, both being 42 inches diameter? I say the shortest is the most efficient, but parties here have bought the longest one, claiming it to be the best.

The Mechanical Engineer is one of the best papers I ever saw. I only wish every engineer in the land took it, it would do them good.

Texas. W. L. R.

[Reckoning boiler efficiency by heating surface the shortest boiler is the best, as it has nearly one-third more heating surface than the other. With equal conditions of management and fuel the shortest boiler should evaporate more water per pound of coal.

We have forwarded our correspondent's inquiry as to associations, to the Secretary, A. M. Davy, 175 Elmwood Ave., Detroit, Mich., to whom all should apply for similar information.—Eds.]

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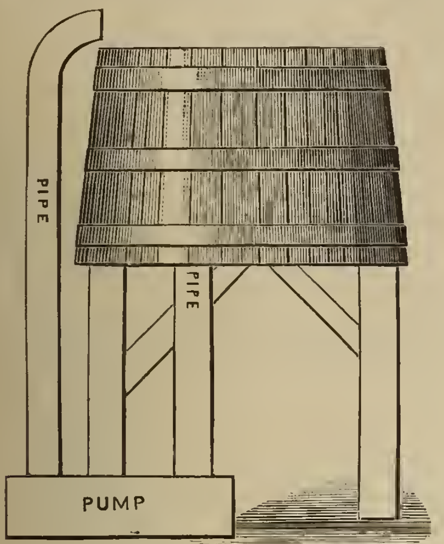
LOAD ON PUMPS.

Editors Mechanical Engineer:

Being one of the many readers of The Mechanical Engineer, I take the liberty of asking you a question; it is this: Which takes the most pressure—forcing water up through bottom of a tank, or pumping it in to the top of tank, the top being seventy-five feet higher than the air chamber on pump and six feet deep? The tank holds one million gallons of water. My opinion is that it is easier to pump water over the top than to force it up from the bottom. The tank is one and one half miles from the pump.



Am I right or wrong? Please answer in THE MECHANICAL ENGINEER.

I wish you would keep up those lectures by N. W. Williames.

Can you make THE MECHANICAL ENGINEER a weekly? If so it would please me. There are sixteen of us here that get it through the news agent at Guaymas. It costs us 18 cents here. We all think that it is as good a paper as ever published. Hoping that you will answer my question, I will bid you a Merry Christmas and a happy New Year.

GUAYMAS, SONORA, MEXICO. H. E. C.

[The resistance to pumping depends upon the heighth of the column pumped against. If, therefore, the tank was only partly full, it would be easier to pump into the bottom. If it was full to the top, it would make no difference in the load on the pump whether the water went through the stand-pipe outside, or up through the bottom of the tank.—EDS.]

MARINE BOILERS OF THE FUTURE.

Editors MECHANICAL ENGINEER:

I have been much interested by the articles in your valuable paper by "*Three Stars*" and "*Detroit,*" upon the marine boiler of the future, and am glad that the matter has been opened for discussion. There is unquestionably a growing demand for improvement in this direction. The increasing competition in steamship and steamboat lines, and the continued demand for higher speeds, requires greater power with less space and weight, and makes it imperative for the marine engineers to evolve boilers more suited to the requirements of the case.

The present marine boiler is much too bulky and too ponderous, both in dimensions and weight. It is also too weak—the strength decreasing rapidly with increased proportions. As to its factor of safety, we have only to review the daily papers and—shudder.

Its shortcomings cannot be remedied so long as boilers are made with shells of large diameter, water-cased fireboxes and combustion-chambers, enormous steam-chimneys, flat surfaces, stay-bolts, crown-sheets, flue-plates, braces, and carrying large quantities of water. The strength must be increased by reducing the diameter, and in the judicious use of the most suitable material, so designed and arranged as to allow free expansion and contraction in each individual member. and providing for a perfect circulation in every part.

The design should also be of such a character as to secure the greatest amount of heat from a given amount of fuel. This will need to be varied to suit the various kinds of fuel, especially with regard to the grate surfaces. As to the firebox, or combustion-chambers there is at present, I presume, no doubt of the efficiency of firebrick-lined furnaces. There may be some question as to the form. Flat surfaces are here objectionable, as they require great thickness to give solidity, but with circular walls, reinforced with iron casings, great strength, permanence and efficiency are obtained, with light weight.

These considerations point to the desirability of some kind of sectional steam-generator for marine purposes.

In the use of steam we have two prominent points of economy, that due to high pressures alone, and that due to high grades of expansion, the latter increasing with the former. To obtain the greatest economy we must utilize both, and when we can use an initial pressure of 200 pounds steam and take advantage of all expansion practicable, we shall have, as "*Three Stars*" asserts, the "greatest economy ever obtained on the sea."

The marine boiler of the future will be required to carry 200, possibly 300 pounds of steam, with almost absolute safety, and this alone will make sectional boilers for marine purposes an absolute necessity.

I notice that your correspondent "*Detroit*" affirms that there is not one of these afloat. In reply, I would state that sectional boilers of small dimensions and great capacity and strength, have been in use on some of our Western rivers—carrying as high as 200 pounds of steam. One such, owned by the United States Government, has been in constant use during the past four years. They are also being introduced into New York waters. During 1882 a boiler of this type, having 85 square feet grate, and 3,000 square feet of heating surface, was put in a steamer and tested to 850 pounds. At a recent test it showed an evaporation of 175 cubic feet of water per hour, from feed-water of 180°, with a constant pressure of 250 pounds steam, and with a consumption of 1,360 pounds of coal. This boiler, in steaming order, weighs only 18 tons, or 12 pounds per square foot of heating surface. Two other sectional boilers are to be found on a boat running in and out of New York daily, which have an aggregate heating surface of 3,400 square feet and 84 square feet grate. These are allowed by the United States Government 200 pounds of steam, and weigh only 17 tons, in complete steaming order, or about 10 pounds per square foot of heating surface, being one-fourth "*Three Stars*'" idea of the desirable weight.

NEW YORK. PROGRESS.

BOILER-BRACES.

Editors MECHANICAL ENGINEER:

Mr. H. G. Hill, Chief Engineer of the *Old Dominion,* objects to the braces shown in the engraving of a vertical boiler of my design, and *as they are shown* he is right. If, however, he had looked at the shell-sheet he would have seen holes laid out for crow feet. If the rivet in the brace-foot on the cone is put close up to the shank I don't see any fault in it.

In looking at Mr. Hill's letter again I find that he says he prefers braces put in with bolts and nuts. I don't think this would do very well on a crown-sheet, or where fire strikes the nuts. On any place about a boiler the braces should not be very tight. If they are put on with pins, these should go in easily, or so that they merely take up the slack, nothing more, for if they are on flat surfaces and there is any draw on the last brace it will loosen all that were put in before. I think there is no need of pins; make all the braces solid.

These are better, stronger, and cheaper, and with a little care in fitting there will be no drawing, one way or another. Let the braces fit snug, mark the holes on the crow-feet and punch, or drill them, and you have a sure thing. A brace that is tighter than the rest—that is carries too much load—is sure to break.

BOILER MAKER.

FROM STATIONARY ENGINEERS' ASSOCIATION. No. 4, OF MISSOURI.

Editors MECHANICAL ENGINEER.

Our association was organized last July with fifteen members, and we now number thirty-nine in good standing, with three applications on the table and more to hear from. We take none but good material. The officers elected at our organization went out Jan. 1st,, and at our last meeting we installed the following for the ensuing six months: President, T. W. Parish; Vice-President, G. Pinkham; Treasurer, G. E. Sortwell; Financial Secretary, C. T. Sortwell; Recording Secretary, J. M. Crabtree; Corresponding Secretary, H. M. Fife; Conductor, F. Cleary; Doorkeeper, A. L. Bergman; Deputy, W. A. Caron. Our meetings are on the second and fourth Tuesday evening of each month, corner of Sixth and Main streets, where all visiting brothers will receive a cordial welcome.

I would advise all associations to work against the Engineers' license law. We have it here in all its glory. I was called to set an eccentric for an engineer who could not do it, but he went before the board of examiners and got a license as a first-class engineer. Another man who never ran an engine or fired a boiler in his life, bought Roper (or one of his books), and in a week he answered all of their questions, paid them the fee ($5) and got his license. As he was a musician he could probably set a valve on a French horn, or play a solo on a bass drum. We have no *engineers* like him in our association; our examination is more rigid. We all take THE MECHANICAL ENGINEER and think it is "the boss;" gets better with every number.

KANSAS CITY, MO. HENRY M. FIFE,
Cor. Sec.

[We are glad to hear from our friends in Kansas City, but regret that they should oppose the licensing of competent men because the law is defective in its workings in some instances. That is a matter which cannot be avoided unless the inspectors are engineers themselves and interested in elevating the status of the trade. Our friends should try and bring about the selection of proper inspectors of engineers, It is manifest that the inspectors should themselves know the business, else how can they certify to the fitness of others. A board of physicians examines candidates for that profession, lawyers examine lawyers, and so on through all others where diplomas, or licenses to practice are given, Wehre politicians have the examination of engineers of course nothing but the mere letter of the law is observed, and the matter stands just where it did before there was one. We have said something about this in another column. If the examitions are honestly conducted there can be no question of the benefit to all.—EDS.

A SCALE-PAN.

Editors MECHANICAL ENGINEER:

I made a discovery which is new to me, and will describe it for the benefit of my brother engineers. I have charge of two tubular boilers 4′ diam., 12′ long. The water I use forms scale, from the thickness of paper up to 1-16″ on the tubes and shell; it then falls off and, of course, settles to the bottom of the boiler. Now for my invention, I had a pan 5′ long and of such a size that it would go through the hand-hole in the front end, and allowed it to sit on the bottom of the boiler over the fire. I ran three weeks on trial and then cleaned out; there was over half a gallon of scale in the pan, *all set up on edge,* and packed in solid from the back end of the pan toward the front end, with as much regularity as it could have been done by the most patient hand. I could have held all the scale I got out, (over and above what was in the pan) in one hand. The pans (I spoke of one only previously, to give the dimensions) were made of galvanized iron and had feet riveted to them so as to raise them about ¼″ from the bottom of the boiler.

Engineers, try it; and explain why the scale settles in the pan. I found it out by accident. I have showed the pan with the scale in it, just as it was when I took it from the boiler, to many persons and they all seem puzzled to account for it, G. W. R.

ANDREWS, IND.

CHANGE NOT ALWAYS IMPROVEMENT.

Editors MECHANICAL ENGINEER:

I have been greatly benefitted by letters written by numerous correspondents relating to their experience, and in return will give some of my own.

Several years ago I was an apprentice in one of the leading railroad repair shops of New England. The master mechanic was a man of many years experience in the construction and repairs of locomotives, and had made it his study for a long period of time. The result was that everything had, by numerous experiments, been put in the proper place and worked in harmony. All at once there came a change, owing to a change of circumstances best known to the master-mechanic, and he left the position. After a short time this was again filled by a much younger man, who, without doubt, was more thoretical than practical. Sizes and proportions which had acquired years of hard study to adjust were changed, and a new system prevailed throughout the shop. A feeling of curiosity took possession of nearly all the men in it, and with anxious feelings they watched the result.

An example of note was to increase the steam-lap on the valve with the intention of saving the coal-pile; if this had been carried to the extent the new man contemplated it would, quite likely, have accomplished the result, but before he had gone far in this direction he became aware of the well established fact that in order to do any work a certain amount of steam must be used.

Another example was to equip a locomotive with steam-packing, which, to his mind, would be a success, but the first trial gave evidence that something was wrong. When the engine began to ascend a heavy grade and struggled to reach the summit, a deep groan could be heard in the vicinity of the cylinders, which convinced the new experimenter that he was again on the wrong track, and so on through numerous other changes, all accompanied with about the same result. After spending large sums of money for the company, he decided that there was not much need of a change over the old system that had prevailed for many years.

Will the time ever come when mechanical problems can be seen alike by different men pretending to understand such matters? The question is, is a change always beneficial or desirable?

BRISTOL, R. I. F. S. B.

NOTES FROM THE MEETING OF THE FRANKLIN INSTITUTE.

At the meeting of the Franklin Institute, Jan. 16, 1884, the subject of examining engineers was discussed as follows:

Mr. W. A. Ingham moved the adoption of the majority report.

Mr. Wm. Helme took the floor and denounced the proposed ordinance for examining engineers to be the greatest absurdity that has ever been proposed at the Franklin Institute, and said that, if such an ordinance could be passed, and there was law to enforce it, there would be the greatest trade-union strike that was ever known.

Mr. G. M. Eldridge read passages from the preamble and proposed ordinance to prove its inconstancy and absurdity, and, finally, denounced it as a "trick," and said there was a "snake" in it!

Mr. Wm. B. Cooper moved to lay the two reports on the table, which was carried, and thus ended the subject at the Franklin Institute.

Mr. S. Lloyd Wiegand exhibited and explained a steam-boiler with flat cast-iron heads of the same pattern as that which exploded at the dye works of Gaffney, Nolan & Co., June 1, 1880, and explained that that explosion was not caused by incompetency of the engineer nor by the flat cast-iron head, but he gave other reasons. Mr. Wiegand defended flat cast-iron heads, and said they are safe, which he will prove by experiment at the next (February) meeting of the Institute.

CADMUS.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,
Editors and Proprietors,

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

LICENSING ENGINEERS.

The status of engineers in charge of steam machinery is a matter of the greatest importance to communities, and anything tending to elevate them, to increase their intelligence, especially their knowledge of the business, makes life and property more secure. This seems to us so palpably true that we take it to be admitted, without further argument.

It is with some surprise, therefore, that we find a proposed license law for the city of Philadelphia discountenanced by the majority of a committee from the members of the Franklin Institute, the persons, of all others, who should have been foremost in recommending it. The objections to a license law are thus stated by the committee:

"It is not advisable to ask for an ordinance, requiring persons in charge of engines, to pass an examination, and be licensed by a board. Such an ordinance would be in restraint of liberty, and should never be enacted, unless a free system is intolerable, or unless the reasons for restraint are shown to be overwhelming. Every security possible should be extended to life and property, but the undersigned are of the opinion that the proposed ordinance would not tend to increase it, for the following reasons:

"1. The qualifications of an engineer, as sobriety, watchfulness, application to his duties, and a knowledge of the machine under his care, cannot be determined by a board of examiners, but can be as now by his employer.

"2. As the examinations must necessarily be upon the same few points, it might be possible for incompetent candidates to become possessed improperly, of the correct answers to the questions, and consequently receive a license without possessing the qualifications of an engineer.

"3. The passage of such an ordinance would create a privileged class of men with power to fix their own wages, regardless of the value of the service rendered, and as proprietors would be compelled by law to employ only those having a license, it would assist in extending an odious feature of trade's unionism.

"4. Should loss of life or damage to property be caused by an exploding boiler, whilst in charge of an engineer licensed by municipal authority, it is a question whether the responsibility would not be removed from the proprietors and placed upon the city.

"5. It is not within the scope of an institution, formed for the promotion of the mechanic arts, to recommend or induce legislation upon matters not relating to its purpose.

"WASHINGTON JONES,
"WM. HELME,
"COLEMAN SELLERS, JR,
"C. M. CRESSON, M. D."

It would seem impossible, for any one acquainted with the facts, to sign such a report, for from the first word to the last the objections are founded on fallacies. Surely Mr. Coleman Sellers, Jr., would not assert that employers of engineers are competent to judge of an engineer's capacity; neither would Mr. Washington Jones, who, we believe, is the superintendent of I. P. Morris & Co. steam engine builders. Both of these gentlemen must be aware that in signing such a report they commit themselves to extraordinary positions, and it seems to us they have done so without careful deliberation.

In a few words these objections to a license law for the better protection of life and property through the separation of capable persons from incapable are in direct opposition to the practices of these gentlemen in their own trades. Mr. Sellers, Jr., is connected with machinists of well known reputation. In his own line of business he endeavors to select and obtain the most capable and intelligent men. He would, we assume, hire a man who came to him with an acknowledged certificate of capacity from his equals in the trade, sooner than he would a man from the street who would have to demonstrate his ability. Yet when engineers endeavor to obtain such acknowledgments from competent authorities he opposes them. When they demand some recognition of their ability he denies them, upon the ground that "it would create a class of privileged persons." It certainly would, and that is the very class wanted in engine rooms and in charge of boilers. Men of high intelligence are always privileged persons in the sense that they are better than the unintelligent, who take no pains to inform themselves upon the business they profess to have knowledge of. There are very many such classes in the community now, and surely the addition of one more would not shake the prosperity of the country. Physicians are of this class, and also druggists' clerks. So are policemen, for even in this latter calling candidates have to undergo an examination as to their fitness, and their uniform is their license. All civil examinations that are searching and sincere develop privileged classes, in the meaning that they sift the good from the bad and elect those most worthy. The assertion that such selection would give the power to fix wages is contrary to facts. No man or body of men in this country can fix wages, except temporarily; but this topic is foreign to the subject in hand and need not be here discussed. In regard to it we can only say that since the engineers' associations of this country have become recognized they have expressly discountenanced such interferences, and their constitutions forbid, in so many words, anything bearing upon it.

Engineers themselves are fully aware of their short comings, and ardently desire to rise higher. Such aspirations should be encouraged, not checked, and the direct effect of a general license law would be to stimulate persons to improve themselves. It would elevate the status of engineers everywhere—always provided the examinations were honestly conducted. We advise the friends of general license laws to persevere, and not give up because of unexpected opposition, and we regret very much that such time-worn arguments—obstacles—should be placed in the way of engineers who are trying to acquire better knowledge of their trade, demanding as a reward therefor merely that they should not be confounded with others who make no effort at all.

We ask Mr. Sellers' and Mr. Jones' attention to this paragraph from the Springfield, Mass., *Democrat*, and request them to tell us, frankly, whether they think the individual in question has his counterpart in Philadelphia:

"The engineer at present in charge of the boilers under Gilmore's hotel is Mr. Ludington, apparently an industrious man, who graduated from a position where he was getting $6 a week to assume the responsible duties of engineer. Mr. Ludington says he didn't know whether to accept this position or drive a team, but concluded to run the boilers, and leave the matter of pay for Mr. Gilmore to decide

"'What do you know about these boilers?' asked a *Democrat* reporter of Mr. Ludington.

"'I don't know much about them,' he said. 'No one has told me about these traps around here, and I've got to find them out myself'

"'Do you know how much these boilers will stand?'

"'No, I don't know anything about it. I don't know when they were inspected, whether they are old, or anything, but should judge they were better than the other one.'"

Should not the public be protected against such imposition as this?

◆

"AN AMERICAN VIEW OF ENGLISH LOCOMOTIVES."

Being peaceably disposed, we will not quarrel with our American contemporaries, and will pass by their complacent assumption that English locomotives are ill designed and worse constructed with as much phlegm as is in our nature. As we are assured, however, on competent authority, that one of Mr. Stroudley's new express locomotives could achieve barely more than the task of standing still when attached to two sleepers, two mail and baggage cars, and two ordinary coaches when burning our soft coal, we very deferentially seek the reasons. These appear to be (*a*) that the cab is contracted in space, (*b*) that the "smoke stack" appears short and temporary looking, (*c*) that the boiler is straight from end to end, and (*d*) that the dome is plain. THE MECHANICAL ENGINEER gives no other reason whatever, and, as it is the infallible authority on the subject, we advise Mr. Stroudley in future to make the funnels of his locomotives more like factory chimneys, to double the size of the cab and furnish it with couches and easy chairs, to make his boilers in outline represent a sinusoidal curve, and to make the dome resemble as near as possible an old world brass candlestick magnified. It is probable, too, that the addition of a gigantic head light and a church bell would add at least ten miles an hour to the speed. We are very grateful to THE MECHANICAL ENGINEER for its perspicuous witticism, and for so clearly indicating the reasons why our locomotives crawl so slowly with a light load. Our wise and infallible friend appears not to know that nothing but "soft coal" is burnt on English locomotives, but that is a detail.—*Mechanical World.*

Our contemporary excites itself needlessly. We fail to see in our remarks upon the locomotive alluded to any cause for its displeasure. We said, page 145, vol. VI.:

"Americans cannot but wish that they could see one of these engines attached to two sleepers, two mail and baggage cars, and two ordinary coaches, run on a time schedule of 50 miles per hour over an American railway, burning our soft coal."

We see nothing unamiable in this; but, possibly, the head and front of our offending lies in saying anything at all.

The gentleman sent by the London *Engineer* to the Chicago Exposition of Railway Appliances seemed to know something about English locomotives, and his statement after seeing an American engine was printed in the *London Engineer* as follows:

> "The English engine would be taxed to her utmost capacity with such a load, and could not possibly make time to the extent of ten minutes."

Not only did this venturesome Englishman say this, but many other things far more disturbing. He even dared to speak disrespectfully of the English plate-frame, to wit:

> "A bar measuring 3½″ or 4″ square can better resist compression than a plain plate 20″ to 24″ deep and only 1″ thick, though the latter frame is nearly double the weight. Thus, the lightness of American engines is due more to their peculiar mode of construction than to weak scantling or small bearing surfaces."

This is certainly much worse than anything we have said, and we are sorry that the *Mechanical World* omitted to controvert it, for the statements above referred to were printed by us in the same issue with the remarks which offended our contemporary. We have never professed to be an authority upon locomotives of English or any other make, but we presume that our transatlantic friend has no objection to our making occasional critical remarks based on actual experience with them, from the "mud-ring" in the firebox to the smoke-stack.

The mechanical practice adopted by engineers of civilized countries is at all times matter for criticism, for by this we learn mutually. If the criticisms are unjust they do no harm, for the well informed see that they miss the mark; if they are malicious they are beneath notice, while if they are honest and guided by practical experience, they are invaluable to those not beyond learning anything. A modern English writer says:

> "When I hear the people who know everything talk of the things that I know, I sometimes wonder whether they know anything."

This rises almost to the dignity of an aphorism and is worth remembering.

A POINT ON COMPRESSION.

The communications on compression as applied to steam engines, published in this issue will be read with interest by those whom it concerns. The tone of both writers is pleasing, in that they show that different views can be presented without acrimony or sarcasm.

Perhaps it is not unbecoming in us to say a word in passing on the same subject, and ask if compression is economical why those who favor it stop where they do? The argument is that a certain amount of compression is desirable, and even necessary to the welfare of the engine, but a certain greater amount—(how much is not stated)—is undesirable. In plain English we may push the steam back in the cylinder a little way without loss, but if we complete the cycle of revolution and compress it to boiler pressure we lose.

It seems to us that in this respect the position of compressionists is weak. If we can compress steam without loss of power for eight-tenths of the boiler pressure we can certainly compress it the other two-tenths, and force it right back into the steam pipe, for the last two-tenths are cheaper in power than the first eight-tenths. The fly-wheel on the last two-tenths of compression is traveling at the same velocity while the piston is at or near point of the least motion.

We believe that even those who advocate compression would not countenance the proposition to push the exhaust back into the steam pipe; this could easily be done if the exhaust closed at seven-tenths of the stroke.

CAST-GEARING FOR MACHINE TOOLS.

Mr. J. Richards, in his interesting articles on machine tools, which we republish from *Engineering*, makes a specific statement which will surprise many American observers. He says that the reason cast-gears are employed on English tools to the exclusion of cut-gears, is that the former are cast "true enough to run well in nearly all cases."

If "true enough" has any meaning as applied to lathe gearing, and "run well" is an admissible expression, then all American tool builders are singularly finical, and foolishly lavish in expenditure to secure exactness in these details.

Our own impression is that Mr. Richards has been inexact in his expressions. He would have great difficulty in convincing American machine tool builders that hot metal poured into a more or less yielding mould, further distorted as to the resultant casting by shrinkage strains in the act of cooling, will produce anything more than an approximation to correctness. We have seen several examples of cast-gearing on tools from abroad, and it did not strike us that they were especially good for cast gears.

TALKS ABOUT THE STEAM ENGINE.—No. VIII.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

In my last I mentioned the various methods of fastening piston-rods, in which the gib and key were not used. Keys have been much used on the older styles of engines, and are still in many large ones for fastening the ends of piston-rods.

In what I have to say I will include the principles involved in all cases where keys are used, save for shafts.

It is customary to assume that wrought-iron is as strong to resist shearing as to resist tension, and as this assumption has practically proved its correctness, we are on the safe side.

In some engines it will be observed that the end of the piston-rod is swelled where it is keyed to the piston-head, but not where it is keyed to the cross-head.

This is a manifest absurdity of design, since the strength of a chain is always that of its weakest link; if it is strong enough at the cross-head it is too strong at the piston-head.

The reason why the rod is strong enough without being swelled at the cross-head is that the rod is confined at that point and only subjected to a stress, in tension, on each side of the key. The most injurious stress is that involving buckling, since it *works* the connections and that we do not have to meet here.

It is customary to make the key and its gib (or gibs) together, equal in width to the diameter of the rod, and their thickness equal to one-quarter of the diameter of the rod.

A key and its gibs can and must be sheared at two surfaces, where it projects from the rod, and as there must be a uniform taper if the key alone is used, we can consider the width at the middle of the rod as a mean or average width when gibs are not used.

We see, therefore, that the cross section of a key subjected to shear is equal to the square of the diameter of the rod, divided by four, and, since the shear must occur simultaneously at two points, the metal sheared would be twice that.

Let us see what results from the above rule. In an example already given we have:

Diameter of piston, 32 inches.
Pressure 40 lbs. per square inch.
Diameter of the piston-rod, 3·84 inches.
For total area of piston-rod we have:

```
      3·84
      3·84
      ————
      1536
     3072
    1152
    ———————
    14·7456
       ·785
      —————
      7370
    11792
   10318
   —————
   11·57   square inches.
```

The two cross sections of the key will be:

```
 2)14·74
   —————
    7·37   square inches.
```

The cross section of the rod through its weakest point, the key-way, will be:

```
   11·57
    3·69
   —————
    7·88   square inches.
```

That is to say, the rod will still be stronger than the key, assuming tensile and shearing strengths equal.

The question at once follows: Is the key strong enough, since it is the weakest point?

We find the total pressure of the steam on the piston-head to be:

```
(1)   32       (2)  1024       (3)  804·25
      32            ·7854              40
      ——            —————       ————————
      64             4096      32170 00  lbs.
     96             5120
    ————           8192
    1024          7168
                  ————————
                  804·2496   square inches.
```

If we divide the total stress by 5,000 lbs., we would have the required double, cross-section of key, thus:

```
5)32.170
  ——————
   6·43   square inches.
```

We see, then, that in average practice where a designer follows successful designs, that this is a good rule, for it probably will bring us out on the safe side.

It is much better, and always safe, however, to proceed as follows:

Compute the greatest stress on the whole piston-head in pounds. Divide this result by 5,000 pounds, and the result will be double the cross section of the through key in square inches.

We then have the required cross section for safety and can divide it up among the gib (or gibs) and key. We can strengthen the piston-rod, if necessary, by making the key less than one-fourth the rod's diameter in thickness, increasing its width or meet any exigencies that may arise.

For steel keys the same rule as the one last given applies, save that we divide by 6,750 instead of 5,000 pounds.

The many forms of gibs and keys used and the methods of adjusting and fastening them I do not mention, for it forms no part of my plan to suggest ingenious arrangements. I shall confine myself to fundamental principles, leaving to those who are designing the ingenuity required.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLVIII.

I thank the gentleman who has written a letter to the editor in this issue in favor of compression. I thank him for two reasons: First for taking the trouble to answer my views on the subject, and secondly, because he seems to represent the opinions of many others who may be led to see the error of their ways. I cannot but think, however, from reading the proof sent me by the editor of THE MECHANICAL ENGINEER that the side presented to us by compressionists—as Mr. Williams gives it—is indefensible, and I will say where and how it appears so to me.

Mr. Williams' definition of work done—power expended—is sophistical, and avoids the issue. Whether he grinds corn or compresses a spring with his piston he has expended so much power, and of this he cannot get back what he has put out. The elasticity, or inelasticity, of the object worked on has no relation to the matter of work done. He compresses a steam spring, for instance, and it resists him; on the return it gives out a portion of the power invested in it, but not all; a fraction still remains behind. It seems hardly necessary to consider this. I believe it is universally admitted that in all the work done a portion of the power is lost in doing it. If this is true, then it would seem that non-compressionists are correct in saying that a loss of power is entailed by compressing steam.

Mere assertion, however, goes for nothing on either side. I have in this matter taken indicator cards into account, and cited their areas as evidence that something was missing from them where high compression is used. I have said that the corner was cut off and that this represented a loss, for the reason that it nowhere reappears on the card. Does not Mr. Williams see that if he gains anything by compression, it is poor policy to fully open the valve at every stroke of the engine? Suppose he starts his engine and runs it half an hour to get it thoroughly heated up, compressing the exhaust to within five pounds of the boiler-pressure! Now if he does this, it is very foolish to continue to open the live steam side and let fresh steam in on that which he has already there to do his work. He should open it only partially, just enough to supply the difference between the boiler pressure and that to which the exhaust is compressed. How does he think this would work?

Of course this is the question reduced to an absurdity, but I have used the point as an illustration of what seems to me a fallacy—to wit: that work can be done without the expenditure of power. This is what it comes to if compressionists are correct—that power put into the fly-wheel as a reservoir can be taken out of the reservoir without any loss in the transfer. Aside from all the laws on this subject, I respectfully submit that this is not mechanical common sense.

Mr. Williams is by no means alone in his belief. I have heard men of collegiate education, familiar with steam engines and experiments elaborately carried out, gravely assert that compression is no loss for the reason that all the power expended was regained on the next stroke. As if all the weights and forces existing in a steam engine in action could be so perfectly weighed, in reversing the action of it, that the same weight of steam would be shown, and the same heat-effect obtained, as if the operation went on direct without any reversal! Let me leave theory to take care of itself, and touch upon the more positive assertions in Mr. Williams' letter, to wit: where he says that the piston won't work close up to the cylinder-head, and that—

> "If there were no clearance there could be no compression, and we would be left without an argument."

Here he has stated the case exactly, and admits that compression is useful to fill up clearance spaces. Now if he can show that clearance is necessary he will have established his argument. The trouble lies in the word itself. It is too elastic. Clearance is anything, so long as the piston does not actually strike the head; but whether it is a thirty-second of an inch, or three inches, makes a great deal of difference to this contention. If Mr. Williams has had a wide experience (I do not question this), he must have seen engines at work with practically no clearance; that is, the piston did not strike the head by $\frac{1}{16}$th of an inch, and this in cylinders of sixteen and twenty inches diameter, and piston-speeds of, say 400 feet per minute. A statement was made in this paper, July 21, 1883, first page, that the steamer *Bristol* of the Fall River Line had only $\frac{3}{16}$ths of an inch clearance—cylinder 110 inches diameter—and I presume it was derived from some good source or it would not have been so boldly made. I might multiply instances at great length showing that clearances can be reduced to practically very small areas. Now clearance is commonly called waste-room. We do not want this in steam cylinders. We can get along with it in very small quantities. If compression has to be resorted to in order to overcome errors of construction and design, it seems to me that, to use a simile "it is slain in the house of its friends." If it (clearance) is not a necessity, then truly compressionists are left without an argument, for with close clearance high compression is impossible, without knocking out the cylinder-head.

Where Mr. Williams argues in favor of compression as a means of making an engine work noiselessly, it seems to me he begs the question. If an engine cannot be made to work noiselessly without it, then it is an essential; but I can show him—as stated in a former letter—large engines working so that he cannot hear them with his back turned; but for the evidence of his eyes he would not know that the engine was there. I have been told of many others which I have never seen. The editor of this paper took me on board of a steamship in New York last summer; the name of it I have forgotten, but the engineer in chief is Mr. Wait or Wade. Her engine is 60″ cylinder and 72″ stroke, and it makes 60 revolutions per minute with 90 lbs. pressure. Velvet is not smoother in surface than the engine is in its action. It is absolutely noiseless, without any reservation. The valves have no lead and there is no compression whatever, for the exhaust valves are independent and are open throughout the stroke. There is not even the compression of re-evaporation. I know other engines in Philadelphia that are running at high speeds without compression, and from these examples which can be seen daily, I deny that compression is an essential to, and inseparable from high velocities. I have known engineers, quite as positive as Mr. Williams on this point, who were certain that an engine could not run quietly without compression. These persons changed their valve-motions, and their engines pounded and badly at that. Then they said triumphantly, "What did I tell you!" But being advised to wait awhile, to go slow, and take as much trouble to disprove their views as they would to prove them, to go honestly to work and get the pound out, they did so, and the result was success.

Where Mr. Williams speaks of a certain make of engine and the valve motion used on it, he reminds me of the fox who got his tail caught in a trap and had it cut off to about 1$\frac{7}{8}$ths over all. When his fellows derided him for it he said it was the fashion, and the only way to have a tail. So it is with the engine he speaks of. With it, at short cuts, high compression is unavoidable, for the exhaust shuts up, anyhow, at half stroke, as it is a single valve automatic cut-off. It seems to me that this is making a virtue out of a necessity.

This applies, also, to the locomotive; so far from compression being the cause of its success—a singular statement to make—it is one of the greatest obstacles to higher speeds, and this is acknowledged by leading engineers everywhere, some of whom have been at great pains and expense to avoid the evil by the introduction of new motions for the purpose.

What Mr. Williams says, in special cases, of engines ceasing from pounding so soon as compression was introduced, does not relate to the matter at all. Many things besides want of compression cause an engine to pound, particularly want of balance. An engine with all the compression that can be given may pound as badly as one without an ounce of it. I consider it a costly cure.

Finally, as I am getting long-winded, I will say that up to within a short time I was as ardent a believer in the virtue of compression as he is, and many is the argument I have had over it upon pretty much the same basis as his, but what converted me was my inability to see how power could be changed from one end to the other without loss in the transfer. Also the experience of others who had been brought up to believe in it, and did believe in it, until the testimony of the coal bunkers shook their faith. Seeing is believing, says the proverb, and when an engineer sees, trip after trip, more coal remaining over than he had when he used high compression, not on one trip or two, but through a series of careful experiments, when he finds he uses less oil also, and his bearings run better everyway—cool where they were hot before—I say when he finds these things in his pocket, it is hard to make him believe he is in error. You can get a camel through the eye of a grindstone sooner.

HOW I SERVED MY APPRENTICESHIP.

BY GEORGE SLOCUM.

NUMBER III.

Old man Jones' lessons interested me a great deal. This was the first time I had ever seen figures applied to machinery—theory and practice coming together face to face as it were—and I made up my mind to dig right in and learn all I could while I had a chance. So that evening I bought a pocket-size blank-book and wrote down all the points Jones gave me, as near as I could remember.

The next day we had some new driving-wheels to press on new axles. Some went on at 60 tons—the lowest limit—some at 80 tons, and one wheel ran the pressure up to 90 tons without bursting. When it reached 81 tons, Smith called the foreman's attention to it. He didn't seem to like it a bit, and growled and grumbled, and went over to the axle-turner, and Smith remarked that he was setting his packing out. Smith was cautioned to report all fits running the pressure above 80 tons—the highest limit.

That evening Jones and I resumed our former positions on the press question, Jones leading off with:

"Say George! While I think of it, let's figure on the *power* of this press."

"That hits me exactly, Jones. I am going to stay right with you," said I to him.

"Well, in the first place, we want to know what load at the ram, one pound at the rim of this pulley will balance. Then we want to know what load at the ram, one pound placed on top of this plunger will balance. You see?"

"I do."

"We said this pulley was 18 inches diameter. Its circumference is 56½ inches, nearly. We said the ram advanced $\frac{1}{16}$th of an inch (nearly) for each 6 inch downward stroke of the plunger; did we not?"

"We did."

"Very well. Now mind, that only half a revolution of the pulley is effective in moving the ram, for the pump is single acting, and, of course the upward stroke does not move the ram at all."

"I see," said I.

"Well, half the circumference of the pulley equals 28¼ inches, don't it?"

"Yes."

"Well, while the pulley moves 28¼ inches; the plunger moves downward 6 inches, and the ram moves outward $\frac{1}{16}$th of an inch."

A few days after this we had some driving-axles to back out of old wheels. Some pressed out at 30 tons, and it took 70 tons to start others. Smith said that the axles that pressed out at 30 tons were tapering the wrong way, and that it was a miserable job at first. I got thinking over this, so I asked Jones for some pointers about axle-fits.

AXLE FITS.

"Some master mechanics," said Jones, "want the axles turned straight; others require a little taper, not a great deal, but just so you can feel the callipers looser at the end than at the shoulder. It stands to reason that this is the best way; because the end of the axle enlarges the bore of the wheel as it passes in, and if the bearing is straight, the part near the shoulder does not compress the iron and it can not be as tight a fit as at the end of the axle. But a slight taper overcomes all this and makes a good fit from end to end of the wheel-bore. Then the axle-turner must use good judgment in callipering the hole and look out for hard and soft iron, or he may get left on a fit.

"It sometimes happens that crank-pins are pressed in after the tires are shrunk on, and it is found on taking the size of the hole that it is oval-shaped. In such a case the turner should calliper the hole on the compromise plan, that is, take half the longer and shorter diameters added together for the true diameter, and then allow for fit at whatever pressure he is told."

"Do you understand?"

"I catch on to that nicely," said I.

"Come! let up on that slang, George, I hate it."

"So do I. I've learned it though, since I came into this shop."

"Well, try and unlearn it. While the ram moves out sixteen times $\frac{1}{16}$th, (or 1 inch) the plunger moves downward sixteen times 6 inches, or 96 inches, and the pulley moves sixteen times 56½ inches, which equals 904 inches; this divided by 2, gives 452 inches of effective movement for the pulley. Now one pound of power at the plunger will balance a resistance of 96 pounds at the ram. Furthermore, one pound of power at the rim of the pulley will balance 452 pounds at the ram."

"Do you understand?" said Jones.

"No, I don't. You've got 96 pounds at the ram, and then you've got 452 pounds at the ram, all for 1 pound of power. How's that?"

"Well, hold on, I ain't through yet. You're a little too previous?"

"Come, let up on that slang Jones, I hate it."

"Dod rot it, I forgot," said he.

"Well, try and unlearn it."

"See here. The ratio between the velocity of this pulley and the velocity of this plunger is equal to

$$\frac{28{\cdot}25}{6}$$

or, 4·71. Now if you multiply 96 by 4·71 you get 452 nearly, don't you?"

"Oh, I see. The greater the distance through which the power moves for 1 inch advance of ram, the greater the power exerted," said I.

"Of course! The more times you reeve a rope through two pulley-blocks, the more power you get, but the slower the load moves."

"How about setting the outside callipers?"

"Well, hold on. I am coming to that," said Jones.

"After taking the size of wheel-bore with inside callipers, I have seen a turner set his outside callipers to them so they would just touch, then he would spring his callipers over the axle bearing and *guess* at a fit. This is what I call a slovenly way.

"Then I have seen turners make good fits right along all the time, by taking the exact size of the hole and then holding both callipers between their eye and the light, so they could just see light between one leg of each calliper. This is a good way, but requires some practice to get the hang of it. I knew a man once who had a great deal of axle and pin fitting to do, and he carried a small piece of medium Russia iron in his vest pocket, and when he sized a hole he put the bit of sheet-iron between the callipers just so he could feel it, and then he callipered his axle in the same way. I think this last plan is the best."

FITTING UP CYLINDERS.

After working five months with Smith, I was told to go and help the man who fitted up the cylinders. This was just the job I had hankered after for some time, and I used to envy the boy who helped Brown—that was the cylinder man's name—because he had so much chipping and filing to do, and I wanted to learn how to chip and file ever so bad. So I gathered up my traps and went for Brown in no time. I was in such a hurry I guess I forgot to say good-bye to Smith.

(*To be Continued.*)

THE STEAM ENGINE INDICATOR AND ITS USE.—No. 9.

BY WILLIAM BARNET LE VAN.

THE POINT OF RELEASE OR OPENING OF THE EXHAUST PORT.

This is at *f*, diagram 12. (See number 1 current volume). To provide a rapid egress for the exhaust steam, and in order that is pressure may be as nearly as possible at a minimum, after the work in the cylinder has been performed, it is necessary that the exhaust port should be opened before the piston reaches the end of its stroke. The proper amount of this pre-release depends, of course, upon the velocity of the piston and the quantity of steam to be discharged, or the grade of expansion. If, on the contrary, the steam be confined until the last instant, the back pressure at the commencement of the return stroke will be considerably increased, or in proportion to the period of admission. The deficiency of early release produces in the indicator-curves a sharp corner at *g*, at the end of the stroke, as shown in diagrams 9 and 11. It will be noticed, also, that a considerable loss of effective pressure is caused, for the same reason, as clearly shown by the reduction of the area of the indicator diagrams. The amount of back pressure against the piston during the remainder of the exhaust, also depends directly upon the amount of release and, indirectly, upon the speed of the engine. If the exhaust-port is not well open at the end of the stroke, it is evident that the greater volume of the steam must be discharged during the return stroke of the piston until the closing of the exhaust port; but as the piston attains its maximum velocity at half stroke, the minimum back pressure above the atmospheric line must then be greater than it would be under the more favorable condition of premature escape of the steam. Therefore, the non-release of the steam before the end of the stroke involves not only a direct loss of the work done by the steam, as shown by the corner cut off from the indicator diagrams 9 and 11, but its injurious effect is also manifest during the greater part of the return stroke.

The loss of work done through an early release of the exhaust is more than regained during the return stroke, the back pressure against the piston becomes reduced to that of the atmosphere. See diagram 8.

THE EXHAUST-LINE.

It is, of course, desirable that the pressure of the steam be got rid of as completely as possible before the piston commences its return stroke. This is accomplished by having the exhaust port and passages sufficiently large, and opening the port a sufficient time before the termination of the stroke, according to the density of the steam to be released and the velocity of the piston.

The exhaust line commences at the point of release *f*, fig. 12, where the expansion-curve changes to convex as the pencil travels to the line of counter pressure, and shows the fall of pressure caused by the release or opening of the exhaust-port for the escape of the steam before the forward stroke is finished, in order to diminish the back pressure. In an engine in which there is no pre-release; (the exhaust port opening exactly at the end of the forward stroke) the diagram during the return stroke is usually a curve more or less similar to the line *g d*, see figure 11 in current number.

The lower side of the theoretical diagram figure 12, used in calculations being the line *V V*, representing the pressure in the condenser, or in non-condensing or "high pressure" engines the atmospheric pressure line, *A*, *D*.

By making the release occur early enough, for example, at the point corresponding to *f*, in diagram 12, the entire fall of pressure may be made to take place towards the end of the forward stroke, so as to make the back pressure coincide sensibly with that corresponding to the line, V V; then the end of the diagram will assume a figure represented by the line, *f D d*, in diagram 12, which is usually more or less concave. The greatest amount of work is insured by making the release take place at point, *f*, so that about one-half of the fall of pressure shall take place at the end of the forward stroke, from *f* to *D*, and the other half at the commencement of the return stroke, as indicated by the curve, *D d*. The line, *f D d*, is traced while the excess of pressure remaining at the point of exhaust is being released.

BACK-PRESSURE, OR LINE OF COUNTER-PRESSURE.

If the steam used in working engines were unmixed with air, and if it could escape without resistance, and in an inappreciably short time from the cylinder after having completed the stroke, the back pressure would be simply, in non-condensing engines (called "*high pressure engines*), the *atmospheric pressure* for the time; and in condensing engines, the pressure corresponding to the temperature in the condenser, which may be called the *pressure of condensation.* The mean back-pressure, however, always exceeds the pressure of condensation, and sometimes in a considerable proportion. One reason for this, which operates in condensing engines only, is the presence of air mixed with the steam, which causes the *pressure in the condenser*, and consequently the back-pressure also, to be greater than the pressure of condensation of the steam. For example, an ordinary temperature in a condenser when working properly, is about 100 degrees Fahrenheit, to which the corresponding pressure (absolute) of steam is about one pound on the square inch. But the absolute pressure in the best condensers is scarcely ever less than two pounds on the square inch or nearly *double* the pressure of condensation.

The principal cause, however, of increased back-pressure, is resistance to the escape of the steam from the cylinder, by which in condensing engines, the mean back-pressure is caused to be from one to three pounds on the square inch greater than the pressure in the condenser.

In non-condensing engines, experiments show that the *excess* of the back pressure above the atmospheric-pressure varies nearly: As the square of the speed; this excess of back pressure is less, the shorter the cut off is, in other words the greater the ratio or grade of expansion; that is to say, the longer the *time* during which the exhaust of the steam lasts. In cylinders with a mean of 16 per cent. of release, that is, with the exhaust-port opened when the piston had performed 0·84 of its stroke—with steam cut off at one-half the length of stroke—that is, with a ratio or grade of expansion of 2 nearly, and with a piston speed of 600 feet per minute, being the maximum of speed in a good engine; the excess of the back pressure above atmospheric pressure was about 0·163 of the excess of the pressure of the steam at the instant of release above the atmospheric pressure. When the pressure falls during expansion, as in Fig. 13, as low as the return or back-pressure, this exhaust line does not exist.

FIG. 13.

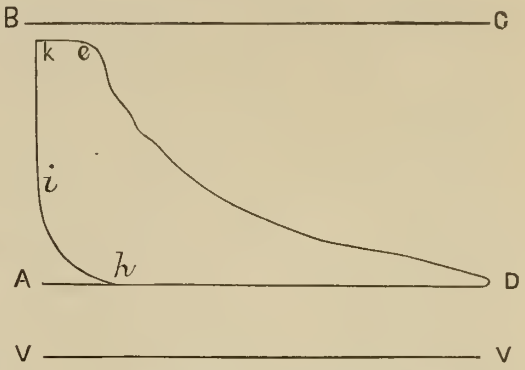
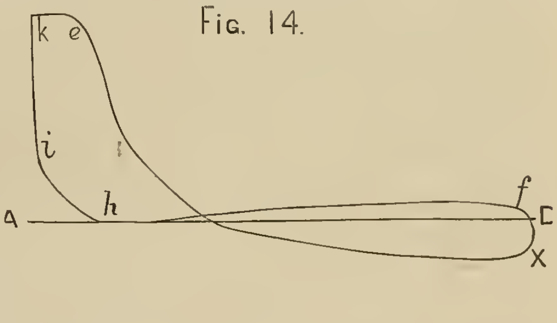


FIG. 14.



When the steam is exhausted below the return pressure, as in Fig. 14, the exhaust line is forced up from *x* to *f*, and indicates a rush of steam from the exhaust chamber back into the cylinder. This shows that the engine is too large for the work and is working at a loss.

When the steam is exhausted at a high pressure, and through cramped passages, the exhaust line extends over most of the return stroke, as shown in Fig. 11.

THE BACK-PRESSURE LINE.

This is represented by the line, *d h*, and is the pressure behind the piston during the return stroke, and is called back-pressure because it acts in opposition to the return movement of the piston. In diagrams from non-condensing engines, (commonly called "high-pressure" engines) it is either coincident with one or more pounds pressure above the atmospheric line, (see diagrams, Figs. 8 and 15)* while in diagrams from condensing engines (commonly called "low-pressure" engines) it it 22 or 24 inches of vacuum below, or such a distance below the atmospheric line as will coincide with the vacuum attained in the condenser (see diagram. Figs. 10 and 12). The resistance offered to the escape of the released steam has the effect of reducing, by a corresponding extent, the effective or indicated power of the engine. When the steam escapes from a non-condensing engine, the back-pressure cannot be less than the atmospheric pressure (14·7 pounds) at the time; and when it escapes from a condensing engine into a condenser, the back pressure upon the piston cannot be less the pressure of vapor existing in the condenser. The excess of resistance over these limits depends chiefly upon the state of the steam, the size and direction of the exhaust passages, and the speed of the engine.

Therefore, the passages and pipes communicating with the atmosphere should be at least

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*Will appear in next issue.

fifty per cent. larger than the ports, and as free from angles as possible.

These requirements apply to condensing engines even more strongly, and in addition the condenser and air-pump must be able to maintain a proper vacuum.

THE POINT OF EXHAUST CLOSURE.

This is represented a *h* in diagram, Fig. 12, and is where the exhaust port is closed against the escaping steam. It cannot be located in all cases very exactly by inspection, for while, like the point of cut-off and exhaust, it is anticipated by a change of pressure due to a more or less gradual closing of the valve, its is not marked by a change in curvature of the line.

FERGUSON'S MECHANICAL PARADOX.

We make no apology for presenting this standard subject to our readers. To the elder ones it will be no novelty, but many younger will see it for the first time. For this compilation and the engravings accompanying we are indebted to *Engineering:*

In the August number of *Blackwood's Magazine* is an article called "James Ferguson, the Astronomer," giving a short biography of him. At page 262 is an extract of a letter of his to a Scotch minister giving a detailed account of what Ferguson calls his "Mechanical Paradox." He is at a public house, and in conversation with a watchmaker on a religious doctrine; not considering the place a fit one for such an argument, he changes the subject thus:

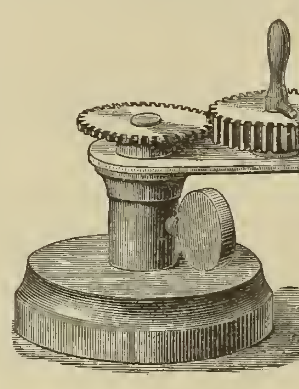
"'Sir,' said I, 'I believe you know very well how one wheel must turn another, or how a pinion must turn a wheel, or a wheel a pinion?' 'I hope I do,' he said. 'Then,' said I, 'supposing you make a wheel as thick as the other three and cut teeth in them all, and then put the three thin wheels all loose upon one axis and set the thick wheel to them so that its teeth may take into those of the three thin ones. Now turn the thick wheel round, how must it turn the others?' Says he, 'Your question is an affront to common sense, for everybody knows that turn the wheel which way you will, all the other three must turn the contrary way to that.' 'Sir,' says I, 'I believe you think so.' 'Think!' says he, 'it is beyond a thought, it is demonstration that they must.' 'Sir,' said I, 'I would not have you be too sure lest possibly you should be mistaken, and now, what would you say if I should say, that turn the thick one whichever way you will, it shall turn one of the wheels the same way, the other the contrary way, and the third no way at all?' Says he, 'I would say there never was anything proposed that could be more absurd, as being not only above our reason, but contrary thereto, and also to plain fact.' * * * The watchmaker asked me if I had ever made or seen such a machine. I told him I had not, but I believed I could make it, although I had never thought of it till this instant.' 'By ——,' said he, 'your head must be wrong, for no man on earth could do such a thing.' 'Sir,' said I, 'be my head wrong or right, I believe I can not only do it, but even be able to show the machine if I may be admitted into this company this day se'night.' The company, who with serious faces were very attentive to all this, requested that I would come. So I made the machine all of wood and carried it under my coat to the same room on the day appointed, and there was the watchmaker. 'Well, old friend,' says he, 'have you made your machine?' 'Yes, sir, said I, 'there it is; let us take it to pieces; are those wheels fairly toothed and fairly pitched into the thick wheel?' 'Yes, they are,' said he. I then turned round the great wheel, whose teeth took into those of the three thin wheels, and asked him whether the uppermost wheel did not turn the same way as the one that turned it, whether the next wheel did not turn in the contrary way, and the lowermost thin wheel no way at all. 'They do,' he said, 'but there is a fallacy in the machine.' 'Sir,' said I, 'do you detect the fallacy and expose it to the company.' He looked a long while at it, took it several times to pieces, and put it together again. 'Sir,' said I, 'is there any fallacy in the machine?' 'I confess,' said he, 'I see none.' 'There is none,' said I. 'How the devil is it, then,' said he, 'that the three wheels should be so differently affected? The thing is not only above all reason, but is contrary to mechanical principles.' 'For shame, sir,' said I, 'ask me not how it is, for it is a simpler machine than any clock or watch that you ever made or mended, and if you are so easily nonplussed by so simple a thing in your own way of business no wonder that you should be so about the Trinity!'"

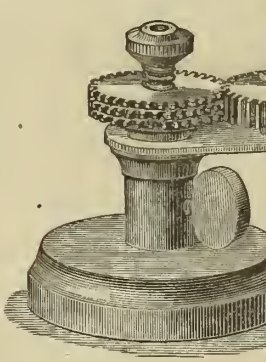
I am in the same unenlightened state of mind as Ferguson's friend, the watchmaker, and if any of your numerous readers will be good enough to furnish an explanation of the trick of "the mechanical paradox," I will be much obliged.

To this letter the following answer was given:

The subject of a letter in a recent issue took my fancy, and I designed a small machine in which one large wheel geared into three thin wheels upon one shaft. can actuate the same in a manner as described by Ferguson.

I then made a search for any other description of Ferguson's paradox, when I found it described in Goodeve's well-known "Text Book on the Principles of Mechanism," page 161. The main points of the original paradox I then found to be the same as conceived by me, viz., that the one thin wheel which turns the same way as the thick wheel, must have a greater number of teeth than the thick wheel. The second thin wheel which turns in a contrary direction to the thick wheel, must have a smaller number of teeth than the thick wheel, while the third thin wheel, which turns no way at all, must have the same number of teeth as the thick wheel. Notwithstanding the similarity of the arrangement of the number of teeth on the four wheels, the paradox as conceived by me differs from the original, which latter, I submit, does not fully produce the effects as stated by Ferguson in his letter.





As you can see from the illustrations in Goodeve's treatise and from the model (Fig. 1) made as the original paradox, Ferguson employed in fact five wheels, and this fifth wheel (not mentioned at all in his letter) is absolutely required to actuate the Ferguson paradox.

This fifth wheel is fixed upon a shaft in the center of the base of the paradox. Around this shaft moves freely an arm, to which two other shafts are attached; the next shaft from the center carries the thick wheel, having 60 teeth. The third shaft carries the three thin wheels, having respectively 60, 59 and 61 teeth. When the arm is rotated around the fixed wheel, the motion given to the thick wheel will then actuate the three thin wheels as specified by Ferguson. The motions of the two thin wheels are hardly visible, and I think many readers will, with me, not admit that the third thin wheel "turns no way at all;" in fact, it describes a circle, whose radius is the distance between its own center and the center of the fifth fixed wheel, during each rotation through this circle the wheel turns once round its own center. This double rotation keeps this wheel always in the same relative position towards the base of the paradox, and thus "seemingly" it turns no way at all.

The paradox as conceived by me is simpler and answers literally the description or specification given by Ferguson in his letter.

I employ only one thick wheel and three thin wheels, Fig. 2, the latter placed upon a shaft in the center of the base; around this shaft moves freely a small arm which carries a shaft upon which again the thick wheel is freely movable, and this thick wheel is well geared into the three thin wheels. When rotating the arm by the small handle, it can be seen that the lowermost thin wheel is at rest, "literally turns no way at all," the second wheel turns in a contrary direction, and the uppermost wheel turns in the same direction as the thick wheel, but whenever the thick wheel is turned directly by hand all the three thin wheels turn in a contrary direction as in the ordinary way.

I produce this effect by giving the thick wheel and the lowermost thin wheel 33 teeth, the second thin wheel 32, and the uppermost thin wheel 34 teeth. To the center shaft, upon which the three thin wheels rotate, I fix below the wheels a plate nearly as large as the thin wheels, so that the lowermost thin wheel may rest thereon with as much friction as possible; and the other two thin wheels I keep slightly at a distance from each other and from the lowermost thin wheel by very small washers, so that the least possible friction may be between themselves and the lowermost wheel. A small spiral spring presses the three thin wheels together, and particularly the lowermost thin wheel, upon its friction plate. When the arm carrying the thick wheel is rotated, the difference of friction between the lowermost thin wheel and the other three wheels will keep this lowermost thin wheel at rest and the motion given to the thick wheel must actuate the other two thin wheels (having different number of teeth as specified by Ferguson. As obvious, the whole is at present a mere mechanical toy, but some practical application, for example, a revolution counter, could be constructed from it, and in such an application the lowermost wheel should be fixed to its shaft instead of holding it by friction.

The original paradox is of the same construction as shown in Goodeve's treatise. Ferguson has, however, made use of the paradox for the construction of an "orrery," which "shows the different length of days and nights, the vicissitudes of the seasons, the retrograde motion of the nodes of the moon's orbit, the direct motion of the apogeal points of her orbit, and the months in which the sun and moon must be eclipsed."

Ferguson himself was fully aware of the apparent inconsistency of his description of the paradox and the actual working of it. He says on page 48 as follows:

"Before we explain the principle on which these three different effects depend it will not be improper to fix some certain *criteria* for bodies turning or not turning round their own axes or centers, and to make a distinction between absolute and relative motions."

On page 51 Ferguson argues as follows:

"If a ship turns round, and at the same time a man stands on the deck without moving his feet he is turned absolutely round by the motion of the ship, though he has no relative motion with respect to the ship. But if, while the ship is turning round, he endeavors to turn himself round the contrary way, he thereby only undoes the effect that the turning of the ship would otherwise have upon himself; and is, in fact, so far from turning absolutely round, that he keeps himself from turning at all; and the ship turns round with him, as round a fixed axis, although with respect to the ship he has a relative motion.

Evidently Ferguson was not aware that a paradox could be made answering literally the specification given by him.

HEAD OF WATER in feet, multiplied by ·434 equals pounds per square inch. Tons, of 2240 lbs., multiplied by 224, equals British gallons.

FRICTION EXPERIMENTS.

(Concluded.)

The arrangement of grooves was then altered to that usual in locomotive axle-boxes, Figs 10, 11 and 12. The oil was introduced through two holes, one near each end of the brass, and each connected to a curved groove; the two curved grooves nearly inclosing an oval-shaped space in the center of the brass. At the same time the arc of contact was reduced till its chord was only $2\frac{1}{4}$ in. This brass refused to take its oil or run cool. It would sometimes run for a short time with an actual load of 178 lb. per square inch, but rapidly heated on the slightest increase of the load. The brass having been a good deal cut about by altering and filling up of grooves, it was considered desirable to have a new brass, and one was accordingly obtained. The grooves being made exactly the same as in the last experiment with the old one, this brass seized with an actual load of only about 200 lb. per square inch. The oil-box was completely cut away so as to allow a freer current of air round the bearing, and the lubricator pipes were soldered into the brass. The wicks were taken out of the lubricators and the lubricators filled full of oil, by which means oil was supplied to the brass under a full head of 9 in., and yet the oil refused to go down, and the underside of the journal felt perfectly dry to the hand and speedily heated with a load of only 200 lb. per square inch.

The fact that this arrangement of grooves, which is found to answer in the axles of railway vehicles, was found to be perfectly useless in this apparatus, can only be accounted for by the fact that a railway axle has a continual end play while running, which prevents the brass becoming the perfect oil-tight fit which it became in this apparatus. The attempts to make this arrangement of lubrication answer were not abandoned until after repeated trials. It now became clear that there was no use in trying to introduce the oil directly to the part of the brass against which the pressure acted, and that the only way to proceed was to oil the lower side of the journal, and trust to the oil being carried round by the journal to the seat of the pressure.

The grooves and holes in the brass were accordingly filled up, and an oily pad, contained in a tin box full of rape oil, was placed under the journal, so that the journal rubbed against it in turning. The pad was only supplied with oil by capillary attraction from the oil in the box, and the supply of oil to the journal was thus very small; the oiliness in fact was only just perceptible to the touch, but it was evenly and uniformly distributed over the whole journal. The bearing fairly carried 551 lb. per square inch, and three observations were obtained with 582 lb., but the bearing was on the point of seizing and did seize after running a few minutes with this load. It will be observed that in this instance the bearing seized with very nearly the same load as it did in the oil-bath experiment with rape oil.

These experiments with the oily pad show a nearer approach to the ordinarily received laws of solid friction than any of the others. The co-efficient is approximately constant, and may be stated as about $\frac{1}{100}$ on an average. There does not in this case appear to be any well-defined variation of friction with variations of speed, according to any regular law.

The results of the experiments with the rape oil, fed by a siphon lubricator to side grooves, follow nearly the same law as the results obtained from the oil-bath experiments, as far as the approximate constancy of the moment of friction is concerned; but the amount of the friction is about four times the amount in the oil-bath.

The results of the experiments on what is called ordinary lubrication, that is, lubrication by means other than that of the oil-bath, were not, as a subject, sufficiently regular to make them worthy of record. Indeed the results, generally speaking, were so uncertain and irregular that they may be summed up in a few words, "The friction depends on the quantity and uniformity of distribution of the oil, and may be anything between the oil-bath results and seizing, according to the perfection or imperfection of the lubrication. The lubrication may be so small as to give a co-efficient of $\frac{1}{100}$, but it appeared as though it could not be diminished and the friction increased much beyond this point without imminent risk of heating and seizing. The oil-bath probably represents the most perfect possible lubrication, and the limit beyond which friction cannot be reduced by lubrication; and the experiments show that with speeds of from 100 ft. to 200 ft. per minute, by properly proportioning the bearing surface to the load, it is possible to reduce the co-efficient of the friction as low as $\frac{1}{1000}$. A co-efficient of $\frac{1}{500}$ is easily attainable, and probably is frequently attained, in ordinary engine bearings in which the direction of the force is rapidly alternating, and the oil given an opportunity to get between the surfaces, while the duration of the force in one direction is not sufficient to allow time for the oil film to be squeezed out. The extent to which the friction depends on the quantity of the lubrication is shown in a remarkable manner in Table I,; which proves that the lubrication can be so diminished that the friction is seven times greater than it was in the oil-bath, and yet that the bearing will run without seizing.

Observations of the behavior of the apparatus gave reasons to believe that with perfect lubrication the speed of minimum friction was from 100 ft. to 150 ft. per minute; and that this speed of minimum friction tended to be higher with an increase of load, and also with less perfect lubrication. By the speed of minimum friction is meant that speed in approaching which, from rest, the friction diminishes, and above which the friction increases:

Table I.—*Comparison of the Friction with the different Methods of Lubrication, under as nearly as possible the same Circumstances. Lubricant Rape Oil, Speed 150 Revolutions per Minute.*

—	Actual load, Pounds per Square Inch.	Co-efficient of Friction.	Comparative Friction.
Oil bath.............	263	·00139	1.
Siphon lubricator.....	252	·00980	7·06
Pad under journal.....	272	·00900	6·48

Table II.—*Comparisons of the Friction with the Various Lubricants tried, under as nearly as possible the same Circumstances. Temperature 90 deg., Lubrication by Oil Bath.*

Lubricant.	Mean Resistance. lb.
Sperm oil	0·484
Rape oil	0·512
Mineral oil	0 623
Lard oil	0 652
Olive oil	0·654
Mineral grease	1·048

N. B.—The above figures are the means of the actual frictional resistances at the surface of the journal per square inch of bearing, at a speed of 300 revolutions per minute, with all nominal loads from 100 lb. per square inch up to 310 pounds per square inch.

They also represent the relative thickness or body of the various oils, and also in their order, though perhaps not exactly in their numerical proportions, their relative weight-carrying power. Thus sperm oil, which has the highest lubricating power, has the least weight-carrying power; and though the best oil for light loads, would be inferior to the thicker oils if heavy pressures or high temperatures were to be encountered.—*Engineering.*

* * *

THE DEPRECIATION OF FACTORIES.

Fixed plant and machinery are sometimes included in one category with buildings, and an average rate written off the whole. With machinery, as with buildings, the first years of working show little effect, no reduction in value being apparent; and yet from the strictest point of view the depreciation in value may really then be the greatest. That is to say, if value be measured by the price which could be obtained by selling, it is obvious that only a second-hand price would be obtainable, even after one year of working, if the machines were removed for sale. In a going concern it would, of course, be unfair to estimate the value in this way; but it must always be borne in mind that the adoption of any new machine not only involves the purchase price, some of which could be recovered by a re-sale, but also the additional expense for installation, the latter outlay being irrecoverable, and only remunerative to the purchaser by the continuance of working.

The deterioration of machinery depends on many circumstances, and it is obvious that no fixed rules can be established. Machines which are heavy and work slowly generally deteriorate less than light, quickly-running machines. The excellence of the machine in the first instance, and the skill with which it has been set up in place, affect its durability. If made too light or not well balanced, it may soon become shaky and untrue. If wearing parts have not been properly hardened, or are not kept clean, they become loose and need renovation. The hours of actual work and severity of working have also to be considered in comparing the deterioration of one factory with another. In some factories overtime is the constant practice, and the wear and tear correspond. This would be duly met if the reserve fund or depreciation rate were proportioned to the output; but under the usual plan of writing off annually a certain part of the capital value, the deterioration due to arduous working would not be provided for.

In regard to the proper rate of depreciation for machinery there is, even in well-managed factories of similar class, a wide divergence of practice. Thus, in a new factory doing a profitable business, private partners will, in their desire to be on the safe side, sometimes commence by writing off annually 10 per cent. from machinery of all kinds. Unless there be some apprehension of the plant becoming obsolete, this is generally too liberal a rate for fixed machines unless it is neutralized in some other way. In other cases the records of many years' working may show that $2\frac{1}{2}$ per cent. is sufficient, because the machinery was good in kind and quality to begin with, partly also because the expenses of installation and liberal repairs have been defrayed out of revenue, and partly because the machines have been moderately worked. In engineering factories the rate which will properly meet the deterioration will generally be found between 5 and 10 per cent. Where the work is of a moderate kind which does not strain the machines heavily, and where the hours of working do not average more than sixty per week, 5 per cent. would generally suffice for machinery, cranes, and fixed plant of all kinds if steam engines and boilers be excluded. Where there is a diversity of machinery and plant, and a past history of twenty years to look back upon, it is not difficult to arrive at an appropriate rate and to make periodical revisions.

Steam engines and boilers if classed separately from the other machinery of a factory would generally require a higher rate of depreciation, and if again separated, boilers a higher rate than engines. Indeed, so wide is the possible variation, that special examinations of engines and boilers should be made at each annual balancing of accounts. If a well-made non-condensing stationary engine with Lancashire boiler cost, including foundations, £500, it would be prudent to write off 10 per cent the first year, and 10 per cent. annually from the diminishing value, this being sufficient if the minor repairs and renewals, such as new brasses and fire-bars, be paid out of revenue. At the end of ten years the book value will stand at £174. If then the cylinder be rebored, possibly a new piston supplied and the boiler renewed by the insertion of a new furnace at a total cost of £80, this sum might be added to the capital value, the depreciation rate of 10 per cent. continuing for a further five years till the value is reduced to £150. A new boiler would then be required costing £200, and the rate of 10 per cent. again go on on the renovated value of £350. In the case of a portable or semi-portable engine and multi-tubular boiler an annual rate of 15 per cent. would be necessary, which in five years would reduce an original value of £300 to £133. If then £50 be spent on repairs, the book value might be increased to £183, and the 15 per cent. rate go on, so that at the end of another four years the value would be reduced to £96. If then patched up at an expense of £50, it might at a low pressure of steam have a few years longer life. No exact rule can, however, be made for steam engines of this kind. The deterioration depends first on the size of the engine—small sizes wearing out quickest—on the care in firing and kind of fuel and water; on whether the working is forced; on the care given to repairs; on the protection from dirt; and on the hours the engine is kept at work. In extreme cases a portable engine is quite worn out in five years, and its value to be broken up would be about one-twelfth part of its original price. Contractors' locomotives working on imperfect railroads soon wear out, and a rate of 20 per cent. is generally required, bringing down the value of an engine costing £1,000 to £328 in five years. Whatever be the exact rate adopted for steam engines, it should be estimated liberally for the first five years, revision then showing if the rate needs alteration.

POPULAR SCIENCE.

The demand for light superficial descriptions of scientific facts is met by popular writers with an amazing and, so far as quantity goes, an adequate supply. From these popular expositions an amount of amusement is derivable which would be perfectly enjoyable, but for their quality of negative instruction. However, we may have our laugh with perfect equanimity, since the staff of a technical contemporary hold that misleading elementary information is rather desirable than otherwise; it is so easily rectified afterwards, and the pupil appreciates fact so much the more for having hugged fiction.

A notable example of popular description was that given by the *Daily Teacher* in describing how a locomotive rounded a curve. In beautiful phraseology we were told how, on approaching a curve, the driver braced himself up, spat on his hands, turned off the regulator and put on full steam. then gazing intently ahead shortened the stroke of his port engine and lengthened the stroke of the starboard wheel, just as oarsmen do when rounding the bend of a river.

Again, it was rather a good idea of another writer, in describing a breakdown of an engine driving a dynamo, to get a quantity of the "electric fluid" mixed up with the steam and imparting its energy to it.

Another writer grew quite pathetic about the explosion of a steam engine when only the boiler had gone off, and sadly described the tribulation of the cylinder, in which he fondly supposed the fire was usually placed, while the piston was a mass of unrecognizable ruins.

The distinction between energy and work appears to these gentlemen to be a barren one, for the *Assinæum* (*!*) itself tells us that a certain effect may be produced by "passing steam of thirty horse power through a pipe."

An editor of a popular penny paper lately undertook to prove that he had suspended the law of gravity. He was successful in one case and took a long railway journey for the purpose, when he found that a stone dropped within the carriage fell parallel with the partition, but when dropped outside it fell far behind and that the air had nothing to do with it, but the unalterable law of gravity alone accounted fully for each case.

We might multiply instances to the point of disgust, but we fear that nothing we might say would induce the writers to keep within their depth. So long as the public resort to defective sources of information, just so long will caterers be found to turn on the tap for them.—*The Mechanical World.*

WHERE BOILER-MAKERS ARE UNJUSTLY BLAMED.

Steel-makers and boiler-makers have to become scapegoats, in many instances, for the sins of the negligent and incompetent. A writer in the *Northwestern Miller* mentions an instance, and engineers of experience can supply many others.

"I heard an agent of one of the best boilers in this country say the other day that he had discarded chemical means of preventing incrustation altogether and had adopted the plan of heating the water and then filtering it through hay or a similar material. This is all right as far as it goes, but it is a dangerous place to stop. He went on to say that the boilers had not been cleaned in six weeks and did not need it, but I know that they do, and with an eye on those boilers I expect to see trouble in the future, and as the boiler is a little out of the usual line of construction the makers will be blamed for the trouble. To be sure, with the arrangement of which he speaks, he will get out a very large amount of dangerous material, but he will not take out the sulphate of lime, which will ultimately cause trouble. The mere heating of the water precipitates the carbonates of lime and magnesia."

A NEW SECTIONAL STEAMER.

A new vessel of peculiar construction has just been completed in England for use on shallow African rivers. The boat, says the London *Engineer*, consists of six galvanized steel square-shaped pontoons, eighteen feet long by eight and a half feet wide by four feet deep; these sections are placed side by side; to them are added a bow piece and a stern-piece, making together a hull seventy feet long by eighteen feet beam. These sections can be readily united or disunited, afloat. On the bow division are two boilers, and on the stern division the engines, which are designed for a working pressure of 140 pounds, and have cylinders ten and one-half inches in diameter by two and one-half feet stroke, which drive a paddle-wheel situated aft well clear of the stern. The engines are each made up on a steel tube as a frame. The strain due to these weights being concentrated at the extreme ends of the boat are taken by a system of light steel tie rods above, secured to tubular king posts. The effect of this system is to throw a compression on the hull at all times thereby tending to keep the various sections together and free from alternating strains. The boilers are made with very capacious grates, wood being the only fuel procurable.

* * * * After the machinery is removed from the deck the hull will only draw six inches; it is then brought into shallow water and the operation of disconnecting the sections proceeded with. To each section, while still afloat, will be secured four large light steel wheels with wide tires. This being done, the divisions are ready to be hauled out of the water and over land, and what was once a section of a boat now becomes the body of a wagon of ample capacity to convey the lighter portions of machinery and stores. On arrival at the next navigable part of the river, these wagons are run into the water, the wheels removed, and the various divisions reunited, forming again an entire vessel. In this way the journey can be continued, the steamer being taken to pieces and put together as often as circumstances require.

FACING THIN DISKS OF METAL.

Regarding facing and turning thin disks a correspondent of a contemporary says:

"I once new a man who was building a small engine, 1¾"×2½". I watched his progress. supposing that when he came to the piston-head there would be music, but I was disappointed. The followers were made from sheet brass, ⅛" thick, with ¼" hole through them. As he had nothing but a 20" lathe—a poor one at that—I did not see just how he was to get along. But he put one of the followers on a mandrel, drove it on a little, and then put the mandrel on the centers. Then he rapped it till it ran true sideways, took it to the tinsmith's bench and soldered the disk to the mandrel, building up the solder quite a distance on one side. He then put it into the lathe, turned off the edge and faced up the side not soldered first, then the soldered side, cutting away the solder the last thing."

We do not wish to be impolite, but it strikes us that our friend above described was very fussy. If he had just driven his disk on a mandrel alone, put on the fastest speed and taken a hand-tool, he could have faced his disk on both sides and turned it on the edge before a man could solder it—if he knew how.

The difficulty with thin disks is that they buckle after being faced. Removing the surface-skin, which in rolled metal is denser and harder than the rest, sets up a new condition of things, and though the piece may run true in the chuck or on the mandrel, it will not be true when taken off of it unless both sides are skinned before either are trued.

This would not be the case with the piece mentioned in our extract, for its thickness, ⅛th of an inch, is sufficient to sustain itself.

AS TO IGNORANCE.

THE MECHANICAL ENGINEER, criticising statements made by one of our technical contributors, says the expression "against the sun" is obsolete, but in old countries some still use it. "A much better statement is to say that a machine runs either right or left-handed." The editor is evidently out of his latitude. The expressions "with" or "against the sun" are as common with the millers of America as the dust which covers their backs. The chap who would enter a mill and commence talking about a right or left hand brush or smut machine would be laughed at for his ignorance. The manufacturers of turbines label their wheels "with" or "against the sun" according to the direction in which they are to run, and take great pains to explain the meaning of the terms to the uninitiated in their catalogues. We extend our right hand to the left-handed editor of THE MECHANICAL ENGINEER, and would advise him, as a friend, to post himself.—*Modern Miller.*

Our young friend of the *Modern Miller* should not make haste to leap into a ditch. If the turbine wheel makers "take great pains to explain the meaning of the terms to the uninitiated," it is obvious that we were correct in saying it was obsolete. It is not necessary to explain terms in general use.

A man who cannot understand when a machine runs right or left-handed, whether horizontal or upright, is not one to handle the word, ignorance, carelessly. It has two edges and cuts both ways.

Success to our young friend, but let him not fall over backwards in the act of crowing.

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TO DETECT BLISTERS IN BOILER PLATES.

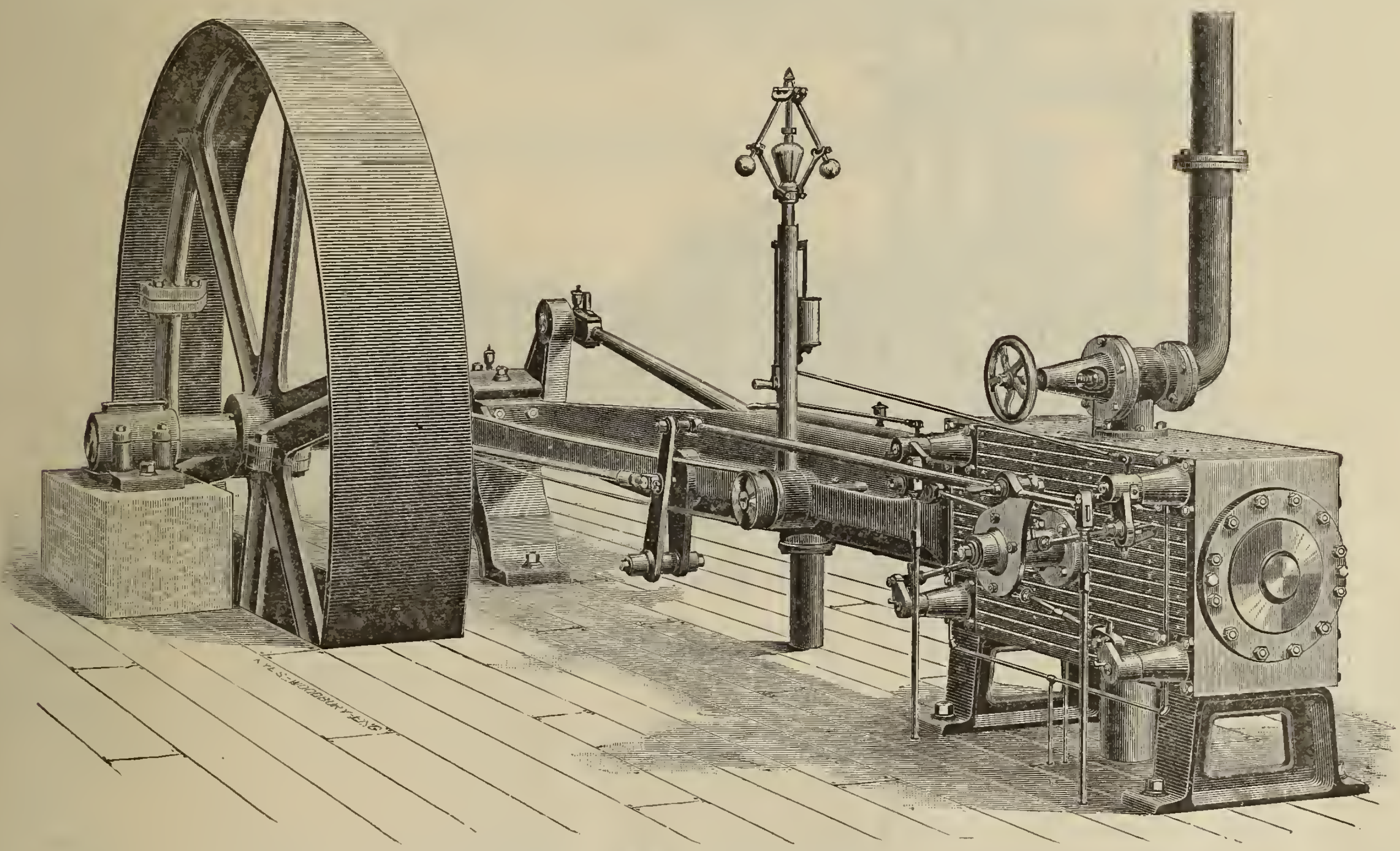
Blisters sometimes appear as mere surface defects, and are of no consequence; but their appearance may be an indication of want of care in making the plate, as well as in working it. Plates which come in contact with the fire should be sounded before being used. The proper way to do this is as follows:

First, lay the plate out in squares of about a foot each.

Second. Then with a light hammer (say $1\frac{1}{4}$ pounds in weight) strike each square separately, and mark it with a piece of chalk, so as not to go over it again.

If the plate is of good iron it will sound clear, and the hammer will fall heavily on it; but if it has a tendency to blister, it will give a dull sound, and the hammer will rebound as if struck on a spring. Both sides of the plate should be tested in this manner.

W. BARNET LE VAN.



THE HARRIS-CORLISS ENGINE.—WM. A. HARRIS, PROVIDENCE, RHODE ISLAND.
For Detailed Report, see pages 49 50, 51, 52.

SPRING MOTORS FOR STREET CARS.

According to Mr. Wilfred Lewis, an engineer of Philadelphia, the energy exerted by a clock-spring weighing 2040 grains, is, when wound up, 45 foot-pounds, or 154 foot-pounds per pound of dead weight.

The transverse strength of this steel within the elastic limit was found to be about 300,000 lbs. per sq. in., and its modulus of elasticity about 30,000,000. Such extraordinary strength, with such a low modulus, was so far beyond conjecture that it seemed to give a new hope for the success of the project referred to; but after making the necessary allowances for weight of car and efficiency of driving mechanism, it was found that not more that about 20 ft. lbs. per pound of car would be available for locomotion. It was therefore improbable that such a car could ascend a hill over 20 feet high.

◆

WE ARE STILL OBLIGED to ask concessions from our friends who take the trouble to write us on various matters of interest. We are compelled to go to press earlier than usual, by reason of our increased size and edition, and many favors are unavoidably postponed thereby.

COMPOUND LOCOMOTIVES.

"The new compound locomotive which has been on trial on the Boston and Albany Railroad for a week past is said to be making a poor showing, because the grades are so heavy that the compounding arrangement won't work. When run as an ordinary double-cylinder engine, it eats up more fuel than the heaviest engines on the road, and draws no more cars."—*The Tech.*

This accords with what we said on p. 102, Vol. 6, of compound locomotives, to wit: "Nothing moved by steam has so variable a load." Curves, grades, cars hauled, atmospheric resistance, etc., enter into the account and are against the value of the compound system. For there are periods when the second cylinder would not only do no work but would be an additional load.

◆

FLOWERS FOR THE ENGINE-ROOM.

A center of attraction to visitors—after the machinery—are the flowers which adorn many engine-rooms. When tended carefully and selected for the situations they are to occupy, they are great ornaments. James Vick of Rochester, N. Y., publishes a catalogue of plants and seeds, and his prices are remarkably low, compared with some others in his line. Our friends will find it attractive.

◆

TENSION AND PRESSURE.

These terms are often used as convertible in speaking of steam pressure, but this is erroneous. Tension is not pressure. In a recent article on the slide valve an unusually clever writer says that—"locomotives formerly employed boiler pressures of 50 lbs.; with this tension of steam," etc., etc. Tension is stretching; tightness. We can say a bolt, or a fiddle-string have a certain tension or tightness, but we must not say that steam in a boiler has 50 lbs. of tightness.

Steam expanded from seventy pounds to the square inch down to five pounds per square inch has increased volume, and consequently more tenuity. We may therefore say that its tension is less, but this relates to the volume, not to the pressure per square inch.

SMALL LEAKS.

The difference in the amount of coal used for the same apparatus but managed by different engineers is often very marked, even when there is no radical change in the adjustment of the valves or conditions all round. The economy can be directly traced to careful management in the use of the various stores required. Many feel that economy is attainable only through the saving of large amounts, quantities that are visible and apparent at once. This is true where gross waste is occurring but, usually, saving is gained in small amounts. A sixty-fourth of an inch is not in itself a great matter, but many sixty-fourths in the fittings make a serious shortage at the last connection. One pound of back pressure per stroke is running very low, but in many strokes even this counts and the difference is shown in the coal used weekly under varying circumstances.

The same is true of oil and other stores. Some men use gallons where others use quarts, and have no better results as to efficiency, they have decidedly worse results as regards economy. This, as we have tried to show, is reached as often through careful management as through higher attainments in any given case.

◆

THE APPLICATION OF HIGH SPEED ENGINES, directly connected to the work, without the intervention of belts, or gearing, is increasing daily and no class of engine for this purpose is more popular than that of the Westinghouse Machine Company. It is astonishing how rapidly the use of them is extending. The *Daily Times* of this city has one of these engines; attached to a press. and controlled by the pressman. It has done so well that another one is being put in.

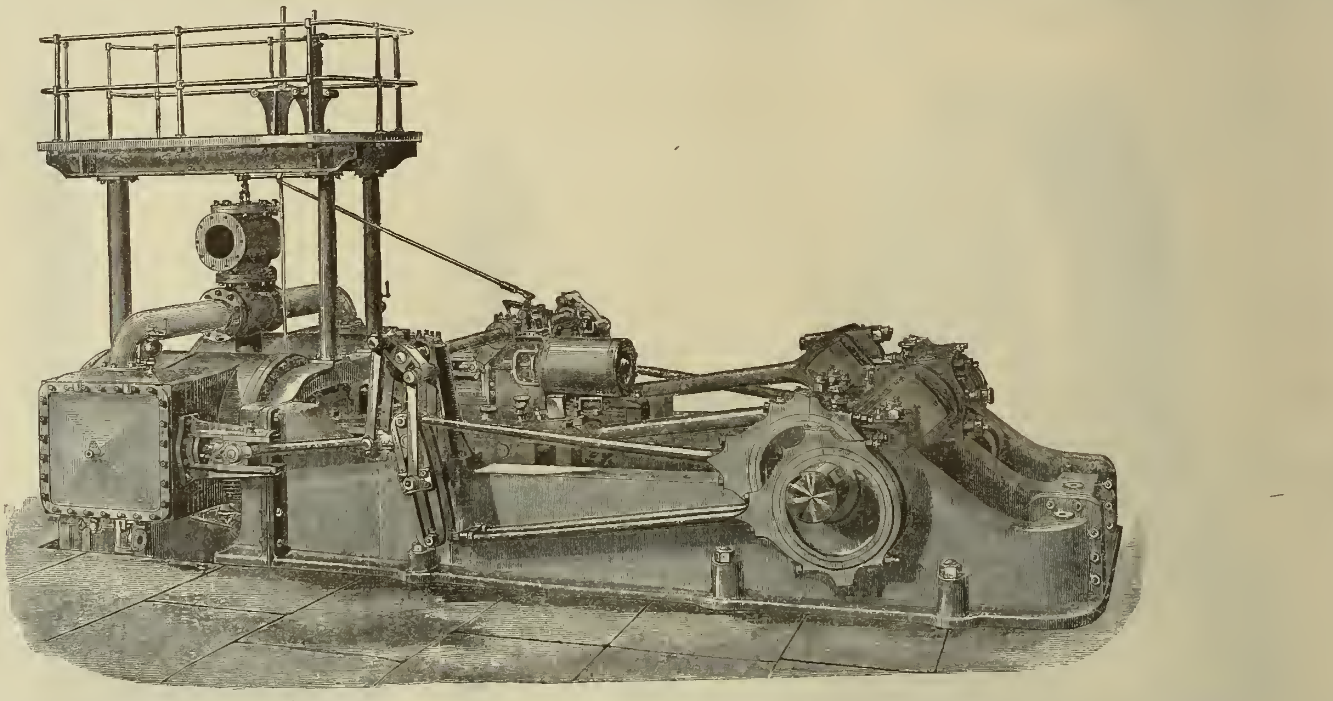
In Buffalo the contract for lighting the city by electricity has been awarded the Brush Company, and the dynamos are driven by Westinghouse engines; these proved most satisfactory after a competitive trial extending over a month. The cities of El Paso and Austin in Texas are also introducing them for the same purpose. The virtues of these machines are extending to

Europe, and English colonies, as recent shipments of them to Australia, and others to France, Holland, and Japan attest.

AN ENGLISH HIGH-SPEED ROLLING-MILL ENGINE.

Our engraving represents a pair of English high-speed engines for rolling-mill service which present many points of interest to engineers. The *London Engineer*, from which we take the engraving, says:

"The maximum speed will be about 150 revolutions, and the piston speed about 1,200 feet per minute. With this object all the bearings have large wearing surfaces, and the momentum of the working parts is carefully counterpoised by balance-weights secured by straps to the webs of the cranks. The cylinders are 36 inches diameter, and have a stroke of 4 feet; they are fitted with slide valves having the pressure partially removed from the back by a balance-piston, and are worked by eccentrics in connection with a link of the Allan type. The reversing is effected by moving by hand the valve of a small auxiliary cylinder, so arranged than the piston cannot overrun, but follows exactly the movement of the hand-lever. As will be seen from the engraving, the reversing lever, the steam valve lever, and the screw for opening the drain cocks are all arranged on a platform elevated to a convenient height to allow the engineer a good sight of the rolls. These engines have recently been erected at the Blaenavon Steel Works, Monmouthshire. Messrs. Davy Brothers have done a good deal to promote the adoption of high-speed engines in rolling-mills by the excellence of their workmanship, design and material, and the engine we illustrate is a fair example of their work."



HOW HINDOO MECHANICS WORK.

The carpenter does without a bench: he squats upon his hams and makes the floor of the building or the ground of the open yard his bench. The smith raises no forge, but makes his fire on the ground and squats beside it, with a bit of iron for his anvil. The tinman works in the same way, and they all appear to be "making shift."

A favorite meal with the Bengali coolies is a sort of pancake fried in oil or butter. With this the vendor serves a round ball or two of sweetstuff made of coarse sugar and some flavoring. These balls—about the size of a billiard-ball—are rolled into a spherical form with a nice glossy surface. On a board, or slab of stone? Oh! no. The Bengali confectioner makes shift with his hands, and gives a final polish by rolling the balls up and down on the skin of his naked chest. A man of the poorest class here is careful to clean his teeth, but he expends no money on a tooth-brush; any bit of stick will serve his purpose if only he can find a bit of stone with which to bruise the end of the stick into a brush form. As to water, a tank, or even the little pools that form in the street gutters will serve.

Men who squat on their hams to work or to rest cannot be confined by clothing about the knees, and consequently trowsers are not needed, indeed they would be an awkward encumbrance to a man who habitually works with his legs bent double. These artisans at all events wear no nether garment; a simple waist cloth is all they use, although they have seen the comeliness and decency of the European method all their lives, and see it at every turn in the streets of this city. Shoes and boots are alike unknown to them, and their feet are splayed and horny by constant attrition and wear. An English working engineer assured us the other day that the native workmen in the smiths' shops would tread on hot cuttings, strips, and scales of iron, and only occasionally flinch when a piece rather hotter than the rest burned through the horny cuticle of their feet.

As we write, we hear some carpenters working in a courtyard beneath the window. We look down upon them, and see that they have a piece or two of old timber to square. The wood was formerly a door-jam and a rabbet into which the door closed has to be cut away ready for squaring up and finishing with the plane. The men squatted down and used adzes with one hand, and were occupied an hour in cutting away a strip of wood that an English carpenter would have adzed off in five or ten minutes, and with a few strokes of his two-handed adze. But it is more in the absence of perfect accuracy that we see the defects of the make-shift method. The Indian workman never seems to be quite master of the material. You can see where his tool jarred even in some high finished art-work. The lines are never exactly rigid, the ornamentation is never in that perfection of symmetry which defies the unassisted eye to detect the error. No line can be perfectly straight, no circle exact. A good English workman proceeds as though he desired to show practically that this is a theoretical error. If his lines be not straight, his circles out of truth, just show him where they are wrong, he seems to say. The workman in this country seem to accept the dicta of the mathematician, and to proceed on the assumption that if lines and curves cannot be exact they may as well be visibly out of truth.—*London Engineer.*

Technical papers are, it appears, confined chiefly to nations who speak the English language. No other countries than America and England have technical periodicals. France is singularly deficient in this respect, for a people so advanced in science and the arts; as for European nations in general, class-papers are unknown among them. There is no doubt but that the marked progress in this country and England is due to the diffusion of general knowledge on trade matters.

OF COURSE.

A writer in the *American Miller* sensibly says:

> The knowledge gained by our failures in life is greater than that gained by our successes. We learn more by having our views opposed and their errors pointed out, than we would to have them applauded as the height of perfection. The ideas which I get from reading the *American Miller* belong to me, and are just as much a part of my mechanical education as if I had acquired them in the engine-room or the work-shop. The very object of publication is that the reader may—for one dollar a year—appropriate the ideas of others to his own use. But to do this we must read carefully, and think more than we read. We cannot, in the nature of the circumstances, expect that these articles, on either side of the question, will be exhaustive of the subject, but merely hints for reflection.

This is well said. Technical papers, whether of this class or that, are the life of trade, not only to the mechanic and actual worker, but to the manager and manufacturer. We think as a rule there are more readers among the latter than the former.

Mr. T. C. Logan of Atchison, Kan., informs us that he organized a new Association of Stationary Engineers at Leavenworth, Kan., on the 2d ult., with fourteen members. Charles Stopherd is past president, P. Strauss, pres., A. O. Wall vice, Robert A. Rees, sec., Arthur Trew, treas., A. B. Bell conductor, G. B. Gritter, doorkeeper. The secretary's address is 323 Shawnee st., Leavenworth, Kan.

POWER OF SPRINGS.

The elastic power of a spring is directly as the fourth power of the diameter of the rod of which it is made, and inversely as the diameter of the coils. The diameter of the coil at the center should be 8 times the diameter of the rod or wire.

Diameter of coil at center. In.	Diameter of rod. In.	Elastic action per coil. In.	Working load. Lb.
4	$\frac{1}{2}$	$\frac{1}{4}$	896
$3\frac{1}{2}$	$\frac{7}{16}$	$\frac{7}{32}$	600
3	$\frac{3}{8}$	$\frac{3}{16}$	378
$2\frac{1}{2}$	$\frac{5}{16}$	$\frac{5}{32}$	218
2	$\frac{1}{4}$	$\frac{1}{8}$	112
$1\frac{1}{2}$	$\frac{3}{16}$	$\frac{3}{32}$	47
1	$\frac{1}{8}$	$\frac{1}{16}$	14
$\frac{1}{2}$	$\frac{1}{16}$	$\frac{1}{32}$	$1\frac{3}{4}$

Experiments with steel helical springs—Extension: A $\frac{1}{4}$in. wire spring, 2in. diameter of coil at center, 38 coils, and $10\frac{1}{2}$in. long, with 56lb. extended to $13\frac{3}{8}$in. long, 84lb. to $14\frac{1}{2}$., 98lb. to $15\frac{1}{4}$., and 112lb. to 16in. Compression: A $\frac{7}{8}$in. spring, 6in. diameter of coil at center, $5\frac{1}{2}$ coils, and $8\frac{1}{2}$in. long, with 6cwt. compressed to $7\frac{3}{4}$in., 7cwt. to $7\frac{5}{8}$in., 8cwt. to $7\frac{1}{2}$in., 9cwt. to $7\frac{3}{8}$., 10cwt. to $7\frac{3}{16}$in., 11cwt. to $7\frac{1}{16}$in., 12cwt. to 7in. (bare), 13cwt. to $6\frac{13}{16}$in., 14cwt. to $6\frac{11}{16}$in., 16cwt. to $6\frac{1}{2}$in., and 18cwt. to $6\frac{1}{4}$in. —*Mechanical World.*

NEW EXPANDING REAMER.

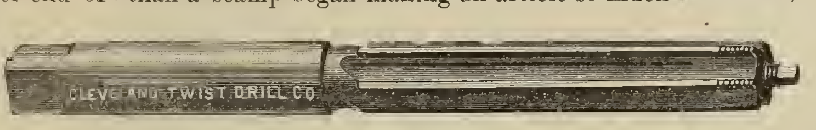
BY THE CLEVELAND TWIST DRILL COMPANY, CLEVELAND, OHIO.

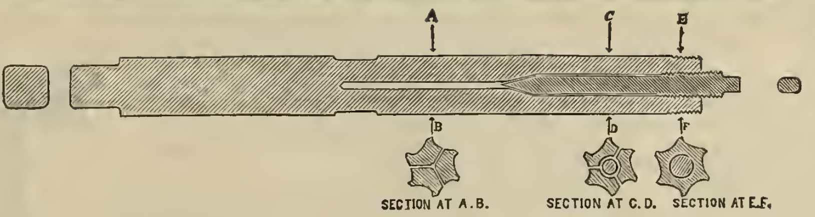
The engravings herewith represent a new form of expanding reamer, which is now in use in many large works, where it has stood the test of practical use very satisfactorily

Figure 1 gives a good idea of the general appearance. Figure 2 is a longitudinal section, showing, also, cross sections in three different places.

It is very simple in construction, not liable to get out of order, easily and quickly expanded or contracted, has no loose pieces to get out of place and only one screw to turn to accomplish the desired result. Reamers from 1″ to ¼″ have six flutes, and are slotted in the center of every other space, leaving the flutes in pairs, so that when set out by the taper-pin or plunger, *all* of the flutes will cut.

By referring to Fig. 2 the construction of the reamer will be easily understood. A small hole is drilled in the center, from the point, running back the whole length of the flutes. This hole is then counter-bored one-half of its length, terminating in a long taper in the center of of the length of the flutes. The outer end of this hole is tapped with a fine thread to receive the expanding-pin, or plunger, which is turned down to the bottom of the thread to allow it to slip in nearly to place before the threaded part engages with that in the reamer, for the longitudinal slots do not run out at the point.





This reamer is strong and practically solid. A very slight turn of the expanding-pin will spring the center of the reamer outwards, and on turning it back again the reamer at once assumes its original size. The expanding-pin is hardened to prevent its being cut or worn out. The reamer shown has a patent self-feed or screw-point. They are furnished also if desired, with a "pilot;" that is a cylindrical end not fluted, but ground true to the proper size of the hole to be drilled. As the "pilot" just fills the hole it keeps the reamer straight, and prevents any tendency to wabble. This reamer, while new to most of our readers, is in daily use in many of the best shops in the country. The verdict says it is the best, most sensible, reliable, and practical expansion reamer in market.

These reamers are made in all sizes from ¼ to 2 or 3″ in diameter, at a slight advance over the price of solid reamers.

An illustrated catalogue sent free on application to the Cleveland Twist Drill Co., Cleveland, Ohio.

THE TUBE POOL'S DISCOUNTS.

The "Base" and "Selling" prices adopted by the association to take effect on December 17th, 1883: Wrought iron butt-welded steam and gas pipe. Discounts, black pipe, base price, 40 per cent.; black pipe, selling price, 30 per cent.; galvanized, base price, 30 per cent.; galvanized, selling price, 20 per cent. Wrought iron lap welded pipe. Black pipe, base price, 57½ per cent.; black pipe, selling price, 50 per cent.; galvanized pipe, base price, 45 per cent.; galvanized pipe, selling price, 35 per cent. Wrought iron butt-welded, extra strong and double extra strong pipe. Base, 40 per cent.; selling, 30 per cent. Wrought iron lap welded, extra strong and double extra strong pipe. Base, 57½ per cent.; selling, 50 per cent. Lap welded boiler tubes. Base, 56 per cent.; selling, 47½ per cent. Artesian well tube or casing. Base, 55 per cent.; selling, 45 per cent.

IN DRILLING SMALL HOLES through very hard material even savages excel. A writer in *Science* states that the *Unapes* of South America drill rock crystal by the aid of a pointed leaf-shoot of plantain, aided by sand and water, and that he has seen beads of the hardest stone, two inches long, pierced with holes $\frac{1}{16}$th diameter.

MESSRS. J. A. LOCKE & SON, formerly at 12 Cortlandt St., have removed to Number 40 Cortlandt St., where they will be pleased to see all in need of non-conducting coverings.

PATENT INFRINGERS.

The article appended was cut from a New York daily paper whose title was not preserved at the time, and is lost in the number of our exchanges. The writer has hit the situation exactly, though the remedy proposed by the manufacturer presupposes a long purse, which inventors as a rule do not have.

"Yes," said the manufacturer, "when a man takes out a patent he may as well roll up his sleeves. It's fight all the time."

"Fight with whom?"

"With infringers. There are men in this country—many of them rich men, too—who lie around waiting for somebody to invent something and make it successful. Then they jump in with infringements and try to steal the market away from him."

"Do they succeed?"

"Sometimes; but oftener they succeed only in ruining the market for themselves and everybody else. But if a man makes the right kind of a fight on them he is likely to win. Some time ago I invented an article that became popular, though the margin of profit was small. No sooner had it been demonstrated a success than a scamp began making an article so much like it that it could hardly be told from mine, and using printing almost like that I used."

"Why didn't you get out an injunction and sue him for infringement?"

"Oh, pshaw! I've done that too many times not to know the folly of it. The courts will not issue an injunction until they have examined the case. They say they do not know it is an infringement until they have examined it; and then they won't examine it perhaps for years."

"But you could have brought suit, and made the infringer give an advance bond to pay damages in case the suit finally went against him."

"Yes; but I had a better scheme than that. I proceeded against a few merchants who sold the infringer's goods. Then I advertised this fact extensively, and it frightened other merchants. You see, if I had brought suit against the infringer and made him give a bond, I could not have proceeded against the merchants, since the infringer's bond would have covered all damages arising from such sales. No; I'll tell you what I did to drive that infringer out. I set my head at work, and made a machine for manufacturing my article much cheaper than it could be done by hand. I covered this machine with patents of all sorts and kinds until it was pretty safe. Then I reduced the price of my manufacture below the cost of the hand-made article. This forced the infringer to put a poor quality of material in his manufacture, so as to meet my price without losing money. I held my price where it was and kept up the quality of my goods, but in addition I made another quality, just like his, and sold that away down below his prices. My salesmen, whenever they found a merchant selling the infringer's article, showed my second-class goods and offered them at the low price. Of course the merchant preferred the cheaper article, since it was of the same quality, so I drove the infringer out of the market. Then when I had the field alone I pushed the sale of our best quality of goods and now we are doing a big, first-class business. Isn't that better," continued the manufacturer, "than fuddling around with the lazy courts and finally being beaten by some sneaking little technicality? Every man his own court is the best motto after all."

The report of The National Association of Stationary Engineers has reached us too late for this issue; will appear in the next.

BOOK NOTICES.

NOTES ON MECHANICAL ENGINEERING compiled principally for the use of students attending lectures on this subject in the City of London College, by Henry Adams, Memb. Ins. Mech. Engr's, etc., etc., New York, E. & F. Spon, 35 Murray Street.

This work is what it professes to be, to wit: notes, or short summaries, from leading authorities in the profession upon points of interest to all concerned in building machinery. The citations are from such authors as Rankine, Box, Unwin, Bauerman, Fairbairn, and others, and the topics adverted to comprise notes on "belt gearing," strength of ropes, wheel-gearing, crane-chains, proportions of keys, gases, vapors, loss of heat in boilers, experiments in evaporation, etc., etc. The book contains 92 pages, and while many of the calculations are made in forms not familiar to all, there is a great variety of general information on mechanical matter that every one engaged in the business will find valuable. As a book of reference alone it is worth the price, for the selections are made with good judgment.

A TREATISE ON CRANES including a description of light hoisting machinery, by Henry R. Towne, Mechanical Engineer. New York, D. Van Nostrand.

This is a hand-book of general information, fully illustrated, upon the above machines, comprising every known form of them. It is not intended as a guide to the construction of cranes, but discusses the general principles involved in those manufactured by the author, who has wide experience in this line.

A TREATISE ON THE COMPOUND STEAM ENGINE, in two parts. Part first by John Turnbull, Jr., part second by S. W. Robinson, Prof. Mech. Eng'g, Ohio State University. New York, D. Van Nostrand. Price, 50c.

The principles involved in the compound engine are here clearly enunciated; that by Turnbull being especially adapted to the use of draughtsmen and constructing engineers. Tables of proportions of cylinders for given powers, and points of cut-off are given, materially reducing the labor of calculation; also, the process, or rule, by which the author arrives at his results. By the aid of this latter any point of cut-off, not laid down in the tables can be worked out for a given engine to exert given powers. Cards are included, and the connection between them and work done clearly traced out. We regard this as being an indispensable book in all shops where engines are built, or run; both for those who use and aperate compound engines. Its price so moderate, fifty cents, that every one interested should send for it. It can be had by remitting the amount to us.

ABOUT POOLS.

Interviews with a number of leading manufacturers, jobbers and brokers show that pools and combinations have few friends in the business world. They are regarded as temporary and artificial expedients to sustain prices and fictitious values. As a rule they do more harm than good to the parties entering into the combination. At the same time very few business men are willing to put themselves on record as as opponents of such schemes, because they are, as a rule, in some way purchasers of or dealers in articles held by combinations. A vast amount of good sense is contained in the following paragraph, which is the expression of one who has studied the questions involved in all their bearings:

"Whatever the general impression may be, overproduction cannot be regulated 'by concerted action.' A number of persons cannot 'by concerted action' hold their breaths any easier than one—and a suspension of industry is virtually trying to hold breath. It cannot be done for any great length of time without asphyxiating the more exposed members. The survival of the fittest is a law which cannot long be evaded, however much the disabilities of the weaker may be distributed temporarily over the stronger."—*Age of Steel.*

This issue is sent to a large number of persons as a sample copy.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

MR. WILLIAMS' RESPONSE TO HIS CRITIC.

Editors Mechanical Engineer :

I note with interest the Professor's response to my communication in reply to his views on compression, and believe it will not be out of place for me to write again on the subject.

I do not propose going beyond the Professor's own arguments, however, which I shall answer to the best of my ability.

In regard to my definition of work done being sophistical, I admit that all that part of the argument is, in a measure, sophistical. But it is the Professor's own, and I intended to show in my former letter that it was sophistical. There is a wide difference between grinding corn and compressing steam, so far as the principles apply to the subject under discussion. In the former, the work performed is lost to the engine; while in the latter it becomes available, stored energy.

The gist of the Professor's argument seems to be that "there is a always a loss of power" in compressing and expanding steam.

There may be, and there may not be. A simple assertion proves nothing unless backed by facts. It appears from his argument that he decides in his own mind that from this simple fact that power is required to compress steam, and the premise that it will not be given back in full, there is a loss in compression. This is a very superficial way of reasoning, and even should he show that to be true; the real principles which have established gain or loss have not yet been considered. He appears to jump at a conclusion instead of making a careful investigation.

If the power required to compress a certain amount of steam into clearance-space amounts to 100 foot-pounds, the reciprocating and rotating parts of the engine must lose 100 foot pounds or 3,219 units of force; this expenditure results in stored energy, the available portion of which depends upon the extent to which expansion is carried behind the piston upon the return stroke. If the steam expands again to the pressure from which it was compressed the full force taken from the piston in compressing is returned again in expanding and the clearance, to that portion to which compression extends is filled without cost. This appears to be the point the Professor disputes.

The operation of compressing steam and allowing it to expand again is too well understood to admit of argument. The only difference being a slight variation in the two curves, of which I will speak later on. It appears to me the only place we should expect to find a loss is in friction. But an examination into the facts seems to prove the contrary. That is to say: compression seems to relieve the bearings from friction rather than urge it upon them. Compression acts near the end of the stroke and is greatest at the very end, counteracting the forces of inertia in the reciprocating parts, storing them into steam to be used upon the return stroke, usefully, instead of allowing these forces to act on the crank-pin and main bearing at so small a purchase as to result mainly in friction.

The purchase of piston at crank varies at its velocity; which, were it not for the angularity of the connecting rod (which I will not take into account), would be directly as the line of angle of crank with line of centers.

A good smooth bearing, oiled, is said to transmit 95 per cent. of the power and absorb five per cent. in friction, which must appear as heat. This being true, at any point when the purchase is five per cent., or, when the motion of crank-pin is twenty times that of the piston, the whole power will be converted into heat by friction. When the purchase is one-tenth, one-half the power will result in heat, and when the purchase is one-half, one-tenth will be lost by friction, and so on. Even ten per cent is a great loss. When the purchase is one-half the crank angle is thirty degrees; and the piston has moved through ninety-three per cent. of its stroke. If the stroke be thirty inches this distance is 27·9 inches leaving 2·1 inches yet to be completed. Compression begins, usually, at an earlier point than this, but its first influence is light, increasing as the end of the stroke is approached. The inertia forces increase in a similar manner; and we see how admirably compression acts to lessen friction, instead of increasing it. The force of retardation often amounts to ten times the weight of reciprocating parts, which, in many engines, amounts to three pounds per square inch of piston-area. So that in such cases the forces of retardation amount to thirty pounds per square inch of piston. To this must be added the steam pressure behind the piston, when it represents the opposing force required to hold the reciprocating parts in a neutral condition, causing no pressure on the crank-pin in either direction. I have noticed in practice that engines run cooler when compression is used.

Yes; the Professor can show reduced card area, but it should be borne in mind that the best indicator diagrams are those which show the most work with a given amount of steam. Simple inspection proves nothing. Let the Professor take one of his cards "with its head chopped off" and draw a line at a height to represent terminal pressure, from end to end, and see where the compression curve crosses it. Then reflect for a moment. The distance from end of diagram back to that point, represents the displacement of steam for the stroke, and it will be found less than the whole line which *would* represent *most* of the displacement, provided there were no compression; but not all, unless the expansion reached the back pressure line. Now if the Professor will go further, and find what the mean effective pressure amounts to in each case, in terms of steam used, he will be getting at the question in a proper manner.

As to the experiment of opening the throttle-valve just sufficiently to supply the difference between the boiler pressure and that to which the steam is compressed, I believe I did not claim that power could be manufactured by the use of compression. I never thought power could be obtained for nothing. There is a very pretty little theory connected with the Professor's proposed experiment, however, which I will notice. Suppose the engine to be frictionless and the walls of cylinder incapable of either receiving or imparting heat. At the end of each expansion if the condensation due to work performed could be drawn from the steam before compression was begun, there would be an amount of work done in excess of that required for consequent compression, and the amount of useful work resulting would be the exact mechanical equivalent of the heat used, and the engine would be a perfect heat-motor, working with ten times the economy of our best engines at the present time.

As to the "mechanical common sense" of storing power in the fly-wheel and taking it out again, it is done every day by every engine that runs with a fly-wheel; and it is considered correct engineering practice, I believe, to have fly-wheels. Some engineers go so far as to claim that a fly-wheel actually makes an engine more powerful. Which is true for limited portions of time.

In rolling mill engines this transfer of power into and out of the fly-wheel goes on to a great extent. The engine stores power into the wheel which in turn gives it out to the rolls, assisting the engine in emergencies. The power is stored and taken out again for a purpose; and if I return a part of it to the cylinder, for the purpose of saving steam, and it accomplishes that object, I don't see wherein there is a lack of mechanical common sense in the practice.

The Professor states that if clearance is necessary I will have established my point.

In all first-class engines clearance has, I believe, been reduced to a minimum, and yet it exists in every engine that runs to-day. It may be the Professor has an engine in his mind's eye that shall have no clearance. I cannot judge of what may come in future. But at present, there are no engines without clearance, and the Professor has virtually admitted the point.

I have seen engines whose pistons came within one-sixteenth of an inch of the cylinder-head. Yet the clearance amounted to over four per cent. of piston-displacement, on account of the waste room in steam and exhaust-ports.

He goes on to state that he has seen engines running without compression at the rate of sixty revolutions per minute without pounding. So have I. Lots of them. But sixty revolutions per minute is slow speed. He admits that an engine runs quietly with compression under conditions that, if there were no compression, would pound badly.

I suspect that he has never had lively, or high speeds of account to handle, or he would fly to the refuge of compression, and takes shelter under its friendly wing. My experience has led me to believe it is necessary to high rotative speeds, unless the inertia of reciprocating parts, is sufficient to absorb she steam-strains at beginning of stroke, as in some of the Porter-Allen engines. The engines he mentions in Philadelphia are probably of that type.

Now a few words about the "single valve" engine, which is supposed to make a virtue out of a necessity. A very wise course, certainly. I did not intend what I said, however, as a defense of that feature in its valve-movement which caused compression. I simply spoke of its effects, whether a necessity or not, as being admirable, and all the ridicule the Professor chooses to use won't make that engine run one particle different in any respect.

Brooklyn, N. Y. Ed. F. Williams.

[Mr. Williams' letter has been seen, in proof, by the writer of "The Professor in the Machine Shop." and he authorizes us to say that in his opinion a reply is unnecessary. He does not desire to convert any one to his views, or to ridicule any one, and regrets that any jocular allusion he made has been so taken. He also feels, he says, that in making quotations, only the strict letter should be used, and no inferences drawn from opinions expressed in so many words. He will only say, in closing his remarks on this matter, that whether 60 revolutions per minute is slow depends mainly upon the stroke, which he stated was 6 feet; 12 feet in one revolution, or 720 feet per minute. This, says the Professor, is not slow in his estimation for a 60-inch piston.

We also think that the matter has been sufficiently discussed. Probably but few will change their opinion on any given subject without their own grounds for so doing, and if this correspondence has stimulated thought it will not have been in vain.—Eds.

GEOMETRY AND ENGINE WORK.

Editors Mechanical Engineer :

On December 31st, 1883, I sent you a sketch of a pair of valves and asked you some questions in regard to them, which I thought any practical engineer ought to be able to answer, but you do not seem to answer any of them.

I want to advance in geometry, where should I begin. Should I first take up algebra, or can I advance in geometry without first studying algebra ?

Cleveland, O. A. E. B.

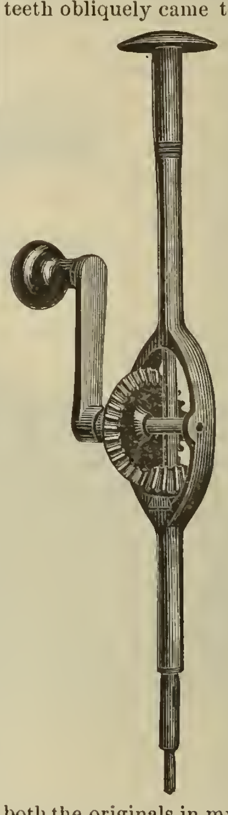
[Mr. B. is informed that his former letter received attention by mail, but was returned to us as "not found." We cannot answer Mr. B.'s former question, as to the proportion a given engine, or angle of advance of eccentric by simply looking at a plain sketch of the cut-off and slide valves. To get the exact eccentric angle, due to lap, lead, and travel, at valve, we should have to lay the parts down, a matter involving time and labor that we are unable to bestow at this season.

In regard to the current question our friend will find *Monckton's Practical Geometry* an excellent introductory treatise to the subject alluded to. Since geometry concerns the measuring and properties of lines, angles and solids he can make his calculations either arithmetically or algebraically, as best suits his views, the latter being of course the most expeditions.—Eds.]

OBLIQUE BEVEL GEARS.

Editors Mechanical Engineer:

About the year 1820 my father, Richard Houchin, Engineer, of London, England, in constructing a large saw mill, found it necessary to run two lines of shafting, crossing each other at right angles. There arose the difficulty of driving one shaft by the other. The ordinary bevel-gearing, of course, would not work. After considering the matter the idea of arranging the teeth obliquely came to him, and he at once made a model and found it worked well. He immediately had a pair of wheels made which gave satisfaction. Some years after, two gentlemen from different parts of England met in the Patent Office, London, while applying for patents for oblique bevel-gear, and made arrangements to work the invention together. After securing a patent jointly, they went to Maudsley's engine-works to have some wheels made. Mr. Maudsley gave them a letter of introduction to my father, Mr. Houchin; they went to his works, and upon showing their drawings, my father sent into the pattern-shop for certain wheel patterns; those he had made for the saw-mills about seven years previously. The patents were of course valueless, and my father made some wheels for them.



Some years later, I think about 1838 or '40, my father designed a drill stock with oblique bevel gear, see engraving taken from the original, made by my brother Thomas, from my father's design. In '46 or '47 I made a larger size from the same design, and sold several hundreds of them. I have both the originals in my possession at this time. I have used the oblique bevel gearing in other machinery.

Brooklyn, N. Y. J. W. Houchin, M. E.

FROM CHICAGO.

Editors Mechanical Engineer:

I take delight in reading the different views of engineers in your paper, and from my own experience must take the side of compression. I think but few engines will run smoothly without it. I use the exhaust, for I consider it more preferable than live steam. The clearance space must be filled with steam any way and while compression is taking place, the crank is passing a point when steam would have but little effect on the other side of the piston. If there is no compression on a fast running engine the steam pressure will never get near the boiler pressure on the piston. Any engineer will soon find that out by taking some indicator cards. Those that don't believe in it, let them run a steeple compound engine for awhile, varying from 150 to 325 H-P.

In reply to *G. W. R.*, Andrews, Ind., I would say that some sixteen years ago a party in this city claimed to have a patent on a scale-pan, and wanted to put some in my boilers, but as there were nothing but small hand-hole plates in front, I did not put them in. Some eight years ago I got a new boiler 5' diameter by 16' long, with a man-hole underneath the tubes in front. I had a copper pan with ¼-inch hole put in the bottom legs. It would hold over half a bushel. I found it full in two weeks, the scales packed tight edge-wise, so that some times I would have to take a chisel to cut them out.

The engineer's license question—I am surprised to hear that any man of good judgment should object to a license law for all engineers. If there is no need of such a law, why then abolish the Government license laws? Why is a boiler any safer in a building where a thousand persons may come and go than on a boat? I doubt if those Franklin Institute gentlemen would like to go to New York on a steam vessel unless they knew she had been inspected and was in charge of licensed engineers. Our employers should be judges! Oh! yes; I told one one day that I would have to put a new sheet in one of my boilers, and he said: "Can you put it in while running?" Of course he was a judge. Few employers know what should be the qualifications of of an engineer. Why don't the Marine Engineers get a corner on their labor? they have licenses. This is all bosh. No intelligent engineer wants any corner on his labor, but he does want protection, as well as the doctor or the lawyers. Our calling is just as beneficial to the world at large as either of these professions. Because we may find some defects in the law in some places, that does not show that the principle is not good. WILLIAM PONSONBY.

CHICAGO, ILL.

◆

IN FAVOR OF COMPRESSION.

Editors MECHANICAL ENGINEER:

"The Professor In The Machine Shop" has given some views on compression which I cannot very well understand.

He says that compressed steam cannot be used for a cushion in the cylinder of a steam engine except at the expense of a portion of the power stored up in the fly-wheel.

Every engineer knows that there is a certain amount of power lost in reversing the reciprocating parts of a steam engine, but what we want to know is how to obtain that power with the least expense. Within certain limits I am an advocate of compression for that purpose. In case we have no compression and the piston is allowed to pass to the end of the stroke perfectly free, we will be compelled either to call upon the fly-wheel to arrest the momentum of the piston and connections or to give the valve excessive lead. In the former case there would be a loss of power, and in the latter a loss of steam.

For instance, take a steam engine 30×36 in. with piston, cross-head, and connecting-rod weighing 1,300 lbs., and a piston travel of 600 ft. per minute. When that 1,300 lbs. of metal is moving in a straight line at a rate due to the piston travel we want to stop it at the end of the stroke and start it back on the return with as little expense as possible. In a well regulated engine the compression should be just sufficient to bring the reciprocating parts to rest independent of any appreciable strain on the crank-pin.

The steam which has been forced into the clearance has taken no power from the fly-wheel, but has relieved it of the resistance it otherwise would have met in reversing the heavy parts.

In my practice I cannot make a steam engine yield good results without a cushion and I take it from where I think it will cost the least.

OSCODA, MICH. J. B. JOHNSON.

◆

THE *Concord Monitor* asserts that a locomotive standing in the depot at that place was fired up by the depot-watchman, preparatory to the arrival of the engineer, for an early morning train. Only a small fire was started with the intention of increasing it when the time came. As the engineer was within a few hundred feet of the depot he saw the train roll slowly out of it, and finally stop a few hundred yards away. Upon investigation it was found that the fire was sufficient to generate forty or fifty pounds of steam, and that the lever was in the first notch. Leakage of the throttle went on until the pressure was great enough to start. The opinion of most engineers would be that with the lever in the first notch, and only fifty pounds pressure, a train of three cars could not be started by leakage.

◆

THE *Iron Trade Review* asks in its last issue: "What has the supervision of runners and the hearing of complaints to do with the science of engineering?" This refers to our paragraph published lately on the term "traveling engineer" which is certainly a very awkward appellation. But this latter does not supervise the runners, he simply sees whether their reports of defects are well founded or not. And the connection with the science of engineering is thereby made, for if the traveling engineer does not understand both theory and practice he is of no use. "When the blind lead the blind both fall into the ditch."

◆

RECENTLY in the shops of the Philadelphia and Reading R. R., at Elizabethport, N. J., an engine had been stripped for repairs, and had stood some time in the shop. Some of the tubes had burst and plugs remained in them. A workman going up to one with a lamp in his hand, knocked the plug out, when there ensued a deafening explosion like a volley of musketry. The same thing was experienced when a second plug was knocked out. The natural answer as to the cause is "gas," but why a leaky tube should hold an explosive gas, or what the nature of the gas was, must be told by others, we chronicle the facts only.

A LESSON IN MECHANICAL DRAWING.

The *American Machinist*, of February 9th, publishes a sketch of a strap in connection with an article on "*Hammers*," which, had it been written by any of its correspondents, we should not have taken notice of the mistakes existing in the drawing. But the author of sketch and article, Joshua Rose, is also author of a work on mechanical drawing, and should, at least, have made the sketch right even if rough.

Such an error affords one of the best lessons in mechanical drawing, and we thank the author and publisher for the chance use of it.

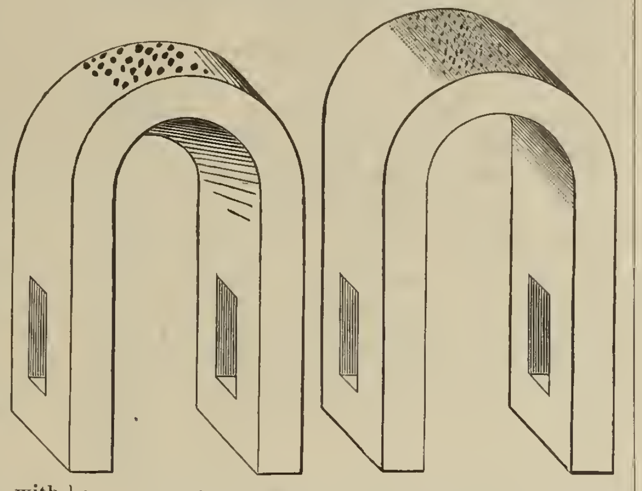


Figure 1 represents the sketch in the *American Machinist*. Figure 2 represents it as it should have been drawn. Figure 1 attempts to shown both surfaces, inner and outer, of the strap in one view, an effort that, it is needless ot say, is not successful.

BOW-PEN.

◆

REPORT OF A BOILER TEST FOR EVAPORATION.

We have been furnished the following report of a test, made by a well known New York engineer, of one of Steads' water-pipe boilers, at Colgate & Co.'s factory, Jersey City, N. J.

Appended are the dimensions of boiler :

Grate surface, 33 square feet.
Heating surface, 1777·8 square feet.
Superheating surface, 211·5 square feet.
Ratio heating to grate surface, 53·9 to 1.
Rated horse power, 150.

Water in boiler when drum is half full, 203·7 cubic feet.

Smoke-stack, 2½ feet diam., 80 feet high. Another boiler of same size discharges its products of combustion into same smoke-stack.

Fuel used, Lehigh Anthracite, Egg Size. Damper wide open two thirds of the time ; half open remainder.

Duration of test	10·97 hours
Average temperature of feed	37 deg's
" " " flue, by pyrometer	621 "
" steam pressure	67 lbs.
Total coal (including wood)	5235 "
Ashes	816 "
Per cent of ashes	15 6
Total evaporation, actual condition	48,220 lbs.
Evaporation per hour, "	4,396 "
Horse power developed (at 30 lbs. of water per hour from and at 212°)	177·9 H. P.
Water evaporated from temp. of feed to 67 lbs. pressure, per lb. coal	9·19 "
" " " combustible	10·91 "
" from and at 212°, per lb. coal	11·16 "
" " " " combustible	13·31 "

We publish this test merely for the purpose of calling attention to its unreliability. We accept without question the records of boiler-tests made by mechanical engineers of good standing and wide reputation, for we do not believe that any such would wilfully falsify the records. They are generally too well informed to be led into making boiler tests without taking all precautions to insure accuracy. The record here published, however, contains internal evidence of worthlessness, and we are surprised that the engineer who made it should allow it to be circulated. If his name were published with it, it would go far to damage any reputation he may have already earned.

It is well known that the maximum heating power contained in one pound of carbon, is equivalent to an evaporation of 15 pounds of water from and at 212 degrees. If we assume that all of anthracite coal, except its ash, is combustible, equal in heating power to the same weight of carbon, the heating power of the anthracite egg-coal used in the test (containing 15·6 per cent of ash), could not be more than 84·4 per cent of 15 lbs., or 12·66 lbs. of water from and at 212 degrees. This is the maximum result theoretically possible with such coal, supposing it to be perfectly burned, that all the heat made was absorbed by the water in the boiler, that there was no radiation, and that the products of combustion escaped into the chimney at the same temperature as that of the atmosphere out doors.

The results reported above, viz. : 11·16 lbs. per pound of coal, and 13·31 pounds per pound of combustible, are respectively 88·1 and 88·7 per cent. of the total values theoretically possible, showing only 11·9 and 11·3 per cent. respectively of total loss from imperfect combustion, from radiation, and from heat carried away by the flue-gases. These results are so surprisingly high as to give *prima facia* evidence of their incorrectness. The reported temperature of the flue-gases, however, if accurate, shows still further the inaccuracy of the record of evaporation. A flue-temperature of 621° is higher than is consistent with good economy with any boiler.

A moderate estimate of the weight of flue-gases is 25 pounds per pound of combustible burned. (See Rankine). Probably 30 pounds is nearer average practice. But assuming 25 pounds as the weight in this case, their specific heat as ·238, the temperature of the atmosphere at 60 degrees, and that of the flue at 621°, we have :

$$\frac{25\times\cdot238\times(621-60^\circ)}{965\cdot7}=3\cdot45\text{ lbs.}$$

That is : 3.45 lbs. of water evaporated, from and at 212°, as the equivalent of the heat carried away in the chimney, for each pound of combustible burned, or $\frac{3\cdot45}{15}=23$ per cent. of the total heating power of the combustible. A loss of 4 per cent. by radiation from boilers set in brickwork is very moderate. Adding this to the loss in the chimney, would make 27 per cent. of the total weight of the combustible portion of the coal not available for steam making. The remainder, 73 per cent, is theoretically capable of evaporating only $\cdot73\times15=10\cdot95$ lbs. of water, from and at 212° per lb. of combustible. Or if the coal contains 15·6 per cent. of ash, one lb. of coal will evaporate only $10\cdot95\times84\cdot4$ per cent $=9\cdot24$ lbs. of water per lb. of coal, from and at 212°.

With the conditions above assumed, viz. : 25 lbs. of flue-gases per lb. combustible, 15·6 per cent. ashes, temperature of air, 60°, and of flue, 621°, and 4 per cent. radiation, the best results which can be theoretically expected from the Stead boiler, or from any other, are 9·24 lbs. water per pound of coal, and 10·95 per pound of combustible, instead of 11·16, and 13·31 lbs. respectively, as shown in the report. The results given in the report are therefore 20·8 per cent. and 21·6 per cent. higher than can be expected from any boiler under the given conditions ; even with the most regular and careful firing.

We do not charge that the figures in this report are wilfully false. Their incorrectness may arise from causes not suspected by the engineer who made the test, but which cause it is part of his business to suspect and to take precautions against. There are a number of such causes possible, such as incorrect weighing or measuring of the water and the coal, leakage of water from the boiler, and not taken account of, or water carried over (entrained) in the steam.

An engineer should always look with suspicion upon the records of any test which shows an evaporation of over 12 pounds per pound of *combustible*, even when the temperature of the chimney gases is as low, nearly, as the temperature of the steam; but when a result twenty per cent above what is theoretically possible is obtained, the test should at once be rejected as inaccurate, and made over again with proper precaution.

PYROMETER.

◆

CUBIC FEET of water passing through a pipe, per minute, multiplied by 9,000, equal imperial gallons in 24 hours.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

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NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

TO WHOM IT MAY CONCERN.

Personally appeared before me this day, Feb. 9th 1884, Egbert P. Watson, of Egbert P. Watson, & Son, who made oath that the circulation of THE MECHANICAL ENGINEER, is Eight Thousand copies, of this edition.

Sworn to before me this
9th day of February, 1884.
E. Ritzema De Grove,
Notary Public,
N. Y. Co.

Egbert P. Watson,

THE NEW CRUISERS, THE LONDON ENGINEER, THE MECHANICAL ENGINEER AND MIERS CORYELL.

Those of our readers who have noted what has been said in these columns in the past few weeks, concerning matters in the above caption, will perhaps be interested in one more allusion, which, so far as we are concerned, will be the last.

Our contemporary, the London *Engineer*, in its issue of Jan. 25th, quotes what we said upon page 6, No. 1, current volume, and to that article appends these comments :

> "It will be seen that our contemporary fails to understand us. We did not mean to assert that the members of the Naval Advisory Board had not experience as engineers ; but we did assert, and repeat, that neither they nor anyone else has had any experience with such engines and boilers as it is proposed to put into the Chicago. They are purely experimental, and if they succeed, then they will also be purely exceptional, and all the experience which has been acquired in this country must go for nothing. Why should experimental engines and boilers, condemned alike by English and American engineers, be put into the *Chicago* is a puzzle to us. It is also a puzzle to us how Mr. Coryell, who is to build the engines and boilers, is allowed to have a seat at the board at all, or, having a seat, why he should be allowed to supply the machinery in question. It is, to say the least, unusual for any member of such a Board to recommend the adoption, we shall not say of his own designs, but the giving of a large contract to himself or the firm to which he belongs. They manage some things, however, in the United States as they are managed nowhere else."

Our contemporary, the London *Engineer*, will permit us to say that an Advisory Board in this country is simply for advice. It is composed of civilian members of professions, supplemented (perhaps in view of what has transpired we might say superintended) by naval officers. None of the civilian members are attached to firms, and none of them have adopted their own designs. They simply submitted them to the Board as a Board ; it required a majority of votes to pass them. Mr. Coryell does not build the engines and boilers, nor has he been awarded a contract for them. John Roach is the man—a distinguished party of whom, perhaps, the London *Engineer* may have heard. None of the members have awarded themselves contracts. Even in the United States, given over to lawlessness and misrule as it is, according to Sir Leppel Griffin, could such a thing happen.

Mr. Coryell is a gentleman of independent fortune, acquired in his profession, in no wise concerned in or connected with jobs of any kind.

In closing this matter, which from many aspects is tedious, and distasteful in its personal allusions, we must say that it has been called out by the criticisms of the London *Engineer* upon American engineering designs, viewed from the standpoint of English experience. We do not object to criticisms in this country ; that is not the spot which galls. We have been moved to a more or less vigorous defence of individuals from the fact of the criticisms aforesaid, having been used by persons in this country to further their own ends. A result, it is needless to say, the London *Engineer* is in no wise responsible for.

The Naval Advisory Board, as such, exists no longer. Mr. Coryell resigned some time ago, for reasons of his own not necessary to publish. Other members of the navy have been withdrawn and the unity destroyed.

It is not extra-hazardous to say that there will never be another in which civilians play any part, for the treatment received is not such as to be rashly incurred a second time.

CORNERING THE TUBE MARKET.

Our manufacturing readers will be interested in knowing that an attempt is being made to control the price of iron tubes and pipes in the interests of certain speculators. They have combined, under the style of the Empire Iron Company, to fix their own prices on iron tubes, compelling consumers to pay whatever they may see fit to demand, or what they think the market will bear. In a word, the tube market is to be cornered in the same way that food staples have been so often. This combination or "pool," is now operating in this city, and, it is needless to say, is not looked upon with great favor by consumers.

The large buyer is put upon the same basis as the small, no one being able to obtain any advantage by reason of ordering large shipments.

We are privately informed, however, that the real work of the Empire Iron Co., is this:

The thirteen manufacturers of iron-pipe and tubes, entering into the combination, hold stock in the Empire Iron Co., in proportion to the capacity of their respective mills. Each mill reports to the company a list of all its sales, and, to ensure that no false report is made, the general manager of the company appoints "competent persons to remain at the mills of the parties under contract with this company, whose special duty it shall be to report to said manager all shipments of goods covered by contracts." To prevent collusion between these competent persons, or inspectors, and owners of the mills to which they are sent, these inspectors are rotated amongst the mills at least once every eight weeks.

Each manufacturer agrees not to sell at a less discount from printed list prices than that agreed upon by the combination. Each manufacturer also pays over to the combination the difference between the selling price and the "base price," which is also agreed upon by the combination, and the fund so made is divided by the association among the various manufacturers in proportion to the amount of stock held by each. Under this arrangement if one of the mills should remain idle it would receive its regular share of the proceeds of this fund, and in certain conditions of the trade it may pay those mills which have the poorest location, and the poorest facilities, to remain idle, and draw dividends from the general pool rather than to run and pay money into the pool.

It is, of course, probable that during the time the pool may be in existence it can create a great deal of hard feeling, and cause much annoyance to boiler-makers, who cannot estimate with any certainty for the future as to prices; byond this there seems to be no cause for serious alarm, for the fate of all pools, sooner or later in this country, is disintegration from the force of circumstances. Pools have been formed before now in this same commodity. but after a precarious existence went to pieces from internal dissension and want of good faith of the members. We do not believe it possible to harmonize all interests and conditions of manufacture so that each member shall be satisfied that he is getting his fair proportion of trade, or that he can make more by putting his affairs into the form of a joint stock concern instead of managing them himself.

THE GRIP.

The repeated failures of Colonel Paine's grip on the Brooklyn Bridge cars have already materially affected the Patent-Office records, and applications for patents on grips are now coming in regularly from week to week. It would seem, in fact, as though the near future would usher in an array of patent grips that will leave car couplers, low-water alarms, electric appliances, and other devices now popular with inventors, entirely in the background.—*Iron Age.*

How can you say the grip is a failure! Don't you know it is constantly in use, and that it has only failed practically, while theoretically it is all right? If it takes a machine-shop to keep it running, and a lumber-yard to supply wood for the sheaves, that is merely incidental. There is nothing like bull-dog tenacity of idea, when you once get a good grip on it!

BRIEF MENTION.

This number of The Mechanical Engineer contains four extra pages of reading matter, and the variety and quantity together will, we hope, be evidence of our intention to give good value for the favors so liberally bestowed upon us by our readers. The list of them is longer than ever before, and is receiving daily accessions from all over the world.

MASTER MECHANICS' ASSOCIATION.

The following circular has been issued from the Secretary's office to the members of the Master Mechanics' Association:

Your Committee on the Best Material for Lubricating Valves and Cylinders respectfully ask for information in reply to the following questions:

1. What kind of lubricant do you use on valves and cylinders?

2. Have you made any experiments with other kinds of lubricants, if so please state results obtained?

3. How is the lubricant applied, by self-feeders, cup or steam chest, or through pipes from cab? Please describe the device you are using. If self-feeding cups, where is best location?

4. Have you made any experiments with self-oilers? If so please describe the different devices and give results of experiments.

5. What mileage are you getting with the lubricant you are using, to the pint or pound?

5. What mileage are you getting with the lubricant you are using, to the pint or pound?

6. What results have you obtained in the wear of valves, piston, packing and glands with the lubricant you are now using compared with others you have tried?

7. What, in your opinion, is the best method of applying the lubricant to cylinders?

8. If you are using a compound that is made of several lubricants, please give proportions.

In answer to above questions please do not confine yourself to the questions, but give any facts or exact data you may have bearing on the subject.

Please send replies not later than April 1, to H. Schlacks, Superintendent of Machinery, Illinois Central Railroad, Chicago, Ill.

SOME TESTS recently made by the Thomas Iron Co. of samples of Muirkirk charcoal pig-iron gave unusually high results. The pig from which the test pieces were taken was first cut into four parts by a shaping machine, two of the parts being afterward turned down to exactly $\frac{9}{16}$ in. diameter. The two pieces were then tested and stood a strain of 12,580 and 13,040 lbs., which was equivalent to 50,320 and 52,160 lbs. per square inch respectively.—*Iron Age.*

ONE INSTANCE.

At the close of a long article on the commercial economy with which manufacturing establishments are managed as regards the one item of fuel alone Mr. John W. Hill cites an instance in the Eastern states where, by making certain changes which he indicates, the sum of $15,000 could be saved in coal. This establishment is one of the best of its kind, equipped with efficient engines, but using cylinder boilers. Mr. Hill closes his report with the remark that his investigations show how losses are incurred where none are supposed to exist. This establishment is shown, from precedents taken on the premises, to be using nearly one-third more coal than should be to do the work. There is no doubt but that the experimenter is quite correct in saying that the same result would be shown in many other large establishments throughout the country.

Essayists are fond of arraying heat units to show that modern steam engines, and boilers of the period, realize only a fraction of the value of the fuel burned. Admitting their calculations as correct we have at once the question of how much of this is wasted through the indifference of consumers. We fear to enlarge upon this topic further, lest many of our older readers feel that we have a stock subject to dilate upon in a dry time. The matter is of so great importance that we cannot refrain from this brief mention of it.

THE SCIENTIFIC AMERICAN ON STEEL.

THE *Scientific American* says:

> We actually pay out several thousand dollars a year to persons skilled in various departments of science and engineering for replying to these questions, besides what are answered in the editorial room of this paper.

We presume this is one answer which originated with the *Scientific American.*

> (1) N. P. asks: What is the difference between crucible steel and cast steel, also what is the difference between common spring steel and spring cast steel, and how can the difference be told? A. Cast steel, such as is used for tools and similar purposes, is made from a particular grade of iron which is rolled into bars of one-half inch by three inches, or thereabouts, and these are packed in an oven with charcoal dust and lime and kept at a red heat for seven or nine days. When they come out the bars are covered with blisters—hence the name "blister steel." They are as brittle as glass when cold, and are broken up into lumps of half a pound to one and a half pounds, and melted in plumbago or in fire clay crucibles—hence the name "crucible" steel—and poured into moulds of cast iron in convenient shapes for the afterward rolling or tilting. * * * * * To make a flat spring that will not set, crucible cast steel must be used and the spring must be heated and hardened and then drawn to a spring temper. Bessemer or open hearth steel will not harden or temper."

As a matter of fact the definition for cast-steel above is incorrect if applied to modern processes. It is not cast-steel, but cemented steel; that is, the iron is made into steel by the cementation process and the casting part does not indicate its grade or quality. The bulk of the tool-steel made in this country is not cemented, but veritable crucible steel, converted from iron in the pot (crucible) and cast direct into ingots. Cemented steel is not necessarily cast-steel, for much of it is piled and welded direct from the bar, and is then known as shear-steel, double or single, according to the times it is welded before use.

Tons upon tons of Bessemer steel are used in this country for springs, and are both hardened and spring-tempered. Both Bessemer and open-hearth steel will harden, and temper. The latter is used for silver-plated, solid-handle knives, and we have sold tons of it for this purpose. Even files have been made of Bessemer steeel.

One more instance of the *Scientific American's* general information and we have done:

> J. A. B. asks: How to make steel castings smooth? A. You cannot make steel castings as smooth as gray iron castings, because, with the same care in moulding and dressing or facing the mould, the steel has to be poured hotter than the iron, and burns into the sand.

Evidently our contemporary has seen but few steel castings. If it pays out thousands of dollars for matter of this sort it wastes its money.

TALKS ABOUT THE STEAM ENGINE.—No. IX.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

The cross-head, or motion-block as it is called by English engineers, has many different forms, and much ingenuity is being shown in getting up others which might have been better expended in other directions.

A true fit, without thump, to the slides, and sufficient area of wearing surface are the important points.

When a horizontal engine crank "throws over," all the pressure and wear come on the under slide, for the connecting-rod is pushing as it goes away from the cylinder, and is pulling as it comes to the cylinder.

When the engine is reversed the contrary is true. Facility of lubrication, and the appearance of a thump as soon as there is any slackness in the slides, have rendered it customary to make engines running in one direction only, throw over.

The pressure on the slides is due to the angular position of the connecting-rod, and is greatest at about mid-stroke.

The shorter the connecting-rod the greater the pressure on the slide will be.

With sufficient approximation for all practical purposes we can use the following rule when the connecting-rod is four or more times the length of the crank:

Divide the length of the connecting-rod by the length of the crank. With this result divide the total pressure on the piston-head; the result will be the pressure on the slide at mid-stroke in pounds.

For example: We have found in the preceding case that the total pressure on the piston-head is 32,170 lbs. Assume the connecting-rod to be five times the length of the crank we then have for the pressure:

5)32,170
6,435 lbs. approximately.

Skilled mechanics of large experience say that 125 lbs on the square inch is a sufficiently small pressure, although in locomotive practice the pressure has been carried as low as 40 lbs on the square inch with great increase in durability. Assuming 125 to be enough reduction except where there is a great deal of dirt, we have in the present case:

125)6435(51½ square inches area.
625
185
125
600

This area can, of course, be divided up into lengths and breadths as we please.

Assume the slide to be 5 inches wide

5)51·5
10·3 inches long

10″ by 5″ would, of course, be near enough.

Since all the pressure is taken by one slide we can use the "slipper cross.head", having only one slide on the under side, in the case of slow-moving engines that throw over. We cannot safely use a slipper-guide on high-speed engines, because of the fling of the connecting-rod.

The cross-head pin is usually made of the same size as the crank-pin, sometimes having two of its sides flattened. The motion of the boxes in the end of the connecting-rod is very slight on the pin, in most cases, and does not require the whole circumference of the pin.

Very little attention is demanded by this pin and it is usually deemed sufficient to make it the same size as the crank-pin which has much severer usage.

Flattening a portion of its circumference would not seem so safe in high speed engines as it is in slow engines, although it is used in the former types.

Pressure on the slide means pressure on the guide, but as the guide for the most part is solidly attached to the engine frame-work, there is no necessity to calculate its dimensions, save in the case of locomotives, where the guides should be calculated as beams loaded at the middle, and *sufficiently rigid* not to deflect one one hundredth of an inch under the greatest stress that can ever come upon them.

HOW I SERVED MY APPRENTICESHIP.

NUMBER IV.

BY GEORGE SLOCUM.

My first introduction to cylinders was through a twelve pound sledge. Brown had a pair of cylinders bolted together, and he and his boy had marked off the saddle and caped it out. So Brown picked up a cold chisel (flogging chisel) with a long wooden handle, held it against one of the ribs he had made by caping, and told me to belt away. I commenced about 10 o'clock in the morning to "belt away," and kept it up, off and on, until six o'clock in the evening, and the way the big chips flew out of that saddle was a caution Along about quitting time I felt as though I had got the Irishman's promotion, who went out two mates of a ship and came back three. My arms ached, and my eyes were tired from winking and squinting at the chips flying out. One big chip got a good start and took a Dutch sweeper on the back of the head. I guess it didn't hurt him much, but he made such a fuss about it, that the foreman told Brown to get some old gunny-bags and put up a screen. We had lots of work, new cylinders standing all around. Brown used to take the cylinders from the boring-mill man, and then do every bit of the work even to swinging them on the frames and bolting them fast, after old Jones had set them.

I got some chisels and a hammer out of the store-room, and Brown set me to work chipping off lumps; gates and such like. At first I struck my hand some hard blows, but Brown only laughed at me and said I was learning fast.

When I got so I could chip to a line, pretty closely, Brown allowed me to rough out ports for him, and towards the end of my term with Brown I could do a tolerable good job of chipping and filing. I wanted to get some pointers about fitting up cylinders, so one day I asked Brown about the matter.

"Oh," said he, "there is nothing much in it, all you have to do is to get your cylinder, frame-bearing, and valve-seat center-lines accurately, work from them both ways, and follow your drawing. You get your center-lines equally distant from both cylinder flanges, by holding a straight-edge against each one, and measuring from it. Just get your center-lines correctly and you're all right."

"Well, how about the holes in the flanges?" said I.

"Why, you get another center-line up and down on each flange and lay your holes off, working both ways from the top of it. If you use a templet for drilling the holes, look out, and don't set it top side down, or you will drill a stud-hole through the cylinder-cock boss, as I once saw a fellow do."

"Is that all? How about the ports?"

"You lay them off, as I told you, working both ways from the center-line. Your drawing will give you the width of exhaust-port, bridges, and steam-ports, and also the lengths of ports; that's all you want."

"You forgot the saddle-joint," said I.

"Yes, that's so. Well, you carry your center-line over to and down the face of the joint, and lay off your saddle-joint holes both ways from the center-line. Or, if you use a templet, as you see me do, you can set it by a straight-edge held against the back cylinder-flange. You must get your back cylinder-flanges in line, regardless of the front flanges, so that the guides will fit in snugly between the cylinder-heads and the guide-yoke, for generally the guide-yoke must be set precisely in a certain place, as it very frequently sets, or properly locates, the rocker-boxes, and reverse shaft-boxes also. So you see if you had one cylinder a thirty-second back of the other, and both heads were turned alike, the guides would come short on that side. Then again you must put centers in the counter-bores, just as we have done, and tram across from one center to the other, front and back, in order to see if the cylinders are parallel with each other. And then you must see that all four centers are the same height from the cylinder frame-bearings. Just imagine where the back ends of main-rods would be with the cylinder-centers $\frac{1}{32}$d of an inch closer together, or further apart, front or back!"

"It would make 'em rub hard against the crank-pin collars, or shoulders, wouldn't it?"

"Well, I should say it would, unless they were made a 'stand off and throw 'em on' fit," said Brown.

"Say, Brown! these are awful big cylinders, ain't they; must take a good deal of steam to run an engine with such big cylinders! I wonder how many cubic feet of steam a pair of those cylinders will use up while the engine runs a mile?"

"I give it up. Ask me something easy."

"Why, haven't you ever figured on such things?"

"Figure nothing. I never bother my head about figures. I can figure out how much is coming to me on pay-day just as well as the smartest of them, and that's all I want. I tell you, young man, lots of people have gone crazy trying to cipher out things," said Brown.

"Yes, but—"

"Now, look at old Jones over there; he is eternally figuring. He's got all my boards, and my pieces of sheet-iron, and,—Why look at all these chalk-marks on these cylinders! I'll bet he uses up ten pounds of the company's chalk every month, making figures, and he don't get a cent more wages than I do, and has no longer lease of his job, either."

"Why, it seems to me it would be a pleasure to a person to know how to cipher out all about engines and machinery, even if they didn't get a cent more by it. Wouldn't it?" said I.

"Can't see it. I can enjoy myself smoking my pipe or a cigar, and walking around down town of an evening, and dropping into the auctions; and listening to the fakirs on the street corners. But then I'm not opposed to people spending their time figuring; that's their business, it's all right, but I can put my time to better advantage, that's all. Figures be blowed. Give us a rest, boy," said Brown.

I saw it was no use talking figures to Brown, his tastes didn't run in that direction, seemingly. I was rather surprised, too, at the way he talked, for he always seemed to me to be pretty well posted. I know he was a rattler on politics, for he used to get away with the smartest of 'em in the shop when they pitched into him on politics. I felt sorry too, for he was a very good workman—Jones said he was—but then he was as blind as a bat on the figure question, and his arguments on that question not worth a cent a gross. I had to fall back on Jones, as usual, and I knew if I asked him, he'd get right down to hard-pan first pop, and sure enough he did."

"You see that engine over there No. 176?" said Jones.

"I do," said I.

"That engine has cylinders 17″ × 24″; she has a five-foot wheel center, and new steel tires three inches thick; that gives her a five foot and a half driving wheel, don't it?"

"Yes, sir."

"She carries 135 pounds of steam. Now, supposing she worked steam at boiler-pressure, full stroke of piston, how many cubic feet of steam would she use in both cylinders in running one mile? Come now, get out of my way and figure that up."

"Running one mile in what time?" said I.

"No odds about the time in this case," said Jones.

I went off and got a pencil and a piece of paper and figured it out at what I thought was the right answer. Presently I went over to Jones.

"Well, I've got it. But, Jerusalem! I didn't think it would take so much."

"What have you got?" said Jones.

"A little over 3,846 cubic feet."

"For one cylinder?"

"No, for both cylinders."

"How did you figure it?"

"This way. There are 5,280 feet in one mile."

"Yes."

"And 3·1416, multiplied by $5\frac{1}{2}$, gives me 17 $\frac{3}{10}$ feet nearly, for the circumference of each driver."

"Correct."

"Now, I divide 5,280 by 17 $\frac{3}{10}$, to find the number of revolutions of each driver in rolling 1 mile, and I get a little over 305 revolutions. Each revolution gives 2 strokes of piston, therefore 305 multiplied by 2 (for both pistons) gives 610 strokes. Each stroke equals 2 feet, then 610 multiplied by 2 gives me 1,220 feet piston travel for 1 mile. I reduce this to inches; 1,220 multiplied by 12 gives 14,440 inches of piston travel."

"All right so far. Now what?" said Jones.

"Now, I square the cylinder's diameter and multiply the product by ·7854, and I get 227 square inches nearly. I multiply 227 by 14,640 and I get 3,323,280 cubic inches, and I divide this by 1,728 (cubic inches in a cubic foot) to reduce it to cubic feet, and the result is 1,923 cubic feet used by 1 cylinder in running 1 mile. As there are 2 cylinders, I double 1,923 and I get 3,846 cubic feet."

"Could you get the answer by any other way?" said Jones.

"Yes, I could get it two or three different ways, but this is as simple as any and just as corect, ain't it?"

"Undoubtedly it is," said Jones.

THE STEAM ENGINE INDICATOR AND ITS USE.—No. 10.

BY WILLIAM BARNET LE VAN.

THE LINE OF COMPRESSION OR CUSHIONING.

This line, when it exists, is formed by closing the exhaust before the end of the return stroke. For example: at the point corresponding to *h*, on diagrams 12, 15 and 16. A certain quantity of steam in the cylinder is then compressed by the piston during the remainder of the return stroke, and the rise of its pressure is represented by the curve, *h k*. In the reduced diagram, figure 15, taken from one of the most advanced types of engines, this curve terminates at *k*, and represents the *most advantageous adjustment* of compression, which takes place when the quantity of confined, or cushioned steam, is just *sufficient to fill the clearance at the initial pressure.*

If this line should be projected above the initial pressure, and then suddenly drop nearly perpendicular to the level of the steam line, thus forming a loop (see Fig. 16), it would indicate an excess of compression, due to closing the exhaust too soon. It is evident that this would be very objectionable, involving a loss of efficiency. In computing such a diagram, the area contained in the loop, *x*, at the commencement of the stroke, denoting negative work as it were, should be subtracted from the total area included in the indicator diagram.

Fig 15

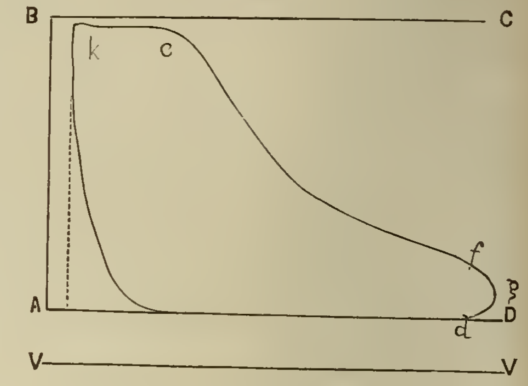
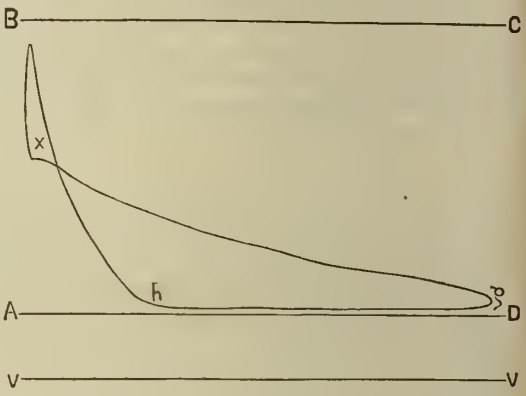


Fig 16



Compression, also, has a useful effect in the working of an engine, by providing an elastic cushion, whereby the momentum of the piston and its connections are gradually absorbed, and the direction of motion reversed without "thump" or "shock." There is no "jar" from the entering steam when a new stroke begins. The proper regulation of compression serves to make an engine work easily and smoothly, and consequently reduces the wear and tear of the working parts. The pressure due to the momentum of these parts will, of course, depend upon their weight and velocity increasing directly as the square of the speed. These data being given, the amount of cushion or pressure required to counterbalance work stored up in the reciprocating parts, can easily be ascertained. It follows that the compression should decrease rapidly as the speed diminishes, and *vice versa*.

In fast running engines compression also serves to prevent waste from clearance, especially locomotives. The capacities of the clearance-spaces and the steam ports are relatively larger than in most other steam engines, on account of the higher speed of the former. These spaces must be filled at the commencement of the stroke with high-pressure steam, which is obtained either by taking a supply of live steam from the boiler, or by compressing into the clearance spaces the low pressure steam that remains in the cylinder at the closing of the exhaust port. But in the latter process a certain quantity of steam is saved at the expense of increased back-pressure. It should be borne in mind, also, that the total heat of the compressed steam increases with its pressure, and as this latter approaches the boiler-pressure the temperature of the steam in compression is also raised, from that of about atmospheric pressure to nearly the temperature of the boiler-pressure. These changes of temperature, which the steam undergoes, will affect the surface of the metal with which the steam is in contact during the period of compression. It follows, of course, that the ends of the cylinder principally comprising the clearance spaces, acquire a higher temperature than those parts where only expansion takes place. This is an important consideration, since the fresh steam from the boiler comes first in contact with these spaces, and by touching surfaces which have been thus previously heated by the high temperature of the compressed steam, less heat will be abstracted from the live steam, and therefore a less amount of water be condensed in the cylinder.

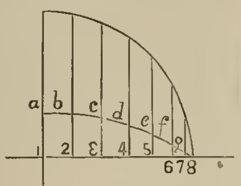


Fig. 3.

Power expended in compression lessens the available power of the engine without necessarily lessening the efficiency of the steam. Under proper management, as stated above, the compressed steam gives out during its re-expansion the power directly expended in compressing it. There is, no doubt, a somewhat great proportional loss by friction, but to counterbalance this, the wasteful back-pressure is reduced by the earlier closing of the exhaust.

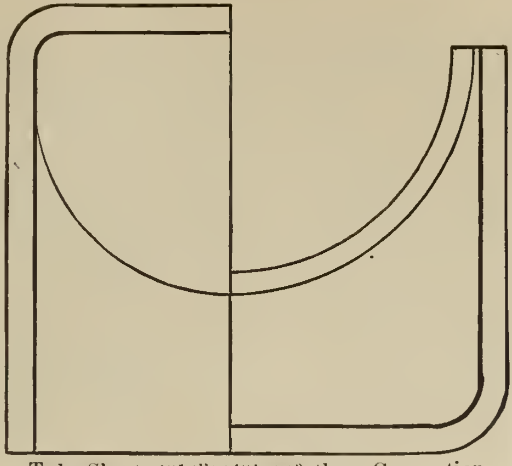
The termination of the compression curve should coincide with the beginning of the admission line, *i k*, see diagram 12.

As in expansion so in compression—the actual curve as shown by the indicator diagrams generally, and more especially those taken from locomotives, do not coincide with the theoretical curve. Here again the application of the law of Boyle and Mariotte, namely, the volume of the retained steam being inversely as the pressure, comes nearest to practical results. It will not be difficult to account for the fact that the indicated compressed curve should be below the theoretical curve. During the period of exhaust the surface of the cylinder-cover, piston, and cylinder have become materially cooled. When the exhaust port closes, the pressure and temperature of the retained steam rapidly rise, the temperature of the metal in contact with it rising simultaneously, but owing to the surfaces being large in proportion to the quantity of steam, a portion of the steam will be condensed. This loss of compression-pressure is attended, on the other side of the piston, by a corresponding gain of total useful pressure; thus the departure of this curve, as well as that of the actual expansion line below and above the theoretical curves, respectively, shows a proportional increase of the power exerted by the engine, which is clearly demonstrated by the increase of area included in the indicator diagrams.

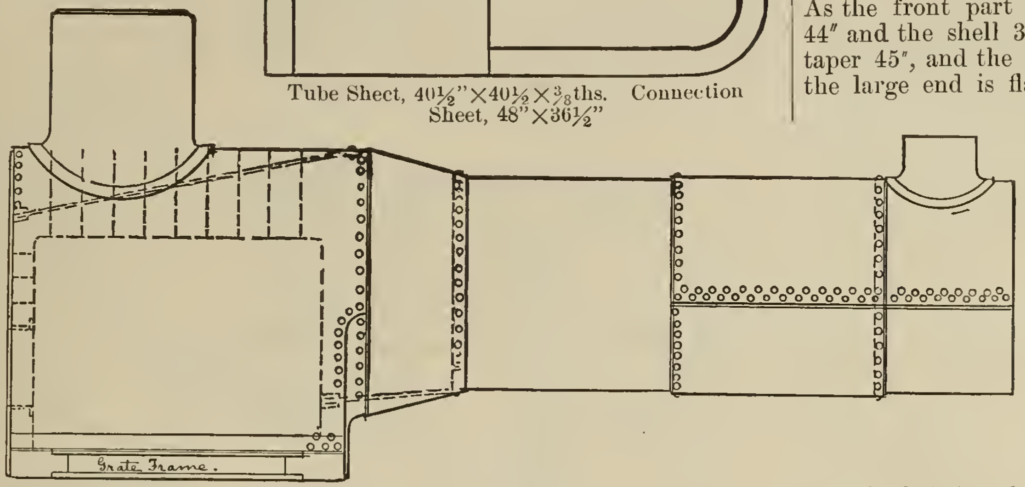
TYPES OF AMERICAN STEAM BOILERS.

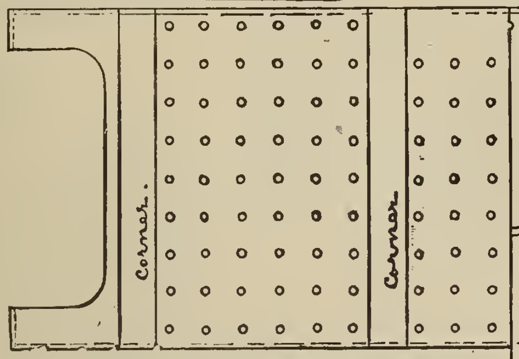
NUMBER IV.

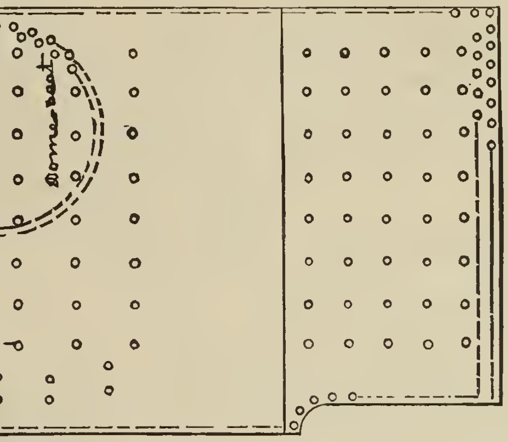
The diagrams represent an oil-well boiler. It is called the Tifft boiler because it was first built by Geo. W. Tifft & Sons, Buffalo, N. Y. It is a style of boiler that has stood more ill-usage than any other boiler made. Our contributor says: "In all cases the layer-out must have a diagram to work by, so I will take the front head and lay off half of fire-box. Mark where the seams come and lay out where the stays bolts will be. Next take the throat-sheet and see how the tubes will come in, and have plenty of clearance. The corners of fire-box I mark for a 3″ radius, the bottom corner has 4″ radius. The fire-box of this boiler can be made in one piece, so as to have as little labor as possible, and all the strength of sheet. I cut out each end for the grate-frame. There are only six rivets on the seam, four of them would have to be there if we put the seam on any other part of it. The taper course I make in four pieces. As the front part of boiler (or wagon-top) is 44″ and the shell 36″, I make the large end of taper 45″, and the small end 34½″; then when the large end is flanged in, it will be 44″ outside, and the small end 36″ inside. The small course of shell goes next to taper. In laying the taper out I take one of the plates and square it up, then get ¼th of the circumference of the large end and divide into two equal parts; now draw a line, and from it as a center, I get ¼th of small end; ⅛th on each side of center-line. Divide both into any number of equal parts, commence at bottom-edge line, and lay the square so it touches on squared line on bottom, and then scribe where the other blade strikes the line next the one the square is on. Keep moving the square to the next line and let the end touch where last scribed, but always be careful to keep the long blade even on the line, and the small blade touch where you last scribed. Then take trammels and get the distance on center-line from where scribed to top of line and set; that will be breadth of sheet. So with all lines, the same, to each end and the curves will be right. In getting out the dome some use trammels and some the sweep of the boiler, others divide off into a different number of lines; the trams and sweep are the same. The proper way is to draw the shell and dome, or parts of them that can be got on the same sheet. Square the sheet, lay out the line for holes, and divide the sheet into 4 equal parts; the sine is 3½″ and flange 4″, draw line 7½″ from edge of sheet, another 8½″ below that; set the dividers from 1 to "*a*," and carry it to sheet and strike 1 and "*a*" on the 3½ line, do same with all, then take rule and measure 4″ for flange, it will be same as figure 4.



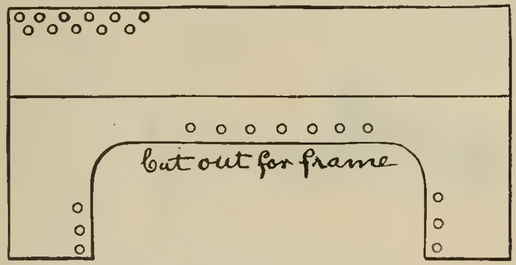
Tube Sheet, 40½"×40½×⅜ths. Connection Sheet, 48"×36½"







Fire Box Sheet, 142"×48"×5-16". Wagon Top, 141½×60.



Bottom Sheet, 58"×54"×⅜.

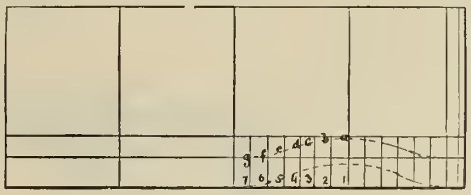
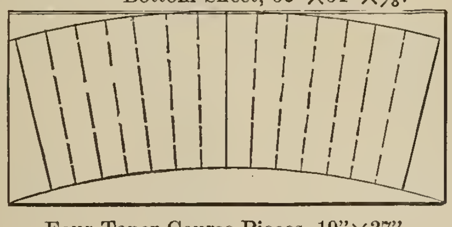
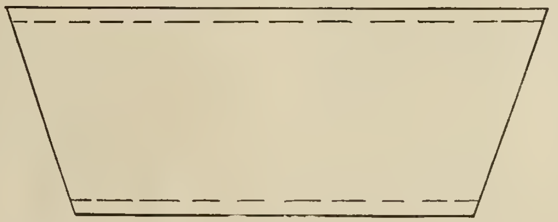


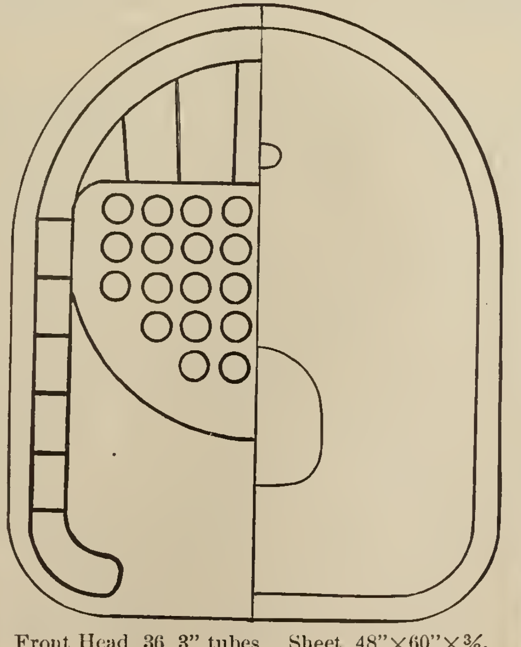
Fig. 4. Dome Sheet.



Four Taper Course Pieces, 19"×37"



Taper Course.



Front Head, 36 3" tubes. Sheet, 48"×60"×⅜.

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RELATIVE COST OF CONSTRUCTING IRON AND STEEL BOILERS.

The number of steel boilers built is increasing yearly. This is owing to the low price of steel as compared with iron, it being only 15 or 20 per cent. higher than that material, while the wages paid for labor remain the same. The cost of construction is, we fancy, somewhat greater than for iron.—THE MECHANICAL ENGINEER.

In this item our contemporary, which, by the way, never neglects an opportunity to accuse other publications of plagiarism, drew its inspiration from *The Age of Steel*. But unfortunataly, in trying to impress its own originality upon the item, THE MECHANICAL ENGINEER squeezed it too much; it is as meaningless now as the talk of a parrot. Just what is meant by "while the wages paid for labor remain the same" is to us a conundrum. If our contemporary means, as we take it, that the same wages are paid for building steel boilers that obtain for iron ones, then how does it "fancy" that the cost of construction in the case of the former kind of boilers is greater that in the case of the latter? Does it take into account time and the wear and tear of tools? If it does, it is figuring on a very small item. In any event THE MECHANICAL ENGINEER'S "fancy" is wrong; the cost of constructing an iron and a steel boiler is practically the same. For this we have the word of more than one large boiler maker.—*Age of Steel.*

If our friend has time to spare from correcting errors of the technical press let him glance over these few lines from one of the largest boiler-works in the United States.

Editors MECHANICAL ENGINEER:

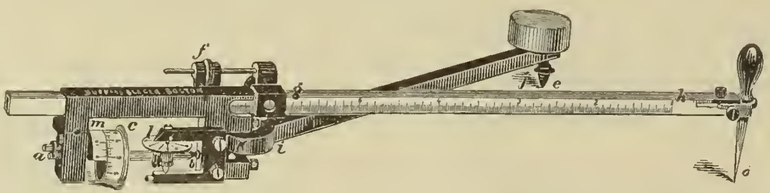
"I received your letter with the above slip inclosed, and would say that you are right. It does cost more to work steel plate than iron, for these reasons: It is harder to flange, harder to chip, caulk, and roll. One reason why it is used in preference to iron, aside from its tensile strength, is that, in flanging, it is less liable to crack in difficult shapes. The *Age of Steel* should ask the actual workers and it would get facts, but any one who knows the difference between iron and steel should know better than to say the cost of construction in the same."

BOILER MAKER.

We do not doubt but that there are many conundrums in technical matters which our contemporary cannot understand, and we suggest that it is at a disadvantage in taking its opinions at second hand. We have a good deal yet to learn about steam boilers and cost of construction, but in what we have said about them we have received no inspiration from our contemporary. The *Age of Steel* has, in some instances, helped itself to paragraphs from this paper without credit. Once we wrote to the editor about it, who replied politely, saying it was an "accident." Soon after there was a similar accident and we then gave our contemporary up as incorrigible in this respect. We do not make random charges.

HIGH VS. LOW SPEED ENGINES FOR DYNAMOS.

As against coupling direct there is little to be said, except that the shocks incidental to the crankshaft are transmitted to the armature, and in some cases these are not small, for instance, when a slight looseness either in the bearings or connecting rod ends is allowed to exist. It is true that such looseness should not be allowed in high-speed engines. As a matter of fact it does arise, and the greatest care is required to prevent looseness and at the same time to be certain that nothing is too tight. A reciprocating engine to run at seven to eight hundred revolutions per minute, must be very strongly made; all bearings must be large, all parts perfectly fitted, and lubrication the best possible. With these conditions faithfully carried out without regard to cost, the wear at such high-speed is very great. The reciprocating parts throw very heavy stresses on the other parts, and this in spite of the fact that the connecting rod is gradually brought to rest, and reversed in direction of motion at each revolution, for, although gradual, it is effected in a very minute space of time, and no amount of balancing will effect this. The tendency to looseness in connecting rod ends is very great with fourteen hundred reversals per minute, over twenty-three per second, and the slightest looseness gives rise to a hammering action on the brasses. This will of course be the same whether a shorter or a longer stroke is used, hence piston velocity is not a criterion by which alone the speed of a fast running engine is to be judged. The piston-speed may be reduced to quite a low one by using a short stroke and large diameter of cylinder, but this will not reduce one of the chief causes for the rapid deterioration, or want of the greatest care, in making high-speed engines.



It is argued that if fast-running reciprocating engines are to be used, then they should be single acting, so that the stress on any one piston and the connections between it and the crank shall be always in one direction, thus avoiding the otherwise inevitable jerk at the change of direction at each revolution. The smoothness with which some engines of this class have been made to run in an argument in favor of single action. For the same amount of power these engines must of course be larger than those which use steam on both sides of the piston, but the extra space occupied with engines up to say one hundred indicated horsepower is hardly worth considering. Engines of this class have not, however, yet been made which can compete in economy with double-acting engines, and thus the advantages secured by high speed, and direct attachment to the dynamo machine, have been the chief reasons for their adoption, these conveniences being of greater importance than the consumption of a little extra fuel. Of rotary engines there is little necessity to speak. The production of a satisfactory rotary engine is a problem not yet solved, for although such engines are made, they are not free from the most serious objections of any fast running engines, while they have some of their own.

The use of counter-shafting is a thing to be avoided if the advantages are a decided gain. There is no doubt that it takes up a good deal of power when it is large and carries a number of large pulleys. But as against this it will be urged by those who favor the slow-speed economical engines that the loss is not so great as it would be with the small fast-runing engine, by which the shafting is dispensed with. Shafting takes room, which may be of importance sometimes, but it is seldom any trouble. Its use, however, involves the use of belting, and here comes a source of trouble and care. Against these objections to the use of shafting, the main argument is that with moderate speed of engine almost absolute certainty of regular working, without hitch, may be relied on. Shafting and belting, in view of this strong recommendation, are secondary matters involving a certain amount of trouble, the limits of which are known. It is further urged that with belts of sufficient width or number, and reserve strength, very little trouble need be met with.

As against the fast-running engines, engine builders assert that with slow-speed engines well above their work, dynamo machines may be driven with an approach to uniformity; which experience proves to be all that is required for any electric lighting purposes. With good cut-off gear, and sufficient fly-wheel weight and velocity this is no doubt the case. There is more irregularity due the irregular slipping of straps, and the jumping of strap-joints over pulleys, than to the engine, and electricians can point to the rhythmic-blinking of incandescent lamps, easily traceable to this cause, inasmuch as it takes place once for each revolution of the strap, though in some cases this may mean ten revolutions of the engine.—*London Electrical Engineer.*

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THE PLANIMETER.

Our engraving represents the planimeter as made by Buff & Berger, Boston, Mass. Its office is to correctly measure and record the areas of inscribed figures, such as indicator diagrams, plots of ground, water surfaces, etc., etc. Its value to engineers consists chiefly in its application to the indicator diagram. In operation and construction, it is easily understood and managed.

The total length of the instrument is about nine inches. The graduated bar, *g h*, can be slid in and out in a socket formed at the top of the frame, the thumb-screw, *f*, being used for fine movements of this sort. By this means, and by the form of graduation adopted, the planimeter may be made to do the various operations spoken of above. Theory requires that the pointer, *d*, which is moved around the periphery of the figure whose area is to be measured, the pivot, *k*, at the junction of the two arms, *g h*, and *i j*, and the main axis, *a b*, upon which turns the measuring and counter wheel, *c*, should all be in one and the same straight line, for this purpose. These instruments have both the pointer, *d*, and the rear part of the frame which carries the rear bearing of the axis, *a b*, adjustable. Each reading of the instrument consists of a record of the number of revolutions of the counter-wheel, *c*, read to three places of decimals; the whole revolutions are read on the wheel, *l*, the tenths and hundredths on the wheel itself, and the thousandths on the vernier, *m*. With such simplicity of construction and operation, the accuracy of work done by this instrument is surprising. The figures given in relation to accuracy of work are, however, reliable; being derived from the experience of several years in the use of the planimeter for many kinds of work.

A brass scale is sent with planimeters and can be used to prove the correct working of the instrument. To use it, drive a fine needle as an axis through one of the small holes of the scale into the paper, then put the tracer into one of the other holes and describe a circle. In this manner large and small circles of known areas can be circumscribed with perfect accuracy. This operation should be repeated in the opposite direction, and if the results agree the instrument is correct. If results differ, correction may be made by means of the two adjusting screws, by which the tracer can be moved to right or left of the graduated bar, as the case may be.

Address the manufacturers, at No. 9 Province Court, Boston, Mass., for price lists.

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MACHINE TOOLS.

BY J. RICHARDS.

Returning to the subject of lathes, it may be said of the common spindle gearing with differential wheels and a back shaft, that it is one of the few mechanical arrangements that have withstood all tests and attempted improvements. No modification worth mentioning has been made since such back gearing was first applied, and this method is likely to remain without much change in the future. It would be difficult to find in the whole range of machine tool construction a like amount of mechanism that so completely fulfils an equal number of functions and in so perfect a manner.

The relative motions of the driving pulleys and spindle can be arranged to meet the various requirements of common use; the changes of speed and power are instantly made, the gearing is so placed as to cause no obstruction or inconvenience, and does not even interfere with what may be called the symmetry of a head-stock.

A single objection, if such it may be called, to such gearing is that the band power and gearing must follow each other in their proportions. The cone pulleys must run clear of the back shaft, and in some cases must, for that reason, be smaller in diameter than they would otherwise be made. The rear pinion, or first mover, cannot be made small in diameter, because of it surrounding or forming a sleeve on the main spindle, so there is a limit to how strong a lathe may be geared if two convenient extremes of speed are assumed. This does not, of course, apply to lathes made with regular variations of speed and power from the fastest to the slowest motions, a matter which in many cases may with advantage be disregarded. The changes of power or driving force are often of more importance than changes of speed. In Fig. 71 is shown a plan partially in section, of a headstock taken from an American example, though not drawn with exactness in respect to proportions. It is not a "type" of American lathes; on the contrary, it is in most respects different from common practice there, and is employed here more as a reference than an example. The bosses at *a a* are cast solid with the headstock, and are bored out parallel with the spindle bearings, large enough to receive the eccentric shell *a*, and enlargement *b* of the back shaft *d*. This method is better than to reduce the diameter of the shaft, *d*, enough to produce eccentric bearing at its ends, and have loose removable caps on these bearings as shown in Fig. 72, which is common practice in America.

In driving a lathe backward, as is sometimes necessary, these caps are liable to be pulled off or broken; besides, to secure journals of sufficient strength, the diameter of the shaft between the bearings has to be made larger than its working conditions demand. As arranged in Fig. 71, the shaft can be instantly removed when the nut at *f* is taken off. The pinion, *g*, is, for the smaller class of lathes, commonly made solid with the sleeve, *h*. This permits it to be smaller in diameter and increases the difference between the pinion and the wheel, *k*. The method is not one to be recommended, because in a set of wheels, as in Fig. 71, the pinion, *g*, is apt to be the weakest part, and should be of forged iron or steel. The strain upon the teeth of the front and rear pairs of wheels is as the relative diameter of *g* and *m*, or as the speed in the two cases. The appearance of the wheels forms some excuse for giving to the rear pair larger proportions than the requirements demand, but it is certainly clumsy practice to employ uniform pairs of wheels at the front and rear, as is common with European makers. It is a neglect of the ordinary rules applicable to gearing even of the lowest grade. The pinion, *n*, (Fig. 71), by reason of the way it is mounted, must be made larger than would otherwise be preferable, and this should be compensated by employing a smaller pinion at *g*.

Without taking into account the exact requirements in respect to strain, and with some reference to what has become common practice, a pitch as three to four and width of face inversely as three to two does very well for such wheels. In the arrangement of trains of wheels for changing motion and force there seems to be a license, so to call it, in respect to proportions that does not exist in other cases. One seldom see a train of wheels where the face and pitch are in proportion to the relative duty to be performed, a matter scarcely to be expected unless wheels were especially made in each case; but to pay no regard to proportions when the strain is as three or four to one is, as before remarked, clumsy practice.

In America the spindle gearing for engine lathes is cut from solid blanks. This of course secures smooth accurate working wheels, and is preferable for small lathes at least. The difference between engine-cut and cast wheels, aside from the greater strength of the latter, is a question of how perfect cast wheels can be made. This again is, to some extent, a question of the form of teeth, accuracy of pattern, and methods of moulding. A general fact in respect to wheel gearing is that in England it is cast true enough to run well in nearly all cases, and in no other country is it made true enough to run well other than in exceptional cases. The reasons for this are not wanting, but their discussion here is scarcely relevant to the subject being considered. One of these reasons may, however, be mentioned. The construction of accurate patterns for tooth wheels and the careful methods required in moulding are beyond the resources of ordinary engineering works. In England wheel-making is to a great extent a special branch carried on by firms who from the amount of such work produced are able to avail themselves of various appliances and special skill that would not be available under other circumstances. The accumulation of skill in works of the kind naturally and to a great extent becomes available to other engineering firms who make their own wheels, so the art, so to call it, of wheel-making has from these causes, and from its vastly greater extent in England, advanced to a point not attained in other countries.

We remember some years ago sending to a firm engaged in wheel-making for a list of wheel patterns, so as to select some required for a special purpose. The reply was that no such lists were made out, or necessary, and that all required was to name the pitch, number of teeth, and face. A second inquiry respecting charges for patterns was answered by saying "the firm furnished patterns, and this matter did not concern their clients."

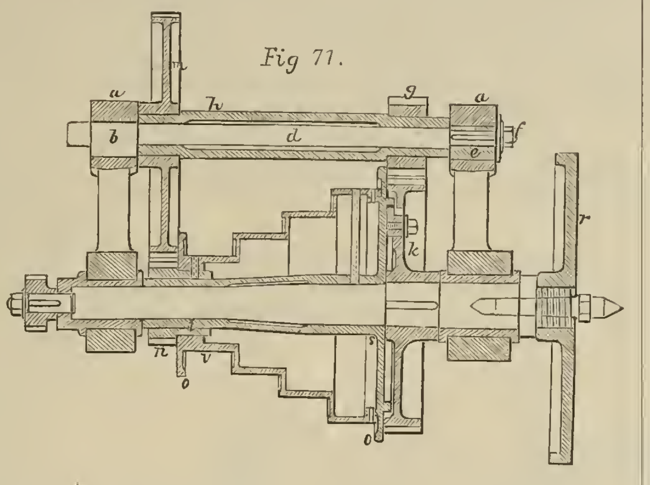

Fig 71.

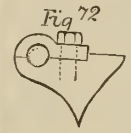

Fig 72

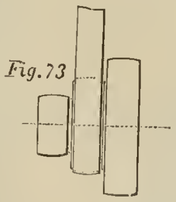

Fig. 73

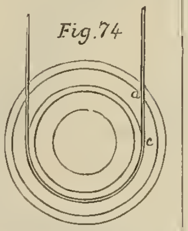

Fig. 74

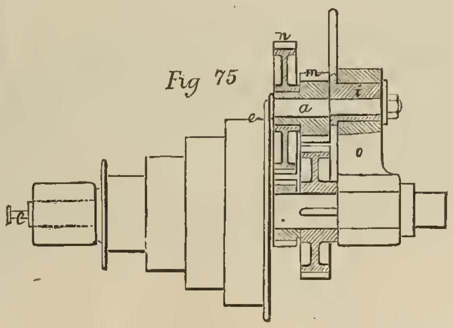

Fig 75

Fig. 76.

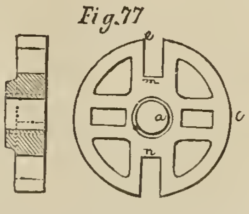

Fig. 77

We relate this circumstance because no amount of explaining could so well illustrate the state of wheel-making in England, and account for the quantity of cast wheels employed for machine tools; wheels such as are engine-cut in America and on the Continent.

It will be noticed in Fig. 71 that the faces of the pulleys are shown flat and a shallow projecting rim overlaps each pulley. This, so far as we are aware, is a new method, at least is new in respect to the flat or parallel instead of convex faces for the pulleys. The inference will be that a base will not keep its position on pulleys made in this form, but in the case of step pulleys the corresponding pulley of the opposite set has its flange or rim on the other side, so the band is kept in its position, and that without injuring its edges as in the case of corners like those shown in Fig. 73. The shifting of leather bands or guiding them, which is the same thing, is a result of deflection in their breadth—bending edgewise it may be called—and the consequent helical path on the pulleys. The facility with which a moderately narrow band moving at high speed can be shifted from one pulley to another is a matter of wonder to one not familiar with the matter. The same thing applies in the case of the step pulleys. In Fig. 74 the band, *e*, comes in contact with the projecting rim at *a*, leaving the distance from *a* to *e* in which the band may be deflected and kept free from contact in the corners. The action corresponds very nearly to that of a common shifting fork, and it will be found impossible to crowd the band into the corners or roll its edges. On the contrary, as in Fig. 73, even when a grooved space is left, as the drawing shows, there is nothing to hinder a band from being crowded into the corners. It cannot move sidewise after it is in contact with the pulley at the center, *c*, and it is sure to get there in being shifted by hand, and in many other accidental ways. The most carefully preserved bands I have seen ran on pulleys made as shown in Fig. 71. In a score of cases and during several years of service no band was rolled at its edges, so the matter is not presented here as inference or bare experiment. It is one that may be easily proved without expense by any one engaged in preparing step pulleys.

These remarks respecting step pulleys apply the same to flanges wherever employed, now, happily in but few cases, in machine tool practice. Flanges should never be employed except in unavoidable cases, to prevent bands from being accidentally thrown off where they will be caught by gearing, and when made should have a projecting rim as in Fig. 71.

The convex faces of common pulleys are quite sufficient to keep bands in position when the faces are true and the shafts parallel. The convexity should vary from $\frac{1}{8}$ in. for bands 2 in. wide to $\frac{1}{2}$ in. for bands 12 in. wide; less will do in most cases and be preferable.

The sleeve and flange plate, *s*, Fig. 71, is something more expensive than if the step pulleys were made with bosses in the usual manner. The arrangement has, however, the advantage of giving free access to the inside of the step pulleys, so they may be turned out true or balanced. The pinion, *n*, requires to be made larger in diameter by the thickness of the sleeve at *i*, but is not then larger than it should be, taking into account the speed at which it is driven when the band is at *v*.

At Fig. 75 is shown a method of gearing lathe spindles that permits the employment of large pulleys, and has advantages when small lathes are to be used for the heavier kinds of work. As drawn, the axis of the back gearing at *a* will almost pass the cone pulleys, *c*, but it will be obvious that the pulleys can be made of any required diameter, without modifying the arrangement of the wheels. The step pulleys are locked to the spindle by a common cross-key operated by the draw pin, *e*. The heavy thrust that falls upon the pinion, *m*, and stud, *a*, is in part balanced by the contrary strain of the wheel, *n*, and is easily provided for in the framing, *o*, and a strong shell, *i*, The face-plate, *i*, Fig. 71, with a rim at the periphery, presents a good appearance and can be made lighter than the flat one, Fig. 76. It is not so convenient, however, even if furnished with slots on the face. For all such plates of 24 in. diameter or less there is no doubt the plain flat form, Fig. 76. is best.

For driving plates the one shown in Fig. 77 has some advantages; the distance, *a*, can be made short enough to receive the small size, driving clamps, because the rim at *e* is left solid. At *e*, where the plate has an open notch, the distance from *m* to *n* is enough, so the plate cannot be broken, even if struck with a hammer at *e*, the common method of loosening such plates.

DEPRECIATION OF FACTORIES.

Loose plant and tools cannot always be satisfactorily treated in the accounts by the system just described for buildings and fixed plant. The various articles are of a more miscellaneous kind, and a suitable depreciation rate cannot be so easily established. There are two other methods available. One is to value the miscellaneous loose plant every year, and the other is to write off nothing, but to maintain and renew entirely out of revenue, revaluing occasionally, say every fifth year; or as a third plan, part of the loose plant may be treated according to the first method, and part according to the second. Such a system is carried out in some engineering factories by dividing the loose plant into classes somewhat as follows: Foundry boxes; foundry patterns; rapidly wearing plant, such as iron and steel tools, belting, chains, ropes, portable forges, carts, wheelbarrows, and ladders; horses. Taking these in their order, a list is kept of foundry boxes, and this is assisted by casting on each box the year in which it is made, and marking on each its weight. The value is, in some factories, at once taken as that of pig iron, but more often is written down to that level in a few years. Supposing one box has been made, weighing one ton, at a cost of £12, then if of peculiar shape or size not likely to be wanted again, all the cost—less that of the iron—should be charged to the first set of castings and the box at once broken up. But if the box be considered useful enough to keep for future use, one-half or even less may be charged to the first castings, and the remainder treated as an addition to capital; but this remaining value should be written down in three years to pig iron value. Another and simpler plan is to value all the boxes, old and new alike, at 10s. or 20s. above pig iron price—that is to say a moderate average price, and not that which may be current at the time, although of course the current price would need consideration in case of valuation for a change of ownership. This summary method does not apply to the elaborately fitted boxes specially prepared for repetition work such as are usual in the processes of machine moulding. Such boxes may be properly classed among machine tools, and depreciated accordingly.

Foundry patterns form a serious item of cost in an engineering works, and one which is often the most unsatisfactory. As a safe general principle or starting point, every casting or set of castings should pay for its pattern; and where some exceptional or peculiar shape is to be made, with no immediate prospect of using the pattern again, this is necessary if loss is to be avoided. There is a natural reluctance to break up costly patterns or core boxes, and an equal reluctance to treat them as valueless. The storing of them is often continued for many years without return, and ultimately the patterns are broken up for fire-wood or scrap iron, as the case may be. On the other hand, it is often expedient in a repetition trade, where a succession of orders may be reckoned on, to spend much money on the patterns, which may have a value many times that of the castings made from them in the first year. Even, however, if durable iron patterns have been made they often become obsolete before worn out, and therefore should be rapidly depreciated. Toothed wheel and pulley patterns may be said to have a permanent value; but since the introduction of wheel-moulding machines it is much less common to store such patterns. Many expensive patterns, especially of an ornamental kind, have a value quite dormant, because they are unknown to purchasers; and it is for this reason that the publication of illustrated catalogues may give life to a stock of patterns otherwise useless. But while this may extend the time over which the cost is to be distributed, the value should generally be written down to one-tenth of the cost in ten years. If not used often they have little value; if used often they soon wear out. Copyright designs or patterns protected by patent may, of course, have a special value; but, as between partners, this should be written off rapidly, as such rights last only a short time. In this category should be included the engraving blocks used for catalogue illustrations.—*London Engineer*

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SIX-WHEELED ENGINES AND THEIR TENDENCY TO MOUNT THE RAILS.

Upon this subject the writer of an article on "*Resistance on Railway Curve*," John Mackenzie, Mem. Inst., C. E, treats at some length. His deductions summarized are as follows:

Restricting the subject wholly to six-wheeled engines with parallel axes, the following inferences may be drawn:

1. That the danger of leaving the rails increases when the adhesion increases.

2. That the greater the portion of the weight of the engine resting on the leading wheels, the less is the danger of leaving the rails at low speeds.

3. That when tight to gauge the danger is increased to the greatest extent by augmenting the load on the trailing wheels, at low speeds.

4. That when slack to gauge, or the driving wheels flangeless, or the radius of the curve large, the greatest danger is brought about by increasing the load on the driving wheels.

5. That the danger increases when the radius of the curve decreases; but at low speeds the danger increases very slowly, until the curvature becomes such that the inner driving-wheel flange is brought into contact with the rail, when the danger increases suddenly; and the danger is aggravated by tightness of gauge.

6. That this sudden increase of danger is obviated by making the driving wheels flangeless; and that flanges on the driving wheels are worse than useless.

7. That the danger increases when the gauge is widened in proportion to the length of the wheel-base.

8. The danger of leaving the rails diminishes when the length of wheel-base increases in proportion to the width of gauge; but when the length of wheel-base increases in proportion to the radius of the curve, the danger increases; so that there is a certain length of wheel-base giving a minimum of danger; but within the limits of practice, the longer the wheel-base, the less the danger of leaving the rails. Nevertheless the tractional resistance always increases with the wheel-base.

9. The danger is increased by increasing the number of wheels; but the tractional resistance diminishes when the number of wheels is increased.

10. That the danger increases when the angle formed by the working side of the flange and the plane of the wheel increases beyond that necessary to keep the rounded edge of the flange clear of the rail on the sharpest curve it has to run on.

11. That the danger is increased by enlarging the diameter of the leading wheels.

12. That the danger is increased by diminishing the projection of the flange.

13. That the danger is increased by making the springs of the leading wheels more flexible.

14. That the danger is considerably diminished by lubricating the flanges of the leading wheels; and increased by applying sand to these wheels.

15. That, when the center of gravity is behind the driving axle, the danger is increased by an excess of super-elevation of the outer rail beyond that required to counteract the centrifugal force.

16. That the danger may be increased by shutting off steam and reducing speed while running on a curve.

17. That, although one engine or carriage may run round a curve with less tractional resistance than another, it is not therefore necessarily in less danger of leaving the rails. In many cases it is quite the reverse.

Lastly. That, assuming an adhesion of 40 per cent. of the weight to be possible, some engines of not unusual proportions have, as regards leaving the rails, a very narrow margin of safety: so narrow that, in any other matter connected with the running of a train, a similar margin of safety would be considered insufficient.

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CARBONATE OF MAGNESIA FOR TRADE USES.

The interesting article appended is transcribed from our contemporary, the *Oil, Paint and Drug Reporter*, and is well worth perusal by engineers and machinists. Carbonate of magnesia is one of the most useful of minerals, and plays no small part in economic processes. Those of our friends who are engaged in manufacturing will find some valuable hints herein.

Crude carbonate of magnesia is known to mineralogists under the name of "globertite." Some deposits are known in France (Auvergne), Italy (Piedmont), High Silesia (Germany), but by far the most important deposits in the world are in the Island of Eubee. These deposits annually produce immense quantities and directly interest American and European industry.

By analysis, globertite is shown to contain 48 per cent. of caustic magnesia and 52 per cent. of carbonic acid. With magnesia that is globertite the very best hydraulic cements are made and their hardness is almost fabulous, if they are carefully prepared with this end in view only, and not that of producing the cheapest possible article. The cements are made either by utilizing the hydraulic properties of silicate of magnesia, or by using the oxychloride of magnesia; the first process is especially employed for the manufacture of stucco work, which, made in this manner, takes the highest polish marble is susceptible of, mantel pieces, pillars, cornices, moldings and objects of art being so perfect that detection from real marble is next to impossible. Manufacturers have become so expert in the art of coloring and imitating the real veins and shades of the genuine marble as to deceive even experts. The second process (by the use of oxychloride of magnesia) is especially adapted for agglomerates to unite with itself any foreign substances mixed with it while in the paste, which it retains after setting, hardening together to an uncommon degree. One of the foremost uses to which oxychloride of magnesia is put is in the manufacture of emery wheels, stones, etc.

These agglomerates can be put to no end of uses, and magnesia cement (silicate of) has no equal for paving, when cast in regular blocks with a mixture of sharp clear quartz sand. This paving has the advantage of being clean, uniform, dry, not slippery, and most resisting, costs less to lay, and is altogether cheaper and better than stone. For forming the foundations and for consolidating aqueducts, dams, foundations of houses, intermediate damp courses, expelling damp and moisture from wet cellars, and a thousand other uses, magnesia cement has no equal. It will prove lasting, resisting, and being in no way porous, will not permit any infiltration or exodus through its coating, while for the construction of submarine highways, bridges and all heavy structures no other should be used.

Having seen magnesia in wet, damp, cold and under heavy pressure, let us now see it submitted to the most intense heat. Calcined magnesia, more refractory than lime, has over this last the immense advantage of never frittering away and crumbling to dust through dampness. All works in progress where magnesia is used instead of lime, can be stopped for any length of time, without in any degree interfering with their solidity; they may be carried on piecemeal without the slightest injury to the stability or quality of the works. For the above purposes, magnesia is made into bricks, mortar or concrete, by a number of processes too numerous to mention and no doubt well known to the trade.

For other purposes magnesia is made into a paste with any sweet or gummy liquid, or is used mixed with tar.

Magnesia makes the best high test fire bricks; the best crucibles in the world, as well as the best smelting furnaces, are made with it, while nothing equal to magnesia crucibles can be used by glass manufacturers. When, however, it is desired to use absolutely pure magnesia bricks or wares, the paste must be made of chloride, sulphide or hydrate of magnesia; these last products are very precious for the calcination of bicarbonate of soda, whereas the concrete made with this organic cement could not be dispensed with in any well regulated metallurgical enterprise.

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In a late issue we briefly noted a caustic soda evaporator wherein it was stated that by the use of this substance in connection with exhaust steam more heat was developed than the exhaust contained. The fact is established, so far as it goes, but the objection to it is that caustic soda solution becomes thinner and thinner, and its capacity for heat is decreased in the same ratio, so that after a while the temperature of the inner boiler differs so little from that of the outer boiler, that the generation of steam becomes impossible. Then the inner cylinder has to be emptied and refilled with caustic soda; and then just as much force as had been saved in the machinery, is necessary to again condense the diluted soda, and make it available for future use. But in spite of this, these machines may be useful as motors, where the absence of smoke is desirable, in tunnels or on the streets.

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A shipment of 250 tons of pig iron in England was three tons short, and on weighing the sand and scrap at the bottom of the cargo the amount in question was found to be comprised in it.

MORE GAS.

A writer in the *Iron Trade Review*, speaking of boiler explosions, cites this fact:

> "If we place a few drops of water on an anvil, and strike it with a piece of red-hot iron, it will be instantaneously converted into its component gases, with a report as loud as a rifle. What causes the explosion of these few drops of water? Two things: heat and the blow that strikes the water, causing the water to separate into small globules which are instantly converted into gases."

From this familiar example, to be seen in every blacksmith's shop whenever the scale of a forging is knocked off, the writer endeavors to show that boiler explosions may arise. That is to say, explosive gases—formed by the decomposition of water—collect and are fired with obvious results.

Red-hot crown-sheets suddenly covered with feed-water decompose the water, furnishing the gas, and the plates aforesaid the necessary heat.

This chain of reasoning is incorrect and impossible for the reason that it leaves out of consideration the amount of air needed to effect an explosion under the circumstances named. Free air. In a closed boiler water may be decomposed, unquestionably, but the gases resulting therefrom are inert, even in the presence of red-hot plates.

No boiler can be exploded by such means, but it is a bug-a-boo which has frightened a great many.

Also, we have it asserted in another part of the same paper, that a boiler exploded and, though it was known to be full of water at the time, no trace of the same was visible after the disaster. Why should there be? The force which can shatter a boiler to atoms, almost, would hardly blow away the shell and braces alone, leaving the water to quietly run out upon the ground. It is much more reasonable to infer that whatever water was in the boiler was projected into space in all directions, and being hot instantly vaporized, going off in a cloud form. In a destructive explosion we should not look for visible evidences of water.

Thirty years of our life has been spent among steam boilers of all kinds, shapes, sizes, and conditions. During that time we have seen many boilers to which casualties of one kind and another had happened. We have, where practicable, looked into them carefully, but have never failed to find good reasons for their giving way. We do not call such things accidents for that is a misnomer, and, while we make an allowance for the weakness and fallibility of human nature, we shall hold to the opinion that all such explosions are entirely preventible, the causes being within human knowledge and foresight. This view of the matter is gaining ground on all sides, to the very great benefit of the community at large.

Joseph Edwards & Co. of New York are building a dredge, or excavator, a novel design for the Okeechobee Land Co., of Florida, to be used for draining the everglades. It consists of a 15 inch centrifugal pump, driven by a Westinghouse engine of 125 horse-power, coupled direct. The outfit with a boiler is mounted on a float, the suction of the pump extending under water, and armed at the end with a set of revolving knives driven from the engine. The action of the knives is to break up the loose, sandy soil, which being suspended in the water is rapidly drawn up by the pump and discharged over the dyke. The engine makes 250 revolutions.

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A foot in China varies with different localities and trades. At Ningpo it is only ten inches, while at Shanghai it is sixteen inches.

The standard foot of the Imperial Board at Peking is twelve and a half inches. A copper foot measure, dated A. D. 81, is still preserved, and is nine and a half inches in length.

A Chinese foot, therefore, is almost as comprehensive as a blacksmith's eighth of an inch.

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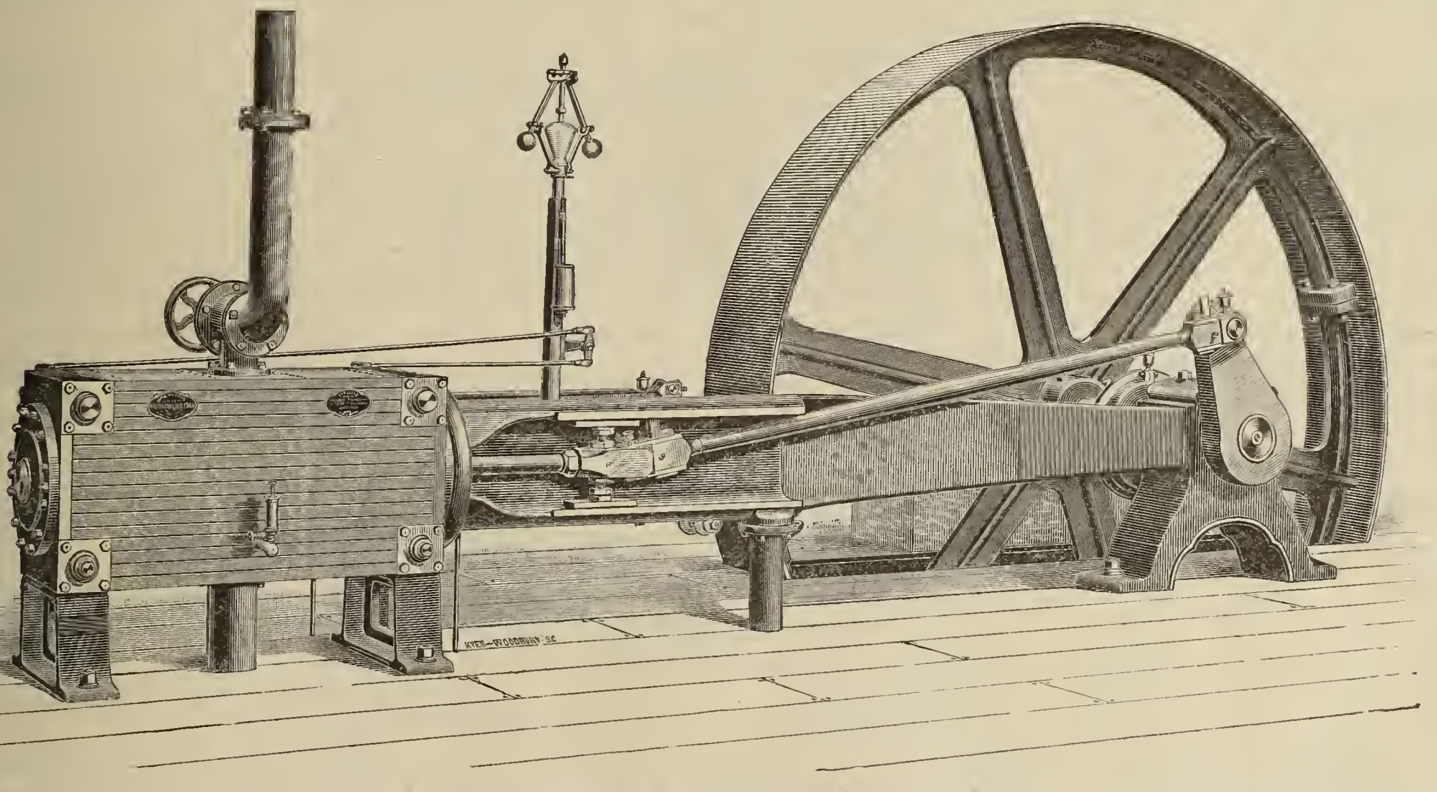
A unit of work is the power expended in moving one pound through a space of one foot; a foot-pound therefore, is the measure of a unit of work.



ECONOMY OF STEAM POWER AT WORKS OF NATIONAL RUBBER CO., BRISTOL, R. I.

By John W. Hill, M. E.

This paper is a resumé of investigations made during August and September, 1883, for the National Rubber Co., at Bristol, R. I., to suggest improvements in the steam plant, for greater economy, comprehending examination of the principal appliances for making and using steam.

The Works are the largest of the kind in the United States—covering more than forty acres of ground, with over two thousand operatives, and consuming for power and steam-heating alone upwards of $60,000 worth of coal per annum. To reduce this consumption by well-advised changes in the plant, was the object of the experiment: the results are here given in narrative form. The investigations embraced the following machinery:

North Boilers.—Steam used for curing rubber goods, heating north building, driving small engine furnishing power to the sewing machines, and elevator engine.

Main Boilers.—Steam for curing rubber goods, heating rolls and presses driving 36″ × 72″ conds. engine, 26″ × 48″ and 23″ 48″, non-conds. coupled engines, 10″ 24″ non-conds. machine-shop engine, driving feed pumps and fire pumps and for heating buildings.

Pump-House Boilers.—Steam to 1,000,000 gallon Worthington compound duplex pumping engine.

Harris-Corliss' Condensing Engine.—Furnishing motive power to machinery of new works.

Harris-Corliss' Non Condensing Coupled Engines.—Furnishing motive to machinery of old works.

Harris-Corliss' Non-Condensing Engine.—Furnishing motive to machine-shop and box factory.

Worthington Compound Duplex Pumping Engine.—Supplying sea-water to the works. The boilers in the North house and in the Main house were tested for economy as follows:

All water supplied during the trial in each instance was carefully weighed in a large tank mounted upon a new Fairbank's scale, capable of weighing 3,500 pounds in gross. From the weighing-tank the water was drawn into a supplemental tank connected with suction of feed pump, from which it was pumped into boilers. In the North house the feed water was taken from the return pipe, from the curing ovens and radiators. In the Main house the feed water was drawn from the city mains.

In order to check the quantities of water delivered to boilers during certain fixed intervals of time, the levels in the glass gauges were carefully read at beginning and at ends of trials; and in all cases when the original levels were not fairly restored at ends of trial, corrections were made by adding or substracting a weight of water equivalent to the volume in excess, or short of true level at temperature of evaporation.

The feed water was tested for temperature just before its entrance to boilers, and in all cases where it went through heaters was tested for temperature before and after passing.

Coal burned during the trial was weighed in uniform charges of 300 pounds upon tested platform scale, dumped as required in front of boilers. Trials were begun and ended with strong charges on the grates and clean ashpits; all ash, clinker and unburnt coal found in ashpits at end of trials were weighed back and credited as noncombustible. Temperatures of air in boiler-house, and hot gas passing in smoke connection, were taken at regular intervals of fifteen minutes. Steam pressure, temperature of feed to boilers, water levels, and pressure of atmosphere were read regularly every fifteen minutes. Calorimeter observations for quality of steam were made similarly or half-hourly in the trial.

In the trial of boiler at Pump-house, the feed water supplied was measured in a large Storm water-tank, capable of carrying several days' supply, by taking levels at beginning and at end of trial, and at regular intervals of one hour during the trial, from which volumes (computed from differences of heads and known diameter of tank) the weight corresponding to observed temperatures was calculated. The coal for this trial was also weighed in charges of 100 pounds. In the test for economy of Harris-Corliss' conds. engine the consumption of steam was measured by weighing the condensation as it was pumped from the condenser (surface) by the air-pump. The discharge of the air-pump was conveyed through a tight rubber hose to the weighing tank previously mentioned for weighing feed-water to boilers, and weighed for hourly delivery. The quality of steam, meanwhile, furnished by boilers, being tested by calorimeter at regular intervals of thirty minutes. Diagrams were taken from each end of cylinder by Thompson indicators, set with short connections, at regular intervals of fifteen minutes. The steam-gauge in pipe, engine-counter, barometer vacuum gauge, thermometers in injection, overflow pipes, and hot well of condenser, and atmospheric thermometer were read regularly every fifteen minutes.

In the test for economy of Harris-Corliss' non-conds. coupled engines, and Harris-Corliss' non-conds. machine-shop engine, the consumption of steam was measured by weighing the feed-water to the plain cylinder boilers of Main house, all the evaporation of which was confined to the coupled engines and to the machine-shop engine during the trial. The arrangement of steam pipes in the Main house is such that steam to the machine-shop engine could not be furnished independent of the main pipe supplying steam to the coupled engines, and as it was inconvenient to stop the machine-shop engine for a day at time of test, the latter was indicated for power during trial, and an estimate was made of steam consumption upon precedents from engines, in similar condition developing similar powers.

The feed water to similar boilers was reported in hourly quantities.

Data of quality of steam furnished by boilers were taken half-hourly during trial. Two Thompson indicators were used upon each cylinder of coupled engines, and a single Elliott-Richard's indicator was used upon the cylinder of machine-shop engine. Diagrams from all cylinders were taken regularly every fifteen minutes. The pressure in pipe, and engine-counter were read regularly every fifteen minutes.

In the tests of Harris-Corliss' conds. and Harris-Corliss' non-conds. coupled engines for distribution of power, the only data taken were the indicator diagrams, lettered to correspond with the known machinery driven.

MAIN BOILERS.

The boiler plant in the Main house consists of a battery of six tubular boilers, and four sections of sixteen plain cylinder boilers, the evaporation from which mingles in one system of distributing steam mains. The tubular boilers are similar in general design to those of the North house, but of larger dimensions, and set in independent furnaces, provided with independent uptakes and dampers, separate feeds, steam and water-gauges. The feed-water is taken from the city mains, and pumped through a fuel economizer placed in the flue leading to the chimney. The smoke connections of sheet iron pass aft over the boiler-setting and bend down at rear end of brickwork into a brick flue, common to all the (tubular) boilers, and leading into the base of brick chimney. The boilers are well designed and set and show a gratifying economy. Appended are the dimensions of tubular boilers, taken partly from the contractor's drawing and partly from personal measurements.

DIMENSIONS OF TUBULAR BOILERS MAIN HOUSE.

Number		6
Diameter of shells	inches	72
Length of shells	feet	15
Tubes		100—3″
Grate		6′1″×4′6″
Heating surface, each boiler	sq. ft.	1319·472
Grate surface, each boiler	"	27·75
Tube vent	"	4·125
Ratio heating to grate surface		47·548
Ratio grate surface to tube vent		6·727
Total heating surface, 6 boilers	sq. ft.	7916·832
Total grate surface, 6 boilers	"	166·5
Chimney height	feet	113·5
Chimney cross section	sq. ft.	25
Ratio total grate surface to cross section of chimney		6·66
Space over bridge-wall	inches	12
Space over grate	"	27

Builder, Whittier Machine Co., Boston.

Two trials were made of the tubular boilers; the first owing to breaks in the record was unreliable, and a second was made with the following results. The trial represents the daily work of boilers as at date, August 27th, with no changes in the management of fires, or consumption of steam from the daily average performance. The coal fired was Cliffield.

PERFORMANCE OF TUBULAR BOILERS MAIN HOUSE.

Date of trial		Aug. 27
Boilers used		6
Heating surface	sq. ft.	7,916·832
Grate surface	"	166·5

GENERAL OBSERVATIONS.

Duration of trial	hours	10
Average steam pressure	pounds	70·545
Average temperature of feed water to heater Fahr		66·4
Average temperature of feed water to boilers, Fahr	107·59=	107·746
Elevation of temperature by heater		41·346
Gain by heater, per cent		3·613
Average temperature of air in boiler room, Fahr		95·050
Average temperature of waste gases in flue front of heater		295·5
Average temperature of waste gases in flue behind heater		233·1
Average temperature of waste gases boiler extension		318·600
Average barometer	inches,	30·214

CALORIMETER.

Average water heated	pounds,	200
Average steam condensed	pounds,	10·157
Average initial temp., Fahr	74·286=	74·314
Average final temp., Fahr	127·952=	128·264
Average heat units per pound of steam		1190·585
Thermal units per pound of steam at observed pressure		1210·33
Difference		19·745
Latent heat at observed pressure		891·29
Percentage of water entrained in the steam.		2·215

TOTALS.

Total water to boilers	pounds,	127,555
Total water entrained in the steam,	pounds,	2,825·343
Total steam furnished	pounds,	124,729·657
Steam per hour		12,472·967
Total coal burned	pounds,	12,361·00
Total ash and clinker and unburnt coal weighed back	pounds,	1,650·00
Percentage of combustible		86·66
Coal per hour	pounds,	1,236·1

ECONOMY.

Steam per pound of coal from temperature of feed water	pounds,	10·091
Steam per pound of coal from and at 212 Fahr	pounds,	11·5208
Steam per pound of combustible from and at 212 Fahr	pounds,	13·2933
Steam per sq. ft. of heating surface per hour	pounds,	1·575
Coal per sq. ft. of grate surface per hour	pounds,	7·724

COAL FOR BANKING AND STARTING FIRES.

TUBULAR BOILERS, MAIN HOUSE.

Coal to start fires Monday, A. M., Aug. 27th	pounds,	6,839
Coal to start fires Tuesday, A. M., Aug. 28th	pounds,	6,000
Coal to start fires Thursday, A. M. Aug. 30th	pounds,	4,246

The economy is excellent, and considering that no exertions were made to improve the performance above the daily average, it shows a result seldom equaled, and never, to the writer's knowledge, excelled. By this the writer does not mean to say that the economy is equal to the best he ever had, but in every instance, and the instances are rare where better work has been done, it has been under "whip and spur," and not under the conditions of ordinary factory practice.

The most important remark to be made in connection with this trial is, that it exemplifies an economy which should be made a standard, and which may be obtained in the North house by the change of boilers previously suggested. The coal required to start fires Monday and Tuesday August 27–28, is excessive, and represents a thickness of fire of six to seven inches over entire grate.

The coal used to start fires Thursday morning, August 30th—4,246 pounds—represents a fire four inches thick on whole grate, which is ample and should not be exceeded.

PLAIN CYLINDER BOILERS.

The plain cylinder boilers are arranged in three sections of four (4), one section of three (3), and a single boiler set in an independent furnace to burn the refuse from the box factory.

During the test for economy, coal was burned under the single boiler as well as under all the rest. The glass gauges on these boilers were clogged with sediment, and the water levels were taken from the register gauge cocks.

Each section of boilers is furnished with its own feed connection, smoke connection and steam-gauge, and a large drum set transversely over each section, collects the steam from the several boilers preliminary to its delivery to the distributing mains. A long brick flue running transversely of boilers behind the setting, collects the hot gases and delivers to the base of brick chimney.

Appended are the dimensions of the plain cylinder boilers:

Number		6
Diameter of shells	inches,	30
Length of shells	feet,	30
Heating surface, each boiler	square feet,	117·801
Grate " " "	"	44·000
Total heating surface 4 boilers	"	471·204
Ratio heating to grate surface	"	10·709

One trial of these boilers was made using same quality of coal as (for North boilers and Main tubular boilers) under the ordinary factory requirements, as at date Aug. 29th.

PERFORMANCE, PLAIN CYLINDER BOILERS, MAIN HOUSE.

Date of trial		Aug. 29
Boilers used		16
Heating surface	square feet,	1884·816
Grate surface	"	176.

GENERAL OBSERVATIONS.

Duration of trial	hours,	10
Average steam pressure	pounds,	69,352
Average temperature of feed water to heater, Fahr		66·5
Average temperature of feed water to boiler, Fahr		152·73=153·339
Elevation of temperature by heater		86·839
Gained by heater, per cent		7·594
Average temperature of air in boiler-room, Fahr		80·727
Average temperature of waste gases in flue		494·024
Average barometer	inches,	29·881

CALORIMETER.

Average water heated	pounds,	200
Average steam condensed	"	10,118
Average initial temperature, Fahr	67·446=	67·4626
Average final temperature, Fahr	119·865=	120·1065
Average heat units per pound of steam		1,160·706
Thermal units per pound of steam at observed pressure		1,210·07
Difference		49·37
Latent heat at observed pressure		891·88
Percentage of water entrained in the steam		5·535

TOTALS.

Total water to boilers	pounds,	136,215·0
Total water entrained in the steam	"	7,539·5
Total steam furnished	"	128,675·5
Steam per hour	"	12,867·5
Total coal burned	"	19,073
Total ash and clinker, and unburnt—coal weighed back	pounds,	2,813
Percentage of combustible		85·4
Coal per hour	pounds,	1,907·3

ECONOMY.

Steam per pound of coal from temperature of feed water	pounds,	6·746
Steam per pound of coal from and at 212 Fahr	pounds,	7·382
Steam per pound of combustible from and at 212 Fahr		8·644
Steam per square foot of heating surface per hour	pounds,	6·827
Coal per square foot of grate surface, per hour,	pounds,	10·837

Coal for banking and starting fires. Cylinder boilers, Main house. Wednesday morning, August 29th, pounds, 4,627.*

The low rate of evaporation by the Main tubular boilers, and the very low temperature of waste gases in the smoke extension, seem to indicate that an improved economy may be had by causing the plant to do more work.

The rate of work for trial of Aug 27 was in round numbers 12,500 pounds of steam per hour; if the evaporation for the boilers as a whole, was increased to 14,500 pounds, per hour, the writer believes the economy would be sensibly enhanced.

The difference in work is about equivalent to that of three of the plain cylinder boilers.

The economy of the plain cylinder boilers is good for the class. The writer's experience, however, with this type of boiler is very limited, their use in the West being confined to blast and puddling furnaces, where the waste gases from the furnaces are conducted under the boilers in transit to the chimney. In these cases the steam made is clear gain, for otherwise the waste furnace gases would pass into the chimney at a high temperature, and a large percentage of the thermal power of the fuel be lost. The writer knows, however, from English data upon the plain cylinder boiler, that high economy is not had excepting with shells of large diameter, and then the economy is always inferior to well-designated tubular boilers, owing to the naturally high temperature of waste gases passing into the flue representing a large percentage of loss of heat, a portion of which is bound to be absorbed in the tubes of a tubular boiler, and made to assist in the production of steam.

Of the total heat of combustion with the plain cylinder boilers of the Rubber Company, from 20 to 25 per cent. is carried off by the waste gases into the stack, while 12 to 15 per cent. is known to be sufficient to produce good chimney draft.

The writer respectfully suggests that no possible change in the plain cylinder boilers could improve their economy up to a fair standard.

The shells (30″) are too small in diameter to hope for any excellence, even if the boilers were divided into two length of 15′ each, and filled with tubes, the only way in which the economy can be increased.

The writer's experience leads to the opinion that long boilers of small diameter are not as safe against rupture as short boilers of large diameter; the latter are more compact, stronger for transverse strains, less liable to injury from expansion and contraction, and with equal factors of safety more liable for continuous use.

MOTIVE POWER.

The motive power of the new works is furnished by a Harris-Corliss condensing engine, fitted with a pair of Gannon surface condensers, the condensation and air from which is removed by an independent air pump of the Deane pattern.

The power is taken from the pulley fly-wheel by two four-foot double leather belts, (running upwards of a mile a minute); to two main-line shafts, from which it is distributed to the different parts of new works, principally by belts and pulleys, with two line-shafts, lying at right angles to main lines, which are driven by bevel gearing.

The motive power of the old works is furnished by a pair of Harris-Corliss non-condensing engines, running coupled, and connected by a spur gearing to the main line-shaft.

The principal machinery driven by the condensing coupled engines is

4 Calendering machines
6 Washing "
8 Warming "
20 Grinding "

The principal machinery driven by the non-condensing coupled engines is

8 Calendering machines
8 Warming "
20 Grinding "

In the following table are given the dimensions of the condensing engines:

DIMENSIONS HARRIS-CORLISS ENGINE.

Style		Condensing.
Diameter of cylinder	inches	36
Stroke of piston	"	72
Diameter of piston rod	"	5·25
Steam ports (each)	"	1·5×36
Exhaust ports (each)	"	2·875×36
Area, front side of piston	sq. inches	996·251
Area, back side of piston	"	1,017·9
Nominal revolutions per minute		50·
Nominal piston-speed per minute, feet		600.
Actual piston-speed, economy trial, Aug. 28	feet	601·8635
Factor of H. P., front side piston, nominal speed		9·057
Factor of H. P., back side piston, nominal speed		9·253
Piston-stroke to release in parts of stroke		0·9888
Piston-stroke from ex. closure, in parts of stroke		0·0902
Clearance in parts of stroke		0·025

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* The coal 4,627 pounds to start fires Wednesday morning, Aug. 29th, under plain cylinder boilers, is a fair quantity and represents a fire four inches thick upon whole grate.

Data from Economy Trial.

Piston displacement per hour to release	cu. feet	249,901·45
Piston displacement per hour to ex. closure	cu. feet	22,796·44
Clearance volume, per hour	"	5,054·64
Pulley fly-wheel diameter	feet	27·
Pulley fly-wheel face	inches	96·
Pulley fly-wheel weight	tons	39·

Surface Condenser, 36″×72″ Engine.

DOUBLE DIMENSIONS.

25 rows of brass tubes, 8 tubes in each row.

Tubes 200	0·875″ outside diameter. 6 feet 1·5″ long.
Returns 25, radius of bend, 1·875″,	diameter, 1·25 inches.
Returns 25, radius of bend, 4·25″,	diameter, 1·00 inches.
Returns 25, radius of bend, 6·875″,	diameter, 1·00 inches.
Returns 25, radius of bend, 8·75″,	diameter, 1·00 inches.

Cooling surface in tubes	sq. ft.	280·525
Cooling surface, 100 returns	"	38·062
Total cooling surface, 1 condenser	"	318·587
Total cooling surface, 2 "	"	637·174

Maker....Gannon, Jersey City, N. J.

Two trials for economy were made of the condensing engine: the first was unreliable by leakage of hose used to convey the discharge of air pump to the weighing tank, and second trial is alone reported.

In the following table are given the principal data from second trial:

Harris Corliss, 36×72″, Condensing Engine.

Economy Trial, Aug. 28th.

Duration of trial	hours,	10

AVERAGES.

Average steam pressure in pipe	pounds	70·137
Average barometer	inches	30·194
Average barometer	pounds	14·822
Average vacuum condenser	inches	20·473
Average vacuum, condenser	pounds	10·050
Average temperature of injection, Fahr		72·225
Average temperature of overflow, "		97·675
Average temp'ture of condensation "		104·037

ENGINE COUNTER.

Counter at 7.02 A. M.	356.	
Counter at 12.00 M.	15,285.	
		14·929
Counter at 1.00 P. M	15,626	
Counter at 6.00 P. M	30,688	
		15,062
Revolutions, 9 hours 58 minutes		29 991
Revolutions per minute		50·155
Piston speed		601·8635

FROM THE DIAGRAMS.

Average initial pressure		pounds	68·795
Average terminal pressure absolute		"	8·933
Average counter pressure at mid-stroke, absolute		pounds	5·383
Average vacuum realized		"	9·439
Av. mean effective pressure	front back	"	21·069 21·699

LOAD.

Average indicated horse power	392·862

RATIO OF EXPANSION.

Apparent cut-off in parts of stroke	0·084
Actual cut-off in parts of stroke	0·104
Theoretical cut-off	0·10895
Expansion by volumes	9·718
Expansion by pressures	9·36

CALORIMETER.

Average water heated	pounds	200·
" steam condensed	"	10·162
" initial temperature, Fahr	79·45=	79·489
" final " "	130·150=	130·481
" thermal units found in steam		1,134·020
Thermal units in steam at observed pressure.		1,210·33
Difference		76·309
Latent heat of steam at observed pressure		891·29
Per-cent. of water entrained in steam		8·561

ECONOMY.

Total water weighed from condenser	pounds	82·088
Actual saturated steam to engine	"	75,103·426
Net steam to engine per hour	"	7,510·342
Steam per ind. H. P. per hour	"	19·095
Coal per ind. H. P. per hour, based upon main tubular boilers		1·892
Per-centage of steam accounted for by indicator		74·048
Steam per indicated H. P. per hour by diagrams		14·139

SURFACE CONDENSER.

Steam condensed per square foot of cooling surface per hour	pounds	11·787

The economy of the engine is excellent, but scarcely up to the standard of Harris-Corliss' engines. With an increase of load to about 600 horse power, the writer is of the opinion that the consumption of steam per horse power will be reduced about fourteen per cent.

With 80 pounds pressure in the pipe, and a mean initial pressure of 79 pounds, the mean effective pressure with a cut-off at 12 per cent. of the piston's stroke, and vacuum of 26 inches, would be about 33 pounds, equivalent to a load of 600 horse power in round numbers. The terminal pressure under these conditions will be 13 pounds absolute, and counter pressure 3·5 pounds absolute, corresponding to a consumption of steam per hour, by the diagrams, of 8,367 pounds or 13·995 pounds per indicated horse power. Under the proposed conditions I expect the diagrams to account for not less than 85 per cent. of net steam delivered to engine, when the actual consumption of steam per horse power per hour would be 16·416 pounds,

and gain over present economy would be

$$1 - \frac{16{\cdot}416}{19} = \frac{1365}{10000}$$ or nearly *fourteen* per cent.

The estimated economy upon a load of 600 horse power is within personal precedent from Harris-Corliss' condensing engines, and can be obtained, and possibly improved, by the Rubber Co's. engines.

The writer's belief is, that with a load of 600 horse power, pressure of 80 pounds in pipe at engine, and a vacuum of 26 inches in condenser, the economy will excel the best he has ever obtained from condensing single cylinder engines, and he has placed the gain at fourteen per cent. as a maximum to be expected.

The expenditure of condensing water for the 36″×72″ engine has been roughly estimated in the following manner:

Thermal units taken up per pound of condensing water 97·675—72·225=25·45 thermal units per pound of steam, difference between observed total temperature of steam as it entered engine and as it left the condenser 1,134·02—104·037=1,029·983, of which quantity the heat converted into work, and that lost by radiation and conduction during expansion in the cylinder, represents about ten per cent. (all heat converted into work or lost by conduction and radiation prior to cut-off being supplied direct from boilers), leaving 926·98 thermal units to be taken up by condensing water, corresponding to 36·42 pounds per pound of steam condensed; the weight of steam condensed per hour was 8,208·8 pounds, and weight of condensing water due this quantity of steam was 299,964 pounds, or 36,010 gallons, or about 68 per cent. of capacity of Worthington pump at wharf based upon delivery during the duty trial (53,790 gallons per hour), 36,000 gallons of sea water pumped 100 feet high equals 3·6 million gallons one foot high, and will cost for fuel alone, not including coal to start fires, $0·216 or 21 6–10 cents for 393 horse power, or at rate of $2.16 per day of ten hours, or 1·82 horse power per *one* cent of cost. The coal for ten hours per horse power is 0·25 bushels, and costs 5½ cents or a total cost per horse power per diem (10 hours) of 6 cents in round numbers for fuel.*

The writer is of opinion that few establishments, in or out of the United States, can exhibit a similar economy for motive power.

In the following table are given the dimensions of the non-condensing coupled engines.

Harris-Corliss' Non-Condensing Engines.

Two coupled cranks set on one shaft at quarters.

RIGHT ENGINE

Diam. of cylinder	inches,	28
Stroke of piston	"	48
Diam. of piston rod	"	4·125
Area front side of piston	sq. in.,	602·386
Area back side of piston	"	615·75
Nominal revolutions per minute		70·
Nominal piston speed per minute	ft.,	560·
Actual piston speed economy trial Aug. 30th,	"	555·344
Factor horse power front side piston nominal speed		5·111
Factor horse power back side piston nominal speed		5·224
Piston stroke to release in parts of stroke		0·9906
Piston stroke from ex. closure in parts of stroke		0·0489
Clearance in parts of stroke (estimated)		0·025

DATA FROM ECONOMY TRIAL.

Piston displacement per hour to release,	cu. ft.,	137,317·49
Piston displacement per hour to ex. closure,	cu. ft.,	6,778·54
Clearance volume per hour.	"	3,465·51

LEFT ENGINE.

Diam. of cylinder	inches,	26·
Stroke of piston	"	48.
Diam. of piston rod	"	3.875
Area front side of piston	sq. in,	519·137
Area back side of piston	"	530·93
Nominal revolutions per minute		70·000
Nominal piston speed " "	ft.,	560·
Actual piston speed economy trial Aug. 30th,	"	555·344
Factor horse power front side piston nominal speed		4·405
Factor horse power back side piston nominal speed		4·505
Piston stroke to release in parts of stroke		0·9926
Piston stroke from ex. closure in parts of stroke		0·0448
Clearance in parts of stroke (estimated)		0·025

DATA FOR ECOMOMY TRIAL.

Piston displacement per hour to release,	cu. ft.,	120,588·04
Piston displacement per hour to ex. closure,	cu ft.,	5,442·62
Clearance volume per hour	"	3,037·117
Fly wheel diam	ft.,	20·
" " weight	tons,	18·5

One trial for economy of coupled engines was made Aug. 30th, under ordinary conditions of work in the old mill, with the following results:

ECONOMY TRIAL COUPLED ENGINES.

Date of trial	August 30th.
Duration of trial	10 hrs, 45 min.

PRESSURES.

Average pressure in pipe	pounds,	68·488
Barometer estimated	inches,	29·9
" "	pounds,	14·678

ENGINE COUNTER.

Counter at 7·01: A. M.	17,917	
Counter at 6: P M.	62,622	
Revolutions for 10 hours 44 minutes		44,705
Revolutions per minute		69·418
Piston speed	ft.,	555·344

FROM THE DIAGRAMS 28″×48″ ENGINE.

Average initial pressure	pounds,	60·415
Average terminal pressure absolute	"	13·094
Average counter pressure above atm.	"	0·914
Mean effective pressure front side of piston,	pounds,	14·915
Mean effective pressure back side of piston,	pounds,	13·954
Indicated horse power		147·886

FROM THE DIAGRAMS 26″×48″ ENGINE.

Average initial pressure	pounds,	60·953
Average terminal pressure absolute	"	15·794
Average counter pressure above atmosphere,	pounds,	1·787
Mean effective pressure front side of piston,	pounds,	23·484
Mean effective pressure back side of piston,	pounds,	22·026
Indicated horse power		200·980
Total load average all day H. P.		348·875

RATIO OF EXPANSION 28″×48″ ENGINE.

Apparent cut-off in parts of stroke	0·1299
Actual " " " "	0·155
Theoretical " " " "	0·1743
Expansion by volumes	6.613
Expansion by pressures	5·735

RATIO OF EXPANSION 26″×48″ ENGINE.

Apparent cut off in parts of stroke	0·235
Actual cut off in parts of stroke	0·26
Theoretical cut off in parts of stroke	0·209
Expansion by volumes	3·942
Expansion by pressures	4·788

CALORIMETER.

Av. water heated	pounds,	200·
Av. steam condensed	"	10·159
Av. initial temperature, Fahr	77·386=	77·421
Av. final temperature, Fahr	129·75=	130·079
Av. thermal units found in steam		1166·759
Thermal units in saturated steam at observed pressure		1209·82
Difference thermal units		43·061
Latent heat of steam at observed pressure		892·49
Percentage or water entrained in the steam		4·824

TOTALS.

Total water weighed to boilers	pounds,	125,745·
Total water and steam to calorimeter,	"	234·5
Total water and steam to engine	"	125,510·5
Total saturated steam to engine	"	119,455·9
Estimated steam to machine-shop engine,	pounds,	8,806·0
Net steam to coupled engines	"	110,649·9

ECONOMY.

Steam per hour	pounds,	10,293·014
Steam per hour per indicated H. P.	"	29·503
Coal per horse power per hour upon performance of tubular boilers, Main house.		2·924

STEAM ACCOUNTED FOR BY DIAGRAM.

By 28″×48″ engine per hour	pounds,	4,377·6
By 26″×48″ engine per hour	"	4,712·5
By both engines	"	9,090·1
Percentage accounted for		88·313
Steam per indicated H. P. per hour by diagrams	pounds,	26,054

Of above load, 46·285 horse power is due to friction of engine and load, and 302·59 horse power represents average load of machinery, including friction of line shafting and gearing, which would be the net average load if the old works were driven by the condensing engine.

The aggregate average load in old and new works, now driven by condensing (36″x72″) engine, and non-condensing coupled engines, is 741·737 horse power, and the aggregate maximum load in the old and new mills from accompanying tables of power per diem, is 949·551 horse power.

In providing for capacity of engine the maximum possible loads should be considered, and in prospecting for economy, the average loads should be considered.

Suppose the total load of old and new mills is divided between the 36″x72″ condensing engine, and the 28″x48″ engine (made condensing), and that the loads are proportioned for best mean effect for the two engines.

Calling the whole load 100, then of this there should be carried by the 36″x72″ engine 64 per cent., and by the 28″x48″ engine 36 per cent.; or if the 36″x72″ and 26″x48″ were run together, which (with the two engines in same condition), is to be preferred for economy; then 68 per cent. of the load to the 36″x72″ engine, and 32 per cent. to the 26″x48″ engine, both engines condensing and producing as nearly as possible similar diagrams.

The writer's recollection now is that the 28″x48″

---

*Coal for steam pier H. P. per hour	1·90 pounds,	$0.0055
Coal for Worthington pump at wharf to supply condensing water per H. P. per hour	0·2 pounds,	0·00055
Total coal 21 pounds per 10 hours		0·06056
or say, in round numbers six cents		

engine is in much the better condition of the coupled engine, and would probably be a better engine to carry the proportional part of total load.

Of the aggregate average indicated power of condensing and coupled engines, 32·042 horse power is the friction of the 36"x72" engines running without load at mean speed, 18·086 horse power is in the friction of 28"x48" engine running without load at mean speed, and 15·592 horse power is the friction of 26"x48" engine under similar conditions.

If the 26"x48" engine is stopped, then of the aggregate average load (7·42 horse power in round numbers) 15·6 horse power of load would be removed, leaving 726·4 horse power to be furnished jointly by the 36"x72" engine, and 28"x48" engine, of this the former engine should carry 465 horse power, as a mean load, and 600 horse power as a maximum load, and the 28"x 48" engine should carry 261·4 horse power as a mean load, ánd 335 horse power as a maximum load (while working condensing). Under these conditions both engines would be so moderately loaded as to warrant excellent wear through many years of continuous service.

The consumption of steam for power alone under proposed arrangement, will be 12,348·8 pounds per hour, or 123.481 pounds per diem of ten hours, corresponding to a consumption of coal, upon basis of 72" tubular boilers in main house of 12,237·4 pounds, or 6·1187 tons.

The consumption of steam from Main house at time of trials, August 27th to September 4th, was:

From 6 tubular boilers, 124,729·66 pounds. From 16 plain cylinder boilers, 128,657·50 pounds. Total steam for 10 hours, 253,405·16 pounds. Representing a coal consumption for same time of 12,361 pounds for tubular boilers. and 19,073 pounds of plain cylinder boilers, or a total per diem of 31,434 pounds, or 15·717 tons, exclusive of coal to bank and start fires.

Of above quantity of steam as at present working, the 36"x72" condensing engine consumed (August 28th) 75,103·426 pounds per day (10 hours), the coupled engines, as run August 30th, consumed 110,650 pounds per day. The machine shop engine consumed 8,806 pounds per day, and the steam pumps and various beating and curing apparatus taking steam from main boilers, consumed the remained, or 58,845·73 pounds per day; of this the consumption by pumps alone will not exceed 10,000 pounds per day, leaving consumption of steam by heating, devulcanizing and curing apparatus, as at date of trial, of 48,850 pounds in round numbers.

The hourly quantities, which is the better method of stating steam consumption, are:

For 36"×72" engine, 392·86 H. P.	7,510·34	lbs.
For coupled engines, 348·87 H. P.	11,065·00	"
For machine-shop engine, 31·45 H. P.	880·60	"
For steam pumps 2 boiler feeders 1 fire pump	1,000·00	"
For heating rolls, devulcanizing and curing apparatus	4,884·573	"

The above, as working at dates of trial, represented an annual (300 days) consumption of fuel for all purposes (banking and starting fires, and running), of 6,046·2 tons, or an expenditure of $33,254.

Under proposed arrangement with 28"x48 engine, condensing, the expenditure of steam per hour will be:

For 36"×72" engine 465 H. P.	7,905·0	lbs.
For 28"×48" engine 261·4 H. P.	4,443·8	"
For 10"×24" engine 31·45 H. P.	880·6	"
For 3 steam pumps reduced duty of boiler feeders	800·0	"
For heating, devulcanizing and curing	4,884·5	"

or a total consumption of steam per day of 10 hours, of 189,285·5 pounds, equivalent to an expenditure of 18,758 pounds, or 9·379 tons of coal, and an annual (300 days) consumption of 2,813·7 tons at a cost of $15,475·35 running time, to which add coal for banking and starting fires, as follows:

For present six tubular boilers per day	4,246	lbs.
For proposed 3 additional tubular boilers to take the place of present 16 plain cylinder boilers	2,123·0	"
Total	6,369·0	"

or 3·184 tons per day, or 955·2 tons per annum, costing $5,253.60, making a total cost for fuel under proposed arrangement of $20,728.95 in main boiler house.

The suggested improvement in boiler economy is based upon precedent in the Rubber Company's own works, and the suggested improvement in engine economy is based upon personal experience with Harris-Corliss and other cut off steam engines.

The testing of the 10"x24" machine shop engine was incidental to the test of coupled engines, and furnishes valuable information only in the power developed, and probable cost of operating the machinery of machine-shop and box-factory.

MACHINE-SHOP ENGINE.

DIMENSIONS.

Diam. cylinder	inches,	10
Stroke of piston	"	24
Diam. of piston rod	"	1·9375
Diam. of fly wheel	feet,	7·5
Width of fly wheel face	inches,	16·
Weight of fly wheel	pounds,	3880·
Clearance estimated	per cent.	3.
Area front side piston	sq. inches,	75·592
Area back side piston	" "	78·540
Estimated revolutions per minute		100.
H. P. front side piston		·458
H. P. back side piston		·476

The mean speed during the trial was 100·749 revolutions per minute, and mean effective pressure front end of cylinder, 28·057 pounds, and for back end of cylinder, 38·583 pounds, equivalent to a mean load of 31·45 horse power. The estimate of 28 pounds of steam net, per horse power per hour, is justified by the general condition of the engine and the load carried, and any error in estimating the economy of this engine is calculated to enhance rather than diminish the economy of coupled engines, which were tested simultaneously with this engine.

The power developed by the machine-shop engine is relatively so small, that an error of several pounds in steam consumption per horse power per hour, might exist, with no practical effect upon the economy of coupled engines.

DISTRIBUTION OF POWER.

Subsequent to the trials for economy of engines, tests were made upon 36"x72" condensing engine, and 28"x48" non-condensing engine for distribution of power, with the following results:

DISTRIBUTION OF POWER 36"×72" ENGINE.

NEW WORKS.	H. P.
A load, average as at 2 P. M., Aug. 31	415·316
B load consisting of 4 calenders, engine, line shafting and empty rolls	118·207
C load, consisting of 3 calenders, engine, line shafting and empty rools	103·510
D load, consisting of 2 calenders, engine, line shafting and empty rolls	98·528
E load, consisting of 1 calender, engine, line shafting and empty rolls	82·193
F load, consisting of engine, line shaftings and (44) empty rolls	77·000
G load, consisting of 8 warmers, engine, line shafting and empty rolls	234·84
H load, consisting of 30 grinders, engine, line shafting and empty rolls	502·352
I load, consisting of 6 washers, engine, line shafting and empty rolls	114·959
J load, consisting of 10 grinders, engine, line shafting and emply rolls	198·004
K load, consisting of 10 grinders, engine, line shafting and empty rolls	259·096
L load, consisting of 10 grinders, engine, line shaftings and empty rolls	238·297

The friction of empty engine at mean speed the writer has estimated at 1·75 pounds per square inch of piston, or 32·042 H. P. Deducting this amount from any of the above loads, gives the gross load on engine, which consists of the machinery driven and extra friction of engine due to load; as the machinery cannot be operated without developing this extra friction, the writer thinks it is proper to charge it to the machines as part of the power required to drive them; of course the actual power consumed at the machine is as much less than that shown as is represented by extra friction of engine and connectors (line shafting and gearing), due to load; but if the load of machine is removed this extra friction disappears, and as in any particular instance, this extra friction is due to the load of machine, the writer thinks best to charge it as necessary part of the power to drive machine.

With this explanation the preceding table shows:

First—That the frictional resistance at mean speed of line shafting and gearing, forming the connectors between engines and machinery, and of the rolls running empty in new works requires, 43·159 horse power.

Second—That the average load (all machinery in new mill), exclusive of engine friction and extra friction of engine due to load, is 367·943 horse power.

The cost of engineer, coal for starting fires, and interest on investment, being a constant quantity independent of water pumped per diem, it is obvious that as the demands upon the engine increase the economy of performance will increase also, the writer does not mean that the duty of engines based upon coal burned during the running time will be enhanced, but that the duty based upon all expenses reduced to a coal basis will be increased.

By separating the weights of coal (daily) to start fires, from the weights of coal burned for running time, it can be determined with a slight calculation, how well the pumping-house is managed in the following manner: If a division of the coal used for starting fires (for any length of time), by the number of days is in excess of 500 pounds per diem, and the number of quadruple strokes (revolutions) by counter for same time divided by the coal burned (running time), is less than 16·76 per pound, then the works are not well managed.

In other terms the standard for coal per day for starting fires should be 500 pounds, and the standard of quadruple strokes of pumps per pound of coal burned while pumping water, should be 16·76; which standards may be exceeded or improved by skillful management upon the part of the engineer.

The air pump furnished with the Worthington air pump engine is insufficient to properly void the condenser of air and condensation, and another should be supplied with ample capacity to keep in advance of the actual maximum requirements.

During the progress of the writer's discussion of the results, he has suggested several improvements which were used only to illustrate the particular portion of plans under consideration, and were not intended as improvements which should be inaugurated in fact, *e. g.*, the change in setting of present tubular boilers in North house, and substitution of six 72″ tubular boilers for present plain cylinder boilers in Main house.

The improvements which the writer submits to the Rubber Co.'s considerations are:

The removal of the plain cylinder boilers entirely, and substitution of three (3) 72″ tubular boilers instead.

The addition of condenser to 28″×48″ engine, arranged to work with 26″×48″ engine if desired.

The stoppage of 26″×48″ engine entirely.

The division of load between 36″×72″ engine, and 28″×48″ engine in the proportion of 64 per cent. to the former, and 36 per cent to the latter.

The substitution of three (3) 72″ tubular boilers for the present 5—48″ tubular boilers in the North house.

By making these changes in a proper manner the writer confidently believes the Rubber Co. will reduce the coal bills $15,000 a year, besides a reduction of labor in wheeling and handling coal.

There are, no doubt, other sources of loss about the works in the consumption of steam, which partly for lack of time, and partly because of the high normal temperatures during his visit, were not investigated.

It is advisable to put a permanent pyrometer in the flue leading to chimney of each battery of boilers, also to furnish convenient dormant platform scales in Norh house, Main house and Pump house for the actual weighing of coal, and the coal should be reported so much for banking and starting fires, and so much for running. The writer would also have an indicator permanently attached to cylinder of 36″×72″ and 28″×48″ engines, for periodical diagrams to be read for load and economy.

The 28″×48″ engine should be furnished with a permanent counter for daily report of revolutions, and daily reports of counters from 36×72″ engine should be had to check the economy at the several points of coal consumption or steam use. The night men in Main boiler house, and each fireman in North house should be required to brush the boiler tubes each night and at end of each watch respectively.

The power is transmitted in the old works to the line shafting by spur gearing, and in the new works by belting, and the demonstration in the preceding paragraph shows conclusively that the loss of effect between engine and machinery is least with the belting connectors.

The fact is well established by numerous experiments, however, in flour mill practice, that the loss of power by frictional resistance of gearing is much greater than with belting, and no gearing, which can be avoided, is used in the large mills of the West to-day.

The foregoing narrative which is an extract from the report to the Rubber Co., may be crude in form and diction, but is, nevertheless, valuable as showing how meritorious improvements may be made in the steam power plants of large establishments, where no losses are supposed to exist. The engines and boilers of the National Rubber Co. are, strictly speaking, first class, yet with precedents from its own works, it appears that the consumption of fuel is ⅓ more than it should be for equal effects. What is shown to be the losses of this concern, may be repeated. *ad infinitum*, in many of the large establishments of the country using steam power.—*Van Nostrand's Magazine.*

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THE MECHANICAL ENGINEER.

New Series. Vol. VII.—No. 5.
Enlarged 1883.

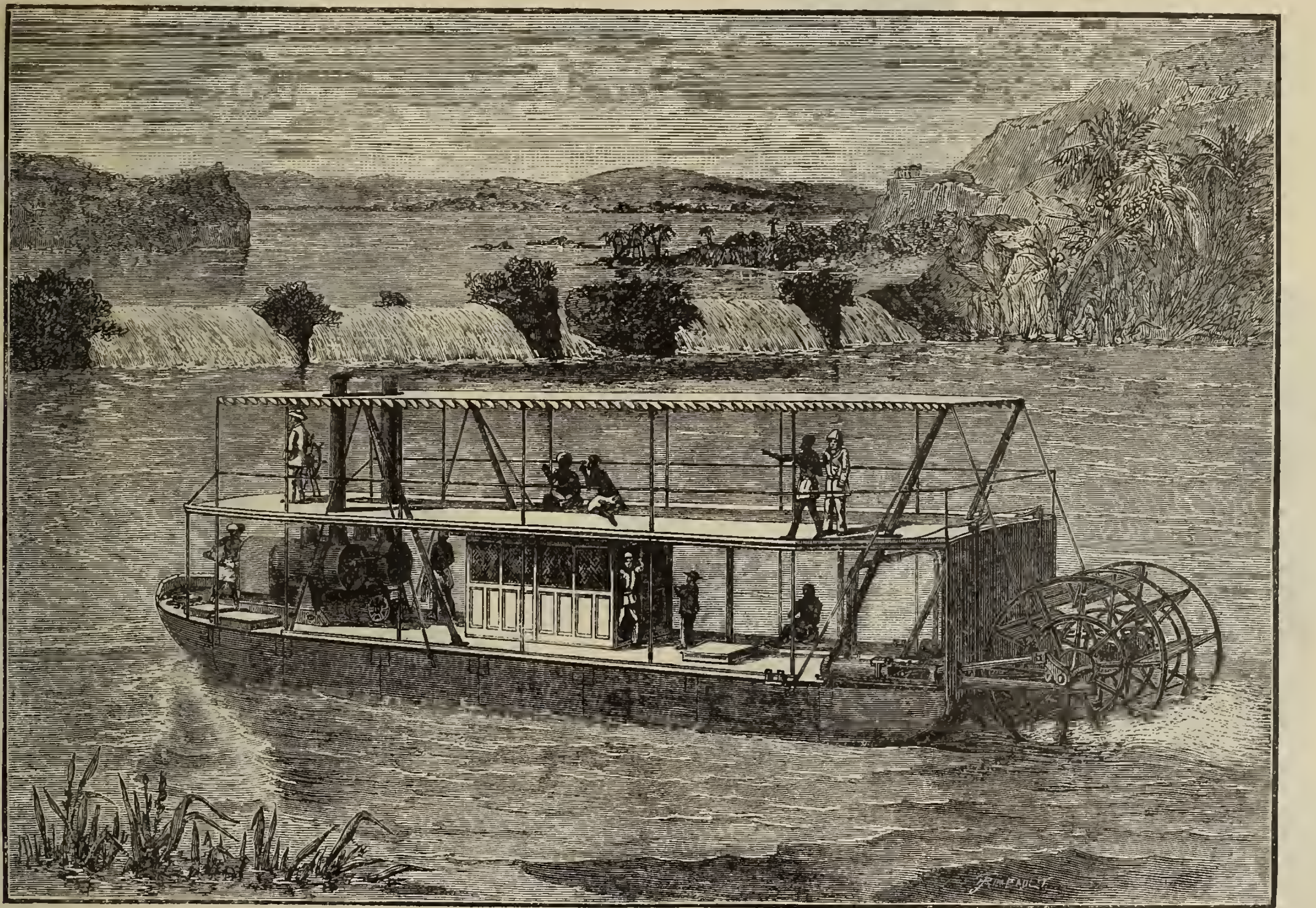
New York, March 8, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

AN ENGLISH STERN-WHEEL STEAMBOAT.

On page 36, current volume, we noted a new English sectional steamer, and gave some details of her construction. We publish herewith an engraving of this vessel, taken from the London *Engineer*. Our contemporary says further in relation to it:

“ Prior to the shipment of this little vessel some interesting experiments were made to test by actual trial how long it would take to connect the various sections forming the entire hull after arrival, and also the time to sub-divide them again into portable pieces. Twelve men and three boys were employed for the purpose; they were able to completely and perfectly connect two sections while afloat in twenty-three minutes—consequently the entire hull, which consists of eight sections, could be connected up in about three hours, provided the sections were all afloat ready for speedily bringing together. The next trial was made to ascertain how long it would take to effect the sub-division of the hull; the same number of men were employed, and it occupied them eight minutes. This mode of construction seems to offer very marked facilities in contrast with the usual plan of shipping such vessels in pieces and riveting them after arrival, entailing slipways, riveters, and all the difficulties of launching, which are not always easily overcome in foreign lands, even at considerable expense and delay.



AN ENGLISH STERN-WHEEL STEAMBOAT.

Many are still unaware that the law which made persons taking papers from the post office responsible for the subscription has been repealed. No such law exists to-day, but some small publishers are endeavoring to obtain a bulldozed subscription, list by threatening legal proceedings. Don't pay for any paper you do not order.

Many persons send postage stamps to us pasted down tightly on the letter. This is not necessary, for to get them off intact we are compelled to soak the letters, which destroys the writing and the gumming. Inclosure in the envelope is sufficient.

“THEY TURNED A SCREW.”

Helpless people, who pride themselves on not knowing anything about mechanics, but are compelled to send for one when a range refuses to burn, or the domestic machinery stops, may reflect upon an occurrence related by the *Builder*.

For several weeks a boiler in the kitchen of a professor's house had been acting erratically, and great was the annoyance caused. Finally it stopped, but by noon, alas, the symptoms again appeared! This time the cook proved equal to the emergency, by setting a pudding dish under the boiler,—a simple and easy relief if the water had dropped straight down; instead of this, it clung to the iron leg and then meandered across the floor till it was arrested by—the dish cloth!

After several weeks of this recreation the Professor went away for a rest. When he reached home his wife met him at the door.

“ The plumbers have been here.”

“ You don't say so! Have they got through?”

“ Yes.”

“ Everything all done and put in order?”

“ Yes.”

“ Did you pay them?”

“ No.”

“ Why not?”

“ They would'nt take any pay.”

“ Would'nt take any pay!”

“ No. They said 'twas'nt worth anything.”

“ How long were they here?”

“ About five minutes.”

“ What did they do?”

“ They turned a screw.”

As if in refutation of our assertion in the last issue that there were no technical periodicals in Germany, the next mail brought a copy of the *Anzeiger zum Centralblatt der Bauver Waltung*, published in Berlin by Ernst & Korn, 90 Wilhelmstrasse. This is a “class-paper” for architects especially, and contains matter suited to them alone. Our broad assertion should have been qualified by saying that no papers similar to many English and American periodicals of our own class existed.

An inquirer asks in a contemporary if a pair of surface plates are put in an air-tight box how much force will be required to move them, and he is informed that exhausting the air will not make any difference—meaning, possibly, that it will require as much force to move one air-tight plate on another in a vacuum as it does under atmospheric pressure. Two plates in a vacuum under such circumstances move without friction, for they are in a state of balance.

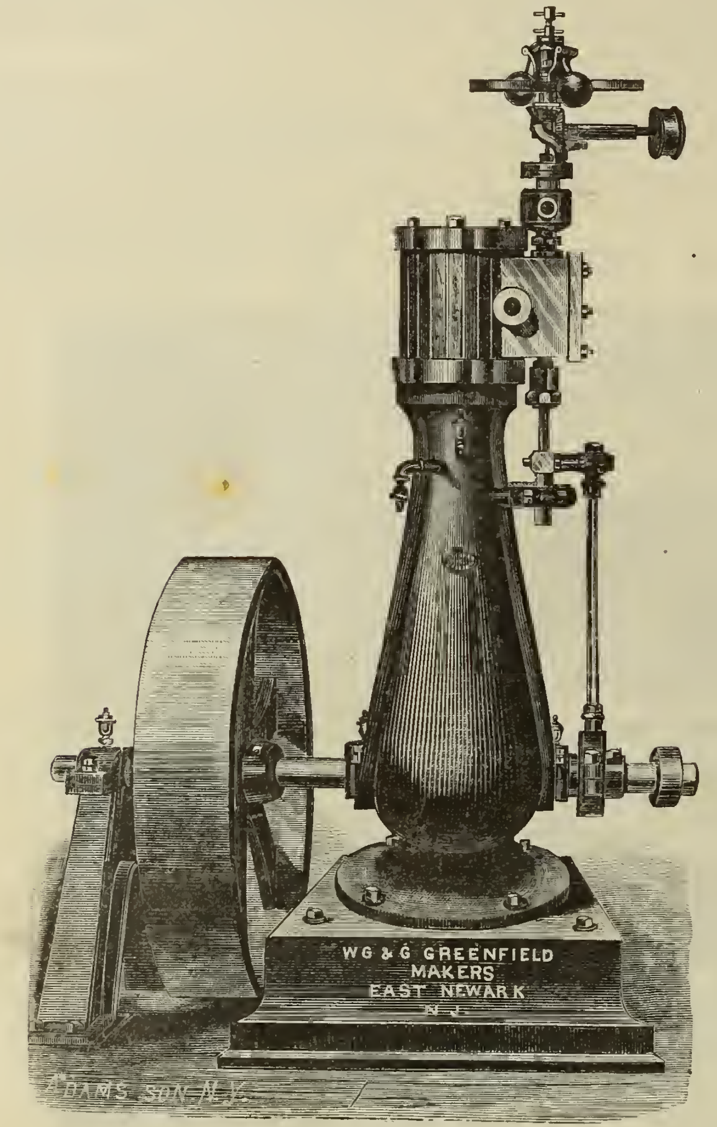
An incident of the recent tremendous floods in the West is thus related in the *Times* of this city: “The first thing we knew,” says a passenger, “we were running through water about 4 feet deep. We had three cars on our train and four engines, two in front and the others in the rear. We ran for five miles through water, and often it came upon the platform and washed in the car. Of course the fires in the engine furnaces were put out at the first plash, but enough steam was carried by the four engines to draw the train out of reach of the water. The fires were then rebuilt, and the train proceeded on its way when steam was raised. You can imagine the fright of the passengers as we went tearing through the water, throwing it on both sides of the train for a distance of 20 feet.”

It is perhaps scarcely necessary for us to point out the great value of the series now running in this paper upon “*How I Served My Apprenticeship*.” Nevertheless, we do point it out, for even those who are no longer apprentices will find benefit by reading it. It is not gossip of the shop, or the opinions of an individual, but a spirited presentation of the experiences of a live Yankee boy in the pursuit of his trade. For those who look beyond mere manual dexterity, and wish to ground themselves in principles, this series has permanent value.

We must again state that we cannot send this paper unless the money is sent with order. Our list is wholly a paid one.

THE GREENFIELD VERTICAL STEAM ENGINE.

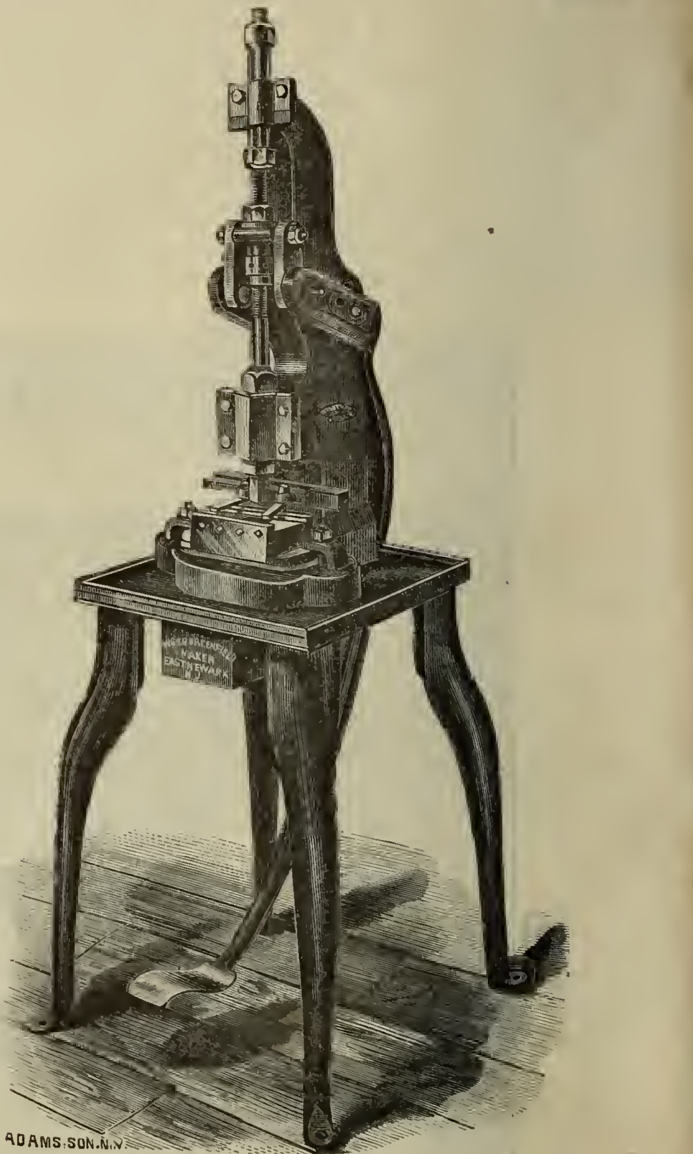
Our illustration represents a very useful type of engine, of which vast numbers are running all over the country. It is especially adapted to small powers and contracted space, or where floor-room is valuable. Its construction need not be explained, as the engraving shows it at a glance, but we may say that only the best materials are used in it. The crosshead has composition gibs, adjustable for wear, and the cylinder, its heads, and the frame, are each separate castings, so that repairs can be made cheaply and quickly in case of accident. The steam-joints everywhere, have ground faces, thus doing away with any artificial means to prevent leakage. All the wearing bearings, shaft, piston-rod, crosshead-pin, crank-pin, valve-rod, etc., are of forged-steel, and the fly-wheel is cored out to balance the reciprocating parts. In short, these engines are built in the most thorough manner by young mechanics, who take pride in their work, and realize that they have reputations to maintain.



The engines are usually run at about 300 feet piston speed per minute, but can be run higher, and are fitted with link-motions for yachts, or tug boats when desired. Price lists and further details can be had by addressing the manufacturers, W. G. & G. Greenfield, Fifth and Cross Sts., East Newark, N. J.

The same parties also manufacture the Riley foot-press, which is described as follows:

It has two bearings, instead of one, as in the usual foot-press. The upper bearing is made in such a manner that it forms the stop or "kick" of the press, and being in perfect line with the spindle, does not cramp the plunger and throw the same out of line, with the breakage of valuable tools as a result. This press is strongly made and adapted to all kinds of work in its line, or drawing, and can be adjusted with little trouble to suit different lengths of tools. It is so arranged that the treadle will always operate from the same starting point, whether the tool is long or short. It has also a longer leverage and stroke than the common press, and may be used in many places where the ordinary press would be either of no service, or the work would have to be done in two operations. Great care is exercised in the material and workmanship, and when the press leaves the shop it is all ready for use. For jewelers, button-makers, brass goods manufacturers and saddlery hardware makers it has no equal.



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Bro. J. F. Holloway, of Cleveland, "who knows whereof he affirms" writes:

> "Your plan of working 'an early cut-off' on delinquents is all right, and I have no doubt but that it serves to keep the wheels moving freely, and prevents clogging the machine with too much back-pressure arising from the accumulation of unpaid bills."

It does have the effect stated Bro. Holloway. We manufacture a newspaper which is sold for a certain price, and the only way in which we can keep ahead is by selling a certain quantity for a certain sum; no sensible person wants a thing he has not paid for. There are no delinquent lists on our books.

* * *

Several friends in Detroit send us communications respecting a controversy now going on there concerning boiler inspection, involving the professional ability of certain individuals who are mentioned by name. We are requested to give an opinion on some points, but our friends will see that this is not only impossible for want of knowledge of the matter, but would be, also, officious on our part. We think the engineers of Detroit are quite competent to manage their own affairs without any advice from us. We express the hope, however, that all conflicting interests will be harmonized.

* * *

ANNUAL REPORT OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors Mechanical Engineer:

Herewith I send you report to date, which please insert.

Providence, R. I., A. H. Warner, New Court House, 82; Detroit, Mich., A. M. Davy, 30; Chicago, Ill., No. 1, Wm. Ponsonby, 244 W. Monroe street, 287; Brooklyn, N. Y., Henry Major, 470 Hicks street, 84; New York, N. Y., J. J. Wrightwrick, care Museum of Natural History, 74; Wilmington, Del., J. H. Baker, 205 Tatnell street, 34; St. Paul, Minn., Jas. Sweeney, care Forepaugh & Tarbox, 16; Canton, O., Jesse T. King, 2 Hane street, 16; Rochester, N. Y,, Jno. F. A. Cullinan, 23 Exchange street, 30; Philadelphia, Pa., Geo. F. Peifer, corner Johnson and 20th streets, 110; Carthage, Mo., W. H. Davis, 16; San Francisco, Cal., Jos. Bell, 1,314 Pine street, 44; Denver, Col., H. F. Howard, 498 Arapahoe street, 22; Chester, Pa., J. D. Rostron, care Chester Dock Mills, 22; Chicago, Ill., No. 2, Aug. Hanson, 309 N. Franklin street, 33; Baltimore, Md., J. B. McClure, 212 Elliott street, 66; Meriden, Conn., Wm. Gage, 243 Crown street, 17; Cincinnati, Ohio, G. G. Minor, 25 Broadway, 42; Owosso, Mich., Andrew Jackson, 16; Louisville, Ky., J. T. McEnnis, 615 Shelby street, 35; New Haven, Conn., H. A. Sanford, 26 South Front street, 69, Rome, N. Y., Chas. Tracy, 12; South St. Louis, Mo., Jno. H. Clark, 25; Kansas City, Mo. Henry M. Fife, 4 West 2d street, 35; Twin City, Ill., Samuel Roughton, Urbana, Ill., 15; Leadville, Col., P. R. Hull, care Harrison Red Works, 32; St. Louis, Mo., E. T. Ivester, 818 Beaumont street, 79; Jersey City, N. J., Jno. H. Clark, 3 Storm avenue, 23; Toledo, Ohio, C. W. Parsons, care Maclean & Sprague, 15; Atchison, Kas., T. C. Logan, 604 T street, 13; Warrensburg, Mo., C. O. Yarrick, 11; Omaha, Neb., D. H. Gould, 1,201 Chicago street, 11; Jeffersonville, Ind., R. H. Timmonds, 15; Bloomington, Ill., J. M. Houseman, 609 East North street, 14; Muscatine, Iowa, Wm. Molis, 12; Madison, Wis., Robt. H. White, 12; Waterbury, Conn., E. J. Schuyler, Box 1322, 24. There are seven associations in Massachusetts under the guidance of the State Association located at Fall River, Salem, Worcester, Boston, Springfield, Lynn and New Bedford. Geo. A. Grover, 42 Bennington street, East Boston, is Secretary of the State Association. Membership, 200; total, 1,683, an increase since Oct., 1883, of 334. There are 45 branch associations working under the rules of the National Association. We are in correspondence with no less than 25 cities where the engineers are organizing.

We wish to state once more that this order is in no sense a trades union. Engineers, superintendents, employers and all doubters who wish to investigate the work of the order, in cities where there are associations, are cordially invited to attend their meetings. They are open to the public.

The price for supplies in future will be Charters, $10, and Rituals, per set of five, $2; Visiting and Clearance Cards per doz., $4; Odes per doz., $1.

A. M. Davy, *Sec.*

175 Elmwood Ave, Detroit, Mich.

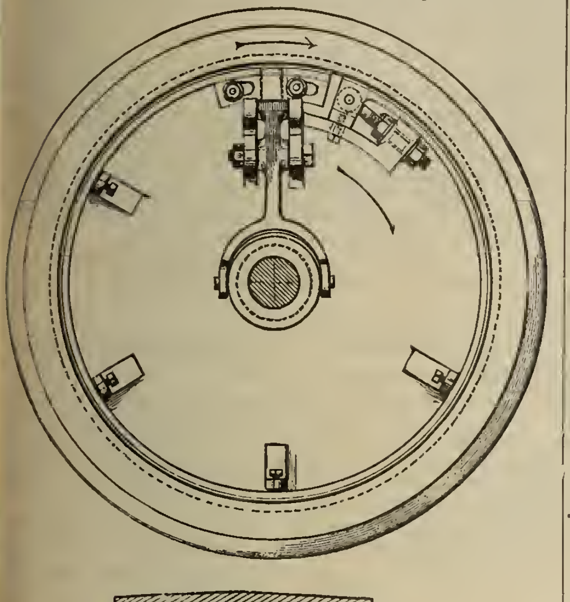
* * *

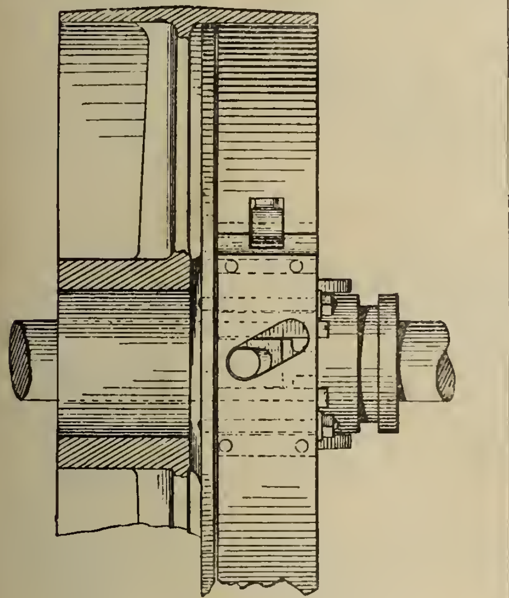
On the New York Central and Hudson River R.R. twelve gills of oil used in the cylinders will run a locomotive to Albany—140 miles.

McINTOSH'S NEW PATENT FRICTION-CLUTCH

Friction-clutches are mechanical devices in constant use on various kinds of machinery, being indispensable for hoisting, where the load has to be quickly released and taken up. Most clutches, in one form or another bring a great strain upon the shaft endwise; so great, in fact, that set-screws are provided to take up this thrust.

This is objectionable, and the purpose of the one here illustrated is to do away with end thrust. To attain this, the disk which usually engages with the inner rim of the driven pulley has a lever pivoted to it, as shown in Fig. 1. The upper end of this lever is round and works in the diagonal slot, Fig. 2, in the friction strap The lower, or superior arm of the lever, is fast to the sleeve, or coupling, which slides upon the shaft in the usual manner.





When this coupling is moved end-wise, it actuates the lever, causing the upper end to travel in the diagonal slot, thereby forcing the friction-band against the inner rim of the driving-pulley, for the purpose intended. The release is, of course, operated in the reverse way.

This clutch is quite noiseless and efficient, a mere model 6″ diameter being capable of sustaining a load of over 200 lbs. It is desirable where light hangers, or counter-shafts are used, as in the overhead gear of screw-cutting lathes, and will be found desirable in many situations. The inventor is David McIntosh, 816 Blake street, Denver, Col.; he desires to treat with principals for the sale of the patent.

◆

PERPETUAL MOTION NOT YET HOPELESS.

Editors Mechanical Engineer :

A statement of great value is given to the public in the last issue of one of our "scientific" publications.

The "impact in foot pounds" of a ball weighing one pound, which has rolled down an incline ten feet long with a perpendicular descent of two feet, will be 11·333 ! Or, if that is not sufficient, we are informed that we may obtain any value in pounds for a one pound ball, from 11 to 44 pounds ! In order to arrive at the latter result, it would seem probable that the ball must be accurately turned and well polished, and the plane carefully surfaced and slightly greased; but, as the gain would be something over 2000 per cent, no doubt the investment would pay !

What a flood of light is thus thrown upon the disturbance which takes place at the business end of a ten pin alley ! A subject so long and laboriously investigated by multitudes of vigorous young men. A few ten-pin alleys mounted on the hurricane deck of a ferry-boat and suitably inclined, would no doubt send it across the North River "kiting."

Keeley motor stock is doomed.

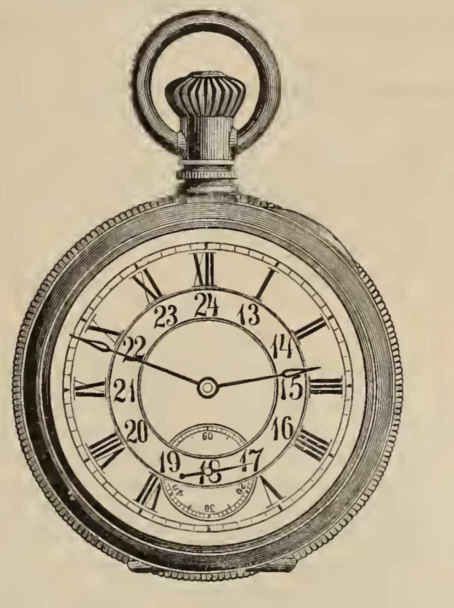
Philadelphia, Pa. Grumbler.

[Our correspondent alludes to the Notes and Queries of the *Scientific American*, for which, according to a late editorial in that paper, the proprietors pay out thousands of dollars per year. If this is the case, it is evidence of fatuous extravagance we can hardly credit. It is also fortunate for our correspondent that his address is not known, or he would probably receive an anonymous letter from the above-named paper rebuking him for his audacity.—Eds.

◆

ADOPTION OF TWENTY-FOUR HOUR TIME MADE EASY.

Much has been recently published in various papers concerning the adoption of twenty-four hour time, and, as has been said, the only obstacle of serious importance seems to be the inevitable expense of changing the millions of watches now in use. That obstacle is soon to be removed, as an application for a patent has been filed for an "Improvement in dials for time-pieces." This improvement consists of an auxiliary, or supplemental dial, having the figures from thirteen to twenty-four inclusive, being capable of attachment to the present watch-dial in the manner shown in this illustration. It is made of a material comparing favorably with the general appearance of the watch, and will in no way mar, or interfere with the proper running of the same. It can be attached in a few minutes by a watchmaker, or any skillful person, and at a cost within the means of any one carrying a watch. This is believed to be the only easy, practical method, of putting the twenty-four hour time in a shape for all to try it, and if found practical, and better than the present imperfect style, adopt it. Those interested can address H. W. Hubbard, 23 Park Row, New York.



◆

CORRECTION.

We were misinformed as regards the Naval Advisory Board and its disunion, as stated in our last issue. Mr. Coryell has been induced to reconsider his resignation, and has resumed his former position. We shall, in due course, give further details of the *Chicago's* engines and the vessel herself.

◆

We are indebted to Mr. J. H. Harris, of St Louis, Mo., for a copy of the Marine Engineers' Report for 1883.

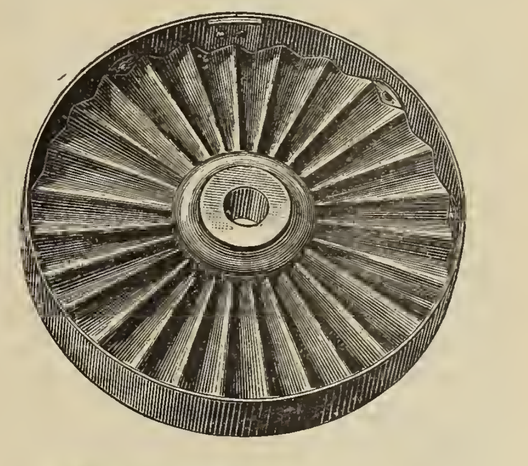
DIVIDING LINE BETWEEN IRON AND STEEL.

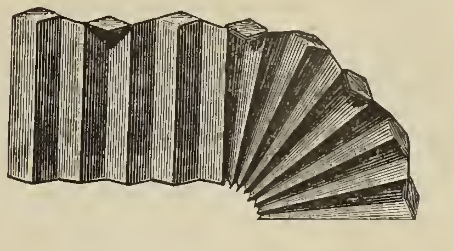
Mechanical tests, as well as chemical analyses, have failed to find any distinct line of separation between the numerous varieties of iron and steel. The physical method employed shows clearly that there is no dividing line between iron and steel. Thus iron is physically a soft steel, and steel a hard iron. All are hardened by temper; all are hardened by mechanical treatment, as hammering and rolling; all are hardened by strains and stresses of any nature whatever; the difference, though large, is only in degree. At the extreme end, towards iron, mechanical hardening has a greater effect than tempering. At the steel end, tempering has a greater effect than mechanical hardening. We might here suppose we could find a physical dividing line, but some mild steels stand just on that dividing line, which had previously appeared most satisfactory. Neither mechanical nor physical methods will suffice to overcome the difficulty. Mechanically a certain tensile strength has been proposed—the objection to which is, that unless we take note of the physical conditions—such as whether soft, tempered, etc.—we shall have very different magnetic readings for what would stand as the same material.—*London Engineer.*

◆

CORRUGATED DISK PULLEYS.

In a recent issue we illustrated a pulley of this class, which was corrugated concentrically, and, by what seems a curious coincidence, we find in the London *Engineer* a similar pulley illustrated, recently invented in England. In this pulley the corrugations are radial and angular, instead of, as in the American pulley, concentric and curved. Moreover the English pulley can be made of ordinary plate-iron, as shown in the second figure. thereby doing away with the necessity of special plates and sheets, and costly stamping machinery.





◆

James H. Reid, Esq., of Detroit, advises us that he recently established a new branch of the Marine Engineers' Benefit Association, No. 43, at Port Huron, Mich., with the following officers : Walter P. Treleaven, president ; Jas. H. Fitzgerald, vice-president ; John H. Hagan, treasurer ; Geo. Bonner, recording secretary ; Chas. Conshaine, fiscal secretary ; H. W. Maines, corresponding secretary ; Luther W. Armson, chaplain ; Geo. Miller, conductor ; Robt. Cameron, doorkeeper. These are all good practical workers, and will add strength to the cause. We congratulate Brother Reid upon his result ; he is a most indefatigable worker.

◆

Water gauge glasses sometimes break where exposed to draught, and it is suggested by a German technical paper, the *Industrie Blatter*, to have two tubes, an inner and outer, the latter, of course, serving as a shield.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

FROM ENGINEERS' ASSOCIATION No 2, CHESTER, PA.

EDITORS MECHANICAL ENGINEER:

This association was organized in this city one year ago, Feb. 14,1883, and celebrated its first birthday Saturday evening, Feb. 16th, with exercises appropriate to the occasion. The members number 25. The association has the hearty sympathy of many of the manufacturers of this city, who have contributed about $150 to procure books and instruments to advance the members in their profession. By this aid the association has been able to purchase an indicator and a planimeter, for the use of the members, They hold a meeting every Saturday evening, in the Post Office Building on Edgemont Ave. to discuss subjects pertaining to the profession. The supper was a grand affair and was attended by many manufacturers and other invited guests. There were many songs sung, with appropriate music, and several recitations. There were displayed on a table a large number of indicators and a planimeter, a Hopkins, Elliott-Richards, Thompson, Thompson improved, Tabor, Crosby, and Crosby improved, and also a special Crosby improved, having a 3⅛ inch drum made of aluminum.

The association invites manufacturers and steam engine builders to assist them in increasing their library, as it is small; also in anything pertaining to their business, viz.: apparatus, books, catalogues, and drawings will also be thankfully received and acknowledged. After supper Mr. President Newell read a paper on the workings of the society for the last year, and its object. After which Mr. N. W. Williames, President of the Keystone Council No. 1, Stationary Engineers of Philadelphia, made an address, partly given herewith:

Ladies and Gentlemen and Brother Engineers.

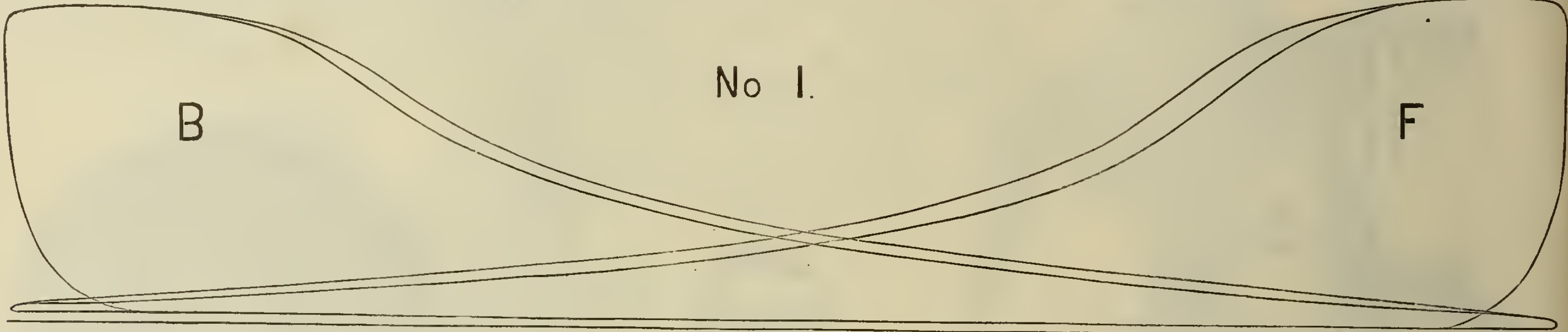
"I am pleased to see the engineers of Chester, Wilmington, and Philadelphia so well represented here, for sociables among engineers are steps in the right direction. Through them we become acquainted personaly, and can exchange ideas upon everyday occupations. By mastering our profession theoretically and practically, we become powerful individually and collectively, and rise in the scale directly as we exert ourselves. It has been charged by some that we are a modified form of trades union organization. The absurdity of this is seen at once by reading our constitution. This strictly forbids strikes, or any interference between the employer and his engineer with regard to wages. Neither is it to be used for political or religious purposes. This in my judgment makes all engineers free and equal without distinction as to nationality, and I am proud to say that I offered it as a corner-stone of the constitution at the first convention in New York. This slander upon the objects of our institution has been so recently repeated, in my own city I am sorry to say, by men who should know better, that I feel warranted in making this brief refutation.

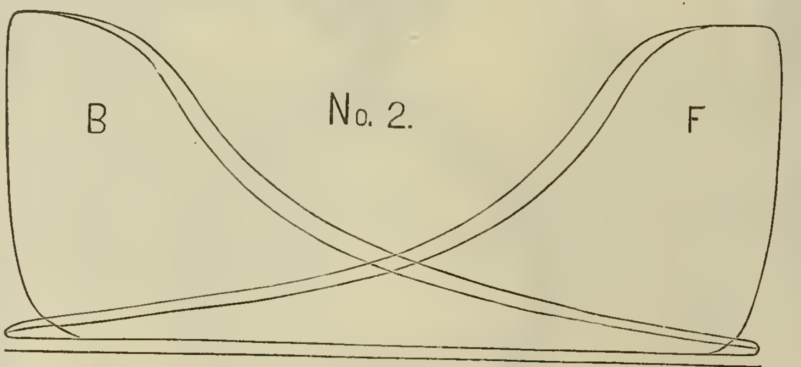
By meeting once a week and comparing notes we are in a short time able to demonstrate, practically, to our employers the advantage attained by our organization, not only by a saving in coal, oil, waste, and many other little things that cost money, but by the greater advantage of a uniform speed; for we must remember that no establishment can manufacture first-class goods without this. When we have proved to employers that we are masters of our profession, and that their establishment where one of our members is employed always starts on time, that we make ten hours per day without stoppage of our own doing, or of our own causing—always being faithful to our duty—there is no employer that will not say, when we demonstrate these things, that we have achieved our ends, and justified the objects of our association; for employers are discriminating, and see for themselves that, merely as an investment, the best man about the place in his line, is the member of the National Association of Stationary Engineers. As to boiler explosions, we know there is no mystery attached to them other than malconstruction, carelessness or ignorance in management; boilers handled intelligently and properly constructed, are then as harmless as teakettles. I feel confident that when we have demonstrated all the facts above set forth to employers, through the logic of cause and effect, they will be the first to contribute means to purchase books and apparatus to educate us in the higher branches.

We can all look back to the days of our inexperience and see the amount of material we have wasted for the want of knowledge. And we know how easy it is to waste five or ten dollars per day for the want of apparatus at hand to detect it, and these trifles, so called, many days in succession, put the balance on the wrong side at the end of the year.

To our young members present I would say : Never be afraid to discuss your business with older men under the impression that they know more than you do, and will find out that you know less than they do. The only way to learn is to study, and ask questions. Don't be afraid of asking even those who believe they know it all. The men that know it *all* are all dead, and I would advise every young engineer to keep *Silliman's Physics and Chemistry* at hand to study along with every day's practice, as it will assist him to understand phenomena taking place every day. The grand results attained in modern engineering are not obtained from knowing how to shovel coal and start an engine, but from a combination of sciences.

I have brought with me one of my indicators which has a drum 3⅜ths inch in diameter, weighing less than 14 drams. It was made for me of the metal aluminum; it is the lightest metal known, and is capable of taking a card 9 inches in length, up to 500 revolutions per min. I have here some cards taken from a Corliss engine built by Wetherell & Co., of Wilmington, Del. (a 24× 48, 70 revolutions, 75 lbs. boiler pressure, with load ranging from 200 to 350 horse power), which has been running for eight years. Four years of that time it ran 23½ hours per day without any stops for repairs. These cards, I think, will speak for themselves as far as engines performance is concerned. Some of the cards taken with this aluminum drum and a 40 lb. spring were traced seven times, which shows accurately the uniformity in speed of the engine.





These cards will average about 230 horse-power, and I will distribute them among you, as they will answer for samples for setting your valves by, subject to your criticism.

These valves were set by sight, with the rocker arms plumbed, ¼th of an inch lap on the exhaust valves, and ⅛th of an inch lap on the live-steam valves when hooked up, and the live-steam valves fish-tailed ⅛th of an inch. They were afterwards adjusted by the use of the indicator. The cards show 95 per cent. of boiler pressure in the cylinder. The indicated horse-power is 90 per cent. of the gross, deducting back-pressure and compression. The mean effective, indicated, is 26½ lbs.; the indicated horse-power is 201·25, and the indicated back-pressure, 22·78 lbs., making a gross indicated horse-power of 224·3. This is when cutting off at less than 1-5th. The theoretical consumption is less than 22 lbs. of water per horse-power. This engine runs noiselessly, and the compression is about right for this speed. With no lead on the live-steam valves, No. 1 card was taken, with the aluminum drum; card No. 2 was taken with a regular 1½ inch drum, and a Crosby improved indicator.

While these cards were being taken the exhaust steam was circulating through over 25,000 feet of 1-inch pipe for warming the factory, heating over 15,000 gallons of water for washing purposes, with exhaust open to the atmosphere, and all the condensed steam returned to the boilers, under a back pressure of less than a pound and a-half above the atmosphere. Ladies and gentlemen I thank you for your attention, and I hope our friend will be able to beat the performance of these cards.

A vote of thanks was tendered Mr. Williames for his instructive remarks.

JAMES D. ROSTRON, Sec.
Chester Dock Mills, Chester, Pa.

[We shall be pleased to receive reports from other Engineers' Associations.--EDS]

A DEMAND FOR BETTER DRAFTING PADS.

Editors MECHANICAL ENGINEER:

Draughtsmen who have used drawing-paper pads know how convenient they are. I have had my students make use of them for a long time; in fact, when the idea of this pad-form first occurred to me as desirable for drawing paper, it was necessary to have the pads made to order, as they were not in the market; and a prominent firm in New York would not make them except as ordered. I find that while they can now be obtained at any dealers in drawing materials, they are not so well made as formerly. They "curl." The reason, probably, is that the pasteboard back was too wet, relatively, when the sheets of paper were fastened to it. On drying, the back contracted more than the paper, and the drawing surface of the paper became convex. I have remedied this defect, in part by cutting, through the middle of the back, a line parallel to the axis of curvature, or by separating the sheets from the back and then fastening them together properly.

What is needed is that these pads should be properly made at first; and the purpose of this communication is, if possible, to induce draughtsmen and draughting students to bring whatever pressure they can upon the dealers in these pads to have them so made.

ISAAC E. HASBROUCK.
RUTGERS COLLEGE, NEW BRUNSWICK, N. J.

* * *

PULLEY FLY WHEELS. THE LICENSE QUESTION.

Editors MECHANICAL ENGINEER:

We had at a late meeting of our Association a discussion in regard to belting from the balance-wheel of an engine. Does it, or does it not, diminish the effectiveness as a balance-wheel? Supposing the balance-wheel to be twenty feet in diameter, and the driven pulley ten feet in diameter:

Then supposing we take a pulley ten feet in diameter and place it beside the balance-wheel and belt from it to a pulley five feet in diameter, doing the same work and running at the same speed? Will there be any gain by the change, and if so, what?

The question has been referred to you for settlement, or your opinion on it.

I am sorry that No. 4 Nat. Assoc. of Kansas City is taking the ground it does in regard to licenses for engineers, as it is a benefit to the trade. If engineers will use their influence to procure a Board of Examiners from the profession, men of integrity and ability, I think there would be no cause for complaint.

It is not necessary to have a printed list of questions to examine candidates by, but, by having men on the board that are thoroughly posted in the business, it is easy enough to detect a "book engineer" from a man who has had actual experience in an engine-room.

In our Association we must *know* that an applicant has had active experience before he can become a member. I think this is a good rule to follow in regard to licenses.

ATCHISON, KAN. T. C. LOGAN, *Sec.*

[We do not think the changes our correspondent mentions will be noticeable in the working of an engine.—EDS.]

* * *

TECHNICAL PAPERS.

Editors MECHANICAL ENGINEER:

In No. 4 of this volume I saw a paragraph which said: "*No other countries than America and England have technical periodicals.*"

Most every one will notice that this is at least a misunderstanding. I will give you here a list of a small number of German technical papers, which are devoted to "mechanical engineering, applied mechanics, and the allied arts," but I do not mention the periodicals for architects. You will excuse the German titles:

Dingler's Polytechnisches Journal, Uhland's practischer Maschinen Constructeur, Gesundheit's Ingenieur, Zeitschrift fur Eisenbahn kunde, Polytechnisches, Centralblatt, Eisenbahn Zeitung, Der Ingenieur, Deutsche Industrie Zeitung, Zeitschrift fur Berg, Hulten u Salinen Wesen, Wochenschrift des Vereins deutscher Ingenieur, Monatsschrift des Vereins deutscher Ingenieur, Zeitschrift des Gewerbe Vereins un Hanover, Zeitschrift des Bayrischen Gewerbe Vereins, Die Muhle, Zeitschrift des Hannoverschen Architecten u Ingenieur Vereins, Zeitschrift des Wiener Architecten and Ingenieur Vereins, Zeitschrift des Bayrischen Architecten and Ingenieur Vereins; in all 18. Also a large number of papers devoted to specialties as surveying, carriage building, Rueben zucker (Glukose) industrie, etc.

I hope this very incomplete list shows you that the Germans have and read technical papers. As to other European nations I know about six French papers, but I am sure that there are as many as in Germany.

As to the number of papers I state here that the United States of America (not America) are far ahead; as to the quality I do *not* state this.

STAMFORD, CONN. A. J.

[We print this correction with pleasure, and will thank our readers to advise us at all times of any erroneous statement in THE MECHANICAL ENGINEER. The tenor of the paragraph alluded to by our correspondent concerned chiefly, class papers; that is such publications as our own, the *American Machinist* and others which depend for support upon professional men in certain trades; not upon amateurs or persons who have a liking for technical matters generally. These latter may be properly called eclectic mechanical reviews, for they touch upon generally, and present broadly, certain features without entering into detail. It is probable, however, from the titles of German technical papers our correspondent mentions that many of them are of this latter class.—EDS.]

◆

RESPECTING STOP-VALVES.

Editors MECHANICAL ENGINEER:

I am having a controversy regarding the proper manner to connect a globe-valve to a steam pipe, which I hope you will decide.

I contend that a globe-valve should be placed so that when the valve is closed the pressure will be on top of it and tend to keep it closed.

My friends claim the opposite, notwithstanding the the fact (especially with large valves), that after they are somewhat worn they will open of themselves; also that the pressure has a constant tendency to open the valve, causing liability to accidents, etc. Their assertion is that it is more convenient to pack the stuffing-box with steam on when the pressure is underneath.

H. CRISMAN, *Eng. Giant Powder Works.*

WEST BERKELY, CAL.

[We always put up globe-valves with steam on top. Mere convenience of packing has no consideration with us. If we were packing a globe valve every day it might have some weight, but the other disadvantages of leakage, chances of accident, etc., are more serious. —EDS.]

◆

DIMENSIONS FOR BRICK STACK WANTED.

Editors MECHANICAL ENGINEER:

Please note we intend building a brick smokestack to replace an iron one, and would be very glad to hear from such of your subscribers as have knowledge of the matter as to the proper proportions.

We have two 40-inch by 22 feet boilers with four nine-inch flues in each. I would like to know what the diameter and height should be and the thickness of the walls at the base, and in fact all the particulars of importance. As I think the discussion of this matter would interest many of your readers, I would like to have the substance of this appear in your paper.

COULTERSVILLE, IND. J. B. B.

[Rules of such writers as Bourne, Scott Russel, Elswick and others, are as follows: Area equals twenty square inches per nominal horse-power; height twenty times internal diameter. Another rule is:

$$\text{Area} = \frac{\text{area fire grate}}{\sqrt{\text{height}} \times 1{\cdot}58}.$$

The bond adopted is one course of headers to four of stretchers. Outside diameter at ground line not less than one-tenth the height. Forty-five feet is an ordinary height of chimney for single boilers —EDS.]

◆

FACTS ABOUT A BOILER INSURANCE COMPANY AND THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER:

One of your contemporaries has again tackled the National Association and a proposed boiler insurance company. It quotes an article from your columns and, in a mild way, implies that your article, the President and Secretary of the National Association do not tell the truth. We have written the facts to the paper aforesaid, but as it is doubtful whether they will print it; we now send you the resolution as passed at Chicago.

"*Resolved*, That a committee of three be appointed to prepare a plan for a boiler insurance company, to be undertaken by this association, *and that they report at the next meeting of this body.*"

There is the molehill that certain parties have made such a hubbub about, and tried to magnify it into a mountain. I will further state that we were ordered by the National Association *not* to print the above in the minutes, or give them to the press. Not because we were in any way ashamed of the resolution, or of being found in so honorable an undertaking as such a venture would be, but rather to escape the cheap notoriety we would receive from certain parties. At the passage of the resolution, reporters of the Chicago papers were in attendance, and they heeded our request, but some delegate, or delegates, were untrue to their trust. The reader can draw his own inferences.

One thing is certain; those who have been so loud to condemn the move have used the expression, "Engineers have no right to enter upon a business venture requiring experience," and have implied that engineers must always be engineers, no matter what business talent they have. If engineers stated their true opinion of such papers, I for one would never want to see or hear of their publication again.

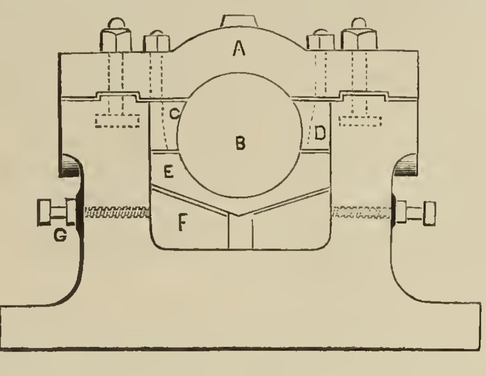
DETROIT, MICH. A. M. DAVY, *Sec'y.*

PILLOW BLOCK FOR HIGH-SPEED ENGINES.

Editors MECHANICAL ENGINEER:

In the December 8th, '83, issue of your valuable paper I noticed a description of a method of adjusting quarter-boxes of pillow-blocks. I inclose herewith a sketch showing an arrangement which we find very good for adjusting the arbor in our direct acting saw-mill engine shafts. These engines run from 600 to 725 revolutions per minute, and as they are most always in charge of "sawyers" we find it necessary to provide simple methods for adjustment.

Referring to the sketch: The cap, *A*, is held down by four *T*-head bolts, working in slots cast in the jaws of the block. As the wear is down and sideways, we adjust this cap, only about once in a year. The quarter-brasses, *C*, are adjusted by means of wedges, *D*, similar to those shown by you. The shaft, *B*, lies in the bed-box, *E*. Below this are two triangular, planed, iron blocks, *F*, having a bevel to correspond with the lower beveled faces of the piece, *E*. When the shaft wears down into *E*, the pieces, *F*, are set in, by the screws shown, until the shaft, *B*, bears sufficiently against the cap, *A*. The quarter-boxes, *C*, are then adjusted by the wedges, *D*, until the "wrist-plate" of the engines shows the shaft to be at right angles to the adjusting spots planed on the bed-plate of the engine.



With ordinary care these engines running at the high speed stated give great power, and cost less for repairs than the engines run at the ordinary speeds common to belt-mills. Having been in successful use for twenty years, they may be said to have passed the experimental stage.

WARREN, O. W. C. PENDLETON,
(*Spangenberg, Pendleton & Co.*)

◆

NOTES ON CYLINDER LUBRICATORS.

During the last few years automatic, or sight-feed cylinder lubricators have grown into general use, the high piston-speed now adopted by many engine-builders having had much influence in bringing about this change in the manner of feeding steam-cylinders with oil. The old system was wasteful, uncertain and unsatisfactory, and the engineer can now see and regulate the supply at will. A saving of fifty per cent. in quantity used is obtained over the old system, and it has been demonstrated that the internal wearing surfaces will run longer without repairs, for friction is perceptibly reduced by properly graduating the lubrication.

There are still some objections to not a few of these new devices which I will note; one is needless complication and frail construction. Some inventors seem possessed with a chronic desire to make things as complicated as possible without rendering them absolutely useless. Many simple machines have been remodeled and useless parts added, then heralded as great improvements, when, in fact, the alleged improvements were no more necessary than an extra handle to a sad-iron would be. Steam users are often deceived into purchasing a "gim-crack" device which is only one more useless detail added to the plant. After such an experience a few times one is liable to look with distrust upon any new contrivance until its utility has been established. This is one reason why machines having merit are sometimes a long time getting a foothold on the market; an invention that is found impractical, soon sinks into insignificance unless it is re-invented and its defects in construction and operation rectified. One would be surprised at the many contrivances devised for injecting oil to steam cylinders. The principles of many are very good, but the details are not properly carried out, and *vice versa.*

I once took charge of an old trap of an engine, badly worn, especially in the valve-gear. The eccentric-straps etc., rattled badly, no provision was made for oiling the cylinder and valve, except a half-inch valve and nipple screwed into one end of the chest, through which a quantity of oil could be poured at morning and noon previous to starting. This was all the lubrication the cylinder received during the day. The proprietors concluded that this device was good enough and answered the purpose admirably. I proceeded, however, to construct a cup of old pipe and fittings which I found about the premises; this cup had a glass-gauge and water-column somewhat similar to Seibert's first water-column cup. The lubricator held about 7½ cubic inches of oil which was sufficient to lubricate the cylinder two days. After attaching this cup the annoyance caused by the eccentric chattering etc., ceased; I called the proprietors attention to this and his reply was:

"It don't oil the eccentric and rocker-shaft too, does it?"

This lubricator was in use several years when I stepped out, and a fossil stepped in, who knew all about oiling cylinders, so he needed no instructions. He filled the cup and opened the feed-valve wide, letting steam into the glass suddenly, which was of course broken by expansion. The sequel to this was that the cup was consigned to the scrap-heap, and, doubtless, the fossil is using the valve and nipple yet.

There are so many conditions which have an influence on the quantity of oil necessary to properly lubricate a steam cylinder that no cast-iron rules can be laid down which could be safely and profitably followed in all cases, this can only be determined by practice. Two drops of good oil is usually sufficient to properly lubricate a cylinder 10″ × 24″, making 80 revolutions per minute. The surface passed over by this piston is 837·76 square feet per minute; the surface passed over by a 20″ piston at the same speed would be 1675·52 square feet, which, if the above rule held good, would require four drops of oil per minute; or if the piston-speed was doubled eight drops would be necessary; but as all the conditions are not the same in any two cases the above is only an approximation under assumed conditions.

I would condemn the procedure of governing the supply of oil, according to the capacity of the cylinder, before the safety and efficiency of such a procedure was demonstrated by practice; but I would recommend a careful consideration of all the details so as to arrive at the reason why a disparity exists in quantity of oil used in two cylinders of the same dimensions, under apparently similar conditions.

It has been demonstrated by practice that oil should be injected into the steam-pipe a foot or so back of the starting-valve, as the current of steam carries the oil directly where it is most needed. Moreover, by this method the lubricant does not enter the cylinder in a mass, but in mist form.

Old time mechanics used to say that cylinders of stationary engines needed no other lubrication than that of the steam itself. I have seen cylinders in fine condition after years of use which were never lubricated, but the piston-speed was very slow compared with modern speeds. I hardly think the old-timer would succeed in running our modern high-speed engine cylinders on the non-lubricating principle.

The theory of a lubricator may be correct, but its successful operation will depend upon accurate conceptions of its designer of diversified conditions likely to exist when the thing is put to use. Those actively engaged where they are brought in daily contact with machines constructed on the theory of some inventor, will observe many practical failures, not because the the principle was wrong, perhaps, nor for lack of ability of the designer, but through a want of practical knowledge.

SMOKE ARCH.

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The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

MODERN TOOLS.

It is sometimes asserted that modern machine tools remain substantially the same as they were a third of a century ago, and that the changes, if any, are so slight as to be hardly worth consideration. Of lathes particularly, it has been said that, beyond some few refinements in mechanism. the productions of 1884 are not much ahead of those of 1850. If this is said of individual tools or isolated cases it is correct, for there are lathes in existence to-day which were built thirty years ago, and, so far as exact workmanship upon parts and correct design are concerned, they will hold their own with any modern tools. Taken in gross, however, the assertion that no advance has been made in modern machine-tools in the past twenty-five years is incorrect. To be sure spindles revolve towards the tool in modern lathes just as they did when the first artificer made one; they also stand on legs and have cone-pulleys with varying velocities, but in other respects the modern lathe in general is far ahead of the average lathe sold in open market when the present generation were at school. The points of superiority lie in details, in workmanship, and in material. In tool building, as in all other things, experience has been the best school, and the result is apparent in better average work more cheaply produced.

He will be a shrewder prophet than we are who can say what the lathe of a half century hence will be. Perhaps in that day there will be no lathe, its office being supplanted by other processes as yet undreamed of. It is by no means improbable that circular forms will yet be produced at a tithe of the cost of the present methods. Even at this day we believe shafting could be rolled so true that it could be ground absolutely so, much cheaper than it can be turned. Perhaps in the future some process will be invented which will be capable of universal adoption to meet any desired want.

WAITING FOR OPPORTUNITIES.

Many friends have written us speaking enthusiastically of our last issue, and the *prima facie* evidence it bears of success; also, our contemporaries have risen to the occasion and paid us so many extraordinary compliments that we hope our heads will not be turned. These friendly attentions are not forgotten, and we shall watch for opportunities to repay them with interest.

INTERESTING FACTS ABOUT HEAT.

Conduction and convection of heat are terms often used in boiler-tests for evaporation, and in engine trials, but many do not fully grasp the meaning of them in the application mentioned. Heat convected is simply heat conveyed. For instance, in a cylinder-boiler the stratum of water lying next the shell is first heated, and conveys the heat to the mass above by the bubbles of ebullition rising through it. Heating by conduction is simply the passage of heat through the material of which the body heated is composed. Solids heat by conduction quicker than semi-solid, or porous bodies, for the latter, permeated as they are by air, will oppose the passage of the heat-fluid through them.

Air is one of the worst conductors known. Next come fur and fibrous materials. We wear woolen in winter and say that it is warmer than cotton, but both materials in a given atmosphere have precisely the same temperatures. Why wool seems warmer than cotton is that, being a non-conductor, it prevents the animal heat of the body from dissipation. Linen in summer feels cool for the opposite reason, being a better conductor than wool, it abstracts the surface heat and leaves the body cool. In summer days the air is stagnant, at times, and we swelter. So soon as a breeze arises we feel cooler, for the animal heat is carried off by it.

When heat is not directly applied to a body by conduction or convection, it may be heated by radiation, but this is one of the slowest sources of transmitting heat. According to the nature of the surface, so is the rapidity of radiation. Dull, rough, and black surfaces lose heat more rapidly than bright ones. A cylinder head painted black is therefore more wasteful of heat than a bright one.

It is equally a mistake to paint steam radiators or stoves in white or light colors. They should be dark colored, and, where possible, black-leaded, for next to lampblack plumbago is the best radiator known. Taking lampblack at 100, crown glass comes next at 90 and black-lead next at 75.

METHODS OF LUBRICATING BEARINGS.

During a discussion of the friction experiments recently made in England by Mr. Beauchamp Tower, and published by us in the current volume, various members of the Mechanical Engineers Institute made remarks upon the subject mentioned in the caption above. We quote from *Engineering.*

"The great point in using oil was to pour it, and not to dribble it on to the running surface. The reason why this was not done in the cases where it would be most advantageous was that until these experiments its value had not been generally recognized. And yet it was evident that it was not entirely unknown, because at trials of marine engines oil was poured over the working parts lavishly. Instead of this being an exceptional condition, once in the life of an engine, it ought to be the normal state; but the oil instead of running into the bilge as it now did, ought to be used over and over again. There was a great difference in the amount to which working surfaces could be loaded, according as the pressure upon them was constant or alternate in direction. On locomotive axles a pressure of 300 lb. per square inch was about the limit, while the crank-pins would carry 1000 lbs. upon the same area without seizing. Mr. Halpin had pointed out that at high speeds a considerable amount of the energy of the steam in the earlier part of the stroke, was absorbed by the weight of the piston and connecting-rod, and this relieved the crank-pin of part of the pressure, amounting at forty miles an hour to one-third or one-fourth. The Committee had met with one fact that had come upon them unexpectedly. In constructing the apparatus they had used they had provided a large dash-pot to prevent oscillations, but in practice they found that they did not require it. The journal had been run at such a rate that increased friction followed an increase of speed, and under these conditions the indications had been perfectly steady. In the earlier trials, before the oil bath was used, this had not been the case, and there had been a good deal of oscillation. They kept the oil bath at a constant temperature, and consequently all the conditions were constant, more than could be said for tests made at varying temperatures, and with the common method of lubrication.

When investigators found that the friction decreased as the speed rose, it was due not to the variations of velocity, but to increased fluidity of the oil, owing to the rise in the temperature. One difference between Professor Thurston's experiments and the Committee's was that the former were tried at slow speeds, and the latter at high speeds."

What is said in the discussions above, of oil being used over and over again would, we think, be objected to by engineers if the bearings were to be kept in good condition. Oil that has gone through bearings in actual work is not fit for use again until it has been thoroughly filtered, or, at least, until the metallic dust of attrition, and dirt collected in running down the frame has been deposited. This is particularly the case if it has gone into the bilge at any time.

IMPROVEMENT IN MARINE BOILERS.

NEW STEAM-YACHTS.

The steam yacht now building for Mr. Elbridge T. Gerry from designs, and under the superintendence of Mr. G. Hillman of this city, will have some improvements in the construction of her boilers that have been found to greatly increase both their safety and steaming qualities. The boilers, of which there are two, are of the ordinary "Scotch" pattern, but the front head of the back connection, or, more properly, the back tube-sheet, is extended on each side to the shell, thus cutting the boiler almost into two parts, except at the bottom, which is left open up to the under side of the furnaces, and at the top above the upper edge of the back-connection.

The action of the under-grate blast is to make the back-head of the back-connection very effective heating surface, and produce a rapid ascending current between it and that end of the boiler. This current can, of course, only be supplied from the body of water lying below and between the furnaces, since there is no communication on the sides.

This rapid and continual circulation has been found to greatly increase the efficiency, while, practically preventing priming entirely.

Two boilers, exactly similar only smaller, were built two years ago for the yacht "*Sophia*" by Mr. Wm. F. Taylor, and have proved themselves greatly superior to the ordinary "Scotch" pattern.

The engine for Mr. Gerry's yacht is of the inverted, direct-acting compound type, with one high-pressure cylinder of twenty-two inches diameter, and one low-pressure cylinder of forty inches diameter, both of twenty-six inches stroke.

With one hundred pounds steam pressure, cutting off at half stroke, and making one hundred and sixty revolutions per minute, they will develop over one thousand horse-power indicated.

The propeller is to be eight feet diameter and thirteen feet pitch.

The boilers, two in number, are ten feet six inches diameter and eleven feet long, with two furnaces in each, and will contain about fifteen hundred square feet of heating surface and forty-five and a half square feet of grate surface each.

The coal bunkers are to have a capacity of one hundred tons, which would be sufficient for over ten days steaming.

The vessel will be lighted with the Edison electric light throughout, will have a refrigerating machine using compressed air, and a condenser for making fresh water for cooking.

Two Sturtevant blowers, driven by an independent engine and blowing into a closed fire-room, will furnish the blast for the boilers, and in summer time will take the air required for this purpose from the cabins and staterooms, so as to keep them cool and well ventilated. Mr. Hillman has neglected nothing that will tend to make the yacht comfortable or seaworthy.

The Harlan and Hollingsworth Co. have laid the keel, and work is progressing rapidly on all the other details, while the large steel-yacht building for Mr. Astor by the same company, and also from the designs and under the superintendence of Mr. Hillman, is nearly all plated, so that both will be ready for launching early in the spring.

TALKS ABOUT THE STEAM ENGINE.—No. X.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

The connecting-rod is in line with the cylinder twice during each revolution, and has its greatest angular position when the crank is at right angles to the center line of the cylinder. The connecting-rod, however, requires the greatest clearance when the crank forms an angle of about sixty degrees with the center-line of the cylinder; clearing in that position it will clear the guides in all other positions.

* * * * * *

The connecting-rod has so many different stresses put upon it as to render an accurate calculation of its dimensions exceedingly laborious to the best of mathematicians.

It is supported between two pins, about which it is free to turn, and therefore in a horizontal engine is deflected by its own weight.

It supports the fling due to its own inertia when the crank is at right angles.

It is twisted by the friction of the pins in their boxes.

It takes the alternate pull and push of the total steam pressure upon the piston.

When there is no compression, or lead, it has to take a blow from the steam equal to a veritable explosion, and finally, it has to transmit stresses due to the inertia of the piston, piston-rod and cross-head.

Fortunately, the stress due to the steam so much exceeds all others as to permit us to neglect the rest in most cases, and to provide for them by an arbitrary taper in the case of high-speed engines.

The stress due to the steam-pressure makes the connecting-rod alternately a tension-rod and a column fixed at both ends, but free to turn about them.

In most cases occurring in practice the connecting-rod is from four to eight times as long as the crank; five might be said to be the average where no special reason exists for other proportions.

The stress on the connecting-rod is slightly greater than that on the piston-rod [3 per cent. greater for a length equal to 4 cranks] when the crank is at right angles to the center line of the steam-cylinder. This difference between the stresses on piston and connecting-rod becomes less as the connecting-rod becomes longer.

As the connecting-rod is free to turn about both ends it resolves itself into two columns of half the length fixed at the middle of the rod, and free to turn at either end.

Of course, these columns, are subjected to excessive shock and jar, and, therefore, must be much stronger than for a similar case supporting a dead load.

We provide for this by taper. In slow moving, large engines, the taper is usually ⅛th of an inch per foot from the center to the necks, which should be of the calculated diameter.

In high-speed engines in which the fling of the rod, and inertia of the reciprocating parts are all greater, and the liability to hot pins especially great, we must provide for these by making the taper about the same per foot, but beginning at the cross-head end. We must increase to the crank-pin end, giving the rod a rectangular shape with its smallest dimension of the calculated diameter of round rod required,—that is, there is no taper save in a plane at right angles to the pins.

A hot crank-pin will make the boxes seize on, and twist off the neck nearest it, if it does not itself give way before it is discovered.

A wrought-iron connecting-rod will have the greatest liability to rupture by buckling when its diameter in half inches is less than its length in feet.

Its liability to rupture by crushing is the greater when its diameter in half inches is greater than its length in feet.

We need not consider rupture by tension.

A steel connecting-rod will have the greater liability to rupture by buckling when its diameter in ¾ of an inch is less than its length in feet.

Its liability to rupture by tension is greater than to rupture by compression.

Let us take the case of a wrought-iron connecting-rod.

I have already called attention to the increase of stress in the connecting-rod due to its angular position, and will add that, for a connecting-rod longer than four cranks, its effect on the diameter of the neck is unimportant.

RULES FOR WROUGHT IRON CONNECTING-RODS.

When we consider the crushing stress—

The rule is:

Take the square root of the boiler-pressure in pounds per square inch.

Multiply this by the diameter of the steam-cylinder in inches.

Divide this product by 56.

The result will be the diameter of the rod in inches to resist crushing.

Of course, a condensing engine requires the addition of 15 pounds to the gauge-pressure.

If the above rule gives a connecting-rod whose diameter in half inches is less than its length in feet, we must use the following rule to prevent buckling:

Divide the length of the connecting-rod by the length of the crank, and square this quotient:

Square the diameter of the steam-cylinder in inches:

Square the length of stroke in inches:

Take the boiler-pressure in pounds per square inch:

Multiply these four quantities together and divide the product by 6,916,000; *extract the fourth root* [*the square root of the square root of the quotient*]. *The result will be the diameter of the connecting rod in inches sufficient to prevent buckling.*

Taking the same example as before, we have:

Boiler-pressure, 40 lbs. per square inch:

Length of stroke, 48 inches:

Diameter of the cylinder, 32 inches:

Length of connecting-rod, equal to five cranks:

The square root of 40 equals, 6·24 (see Haswell, page 210.)

```
       6·24
         32
       ----
       1248
      1872
      -----
  56)199·68(3·56 inches.
      168
      ---
       316
       280
       ---
       368
       346
       ---
        32
```

3·56 inches is sufficient to prevent crushing.

The length of the connecting-rod is 2 ft. × 5=10 ft., and, as the result gives only 7 half-inches for the diameter, we must use the rule for buckling.

The connecting-rod equals five cranks: the square of 5 is 25;

The square of 32 inches is 1024.

" " " 48 " " 2304.

The boiler-pressure is 40 lbs.

```
25×40=1000        2304
                  1024
                  ----
                  9216
                 4608
                2304
               -----
          6916(2359296(341·13
                20748
                -----
                 28449
                 27664
                 -----
                  7856
                  6916
                  ----
                   9400
                   6916
                   ----
                  24840
```

The square root of 341·13 is 18·47.

" " " " 18·47 is 4·3 inches, which is a sufficient diameter at the neck.

Since it is intended for a slow-moving engine it should be largest at the middle, and there have a diameter of about 5 inches.

A fillet around the middle of a connecting-rod is of no possible use.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER XLIX.

A correspondent in one of your recent issues asks a question which I presume thousands of other persons have asked, and will continue to ask for all time to come, and be none the wiser, for the answer no man knoweth. The question was:

> "Will the time ever come when mechanical problems can be seen alike by different men pretending to understand such matters?"

I said the answer to this was unknown, but I can give one, howbeit it is no solution of the question, and this answer is: No; it will never come.

A good many savants have located the Tower of Babel satisfactorily (to themselves); many others have boldly denied that there ever was such a structure; that it is merely typical of the differences of opinion which exist, and sets forth to some extent, allegorically, the variableness and fickleness of the human mind.

I do not know much about the Tower of Babel, and if I were to be candid, would say I cared less; but it seems to me that it does set forth the differences which exist in opinion, and the many sidedness of things which have only one side—to the man who has settled all things.

Not being quite so old as Methuselah, or so wise as Solomon, I have not seen so much as the first, nor do I know as much as the last. So frank a confession should disarm the most cynical critic, but even in my narrow orbit I have seen men daily trying to convince themselves that what they wished to do was the most expedient thing to be done. Their mechanical wills, or notions, were mistaken for devices that the world wabbled in its course for want of, and they would not be satisfied until, their money all gone, their credit out at elbows, the fire alike dead in their houses and their hearts, compelled them to stop.

I do not here allude to disappointed inventors, or persons worshiping false gods in mechanical matters, but to those who have made a success of a certain kind. I recall an individual of high mechanical and mathematical attainments who conceived the idea of a certain machine. He made it, formed a company to manufacture it, did manufacture and sell it in the open market, and failed completely to establish it. This man associated with himself shrewd capitalists, good business men, and able experts in his line, who were interested in trying to make water run up hill. It did so run, apparently, but it also found its level at last, and, to drop metaphors, so did the machine.

During the progress of the experiment—for I call it such—various uninterested and sceptical persons volunteered their advice (individuals will do just this thing whether invited to proffer it or not), but all their prognostications and predictions of certain failure went for nothing. To those who believed in the scheme these people were merely prejudiced, bigoted, and even besotted in their ignorance, and their expostulations had no more effect than the wind has on the Pyramids.

Now, how can we account for this? It is fact as regards the occurrence, and made noise enough in the mechanical world in its day. Here was a man thoroughly versed in mechanics, mathematics, and natural philosophy; he was also of mature years, but he ignored all these, and tried to build up a trade on a shaky foundation. With him were others; these last all saw the fallacy after the fact, but I think the principal believes to this day that he did not have what is called "a fair show."

A few lines back I asked how we could account for these occurrences, and I can only answer that we can't account for them, except from the Tower of Babel basis, which is, I admit, unsatisfactory. Whether it is that this world would be monotonous and dull unless we had the stimulant of differences in opinion in feature, form, dress, temperament—what not—is more than one man can decide; in common with others, I only ask why it is?

Of course, when persons know nothing of the business they undertake, they have to purchase their experience, and it depends upon whether their aims are legitimate or not, and their natural ability, whether the experience so bought is of any value. It is no hazard to predict that an ignorant person will fail when he essays unfamiliar things. If this was a sermon, it ought to be called "The springs of human action," or something similar; for when we can divine why men do certain things, and establish a key that will unlock the mind, we hold the solution of all erratic action.

Here is another case: A certain person has established a high reputation for learning of a specific kind. He has written many books, and is well known in the world of letters. He has a reputation for integrity and probity of character, and is known to be above mercenary motives of any sort; at all events no charges of this kind have ever been even hinted at. Sometimes his indorsement of commercial schemes of undoubted merit have been sought and paid for, which is a perfectly legitimate transaction.

But now comes another aspect of the matter: This man is not in want, he has not lost caste, his reputation is as ripe as his years; but extraordinary certifications have recently appeared, stating, in effect, that he has found in some instances, that more water can be got out of a well than there is in it. In other words, he has asserted that the efficiency of some machines—well known to be inefficient as compared to others—is equal to the best. The cynic and the scoffer will say at once that the motive is too apparent to need comment, but in the case of this man it is an unfounded suspicion.

I know of another man and another case exactly similar in all points, and when I reflect upon them they seem to me accountable only upon the basis of temporary aberration of mind, or that other baseless fabric—the Tower of Babel. It is a great comfort to have this to lean upon, for otherwise one's faith in human nature would be shaken. If a man has served all his life in the exaltation of the fact that two and two make four, why shall he pervert what talent he may possess in that line by directing my attention to the fact that they also make twenty-two?

It is not good for a man to know too much, for it blinds him to the fact that he has a great deal yet to learn. We are ready enough to admit this truth in its broadest sense—that there is much yet to be learned—but we always feel that it is the other fellow who has to learn it, not ourselves. We have already compassed that which is possible. The elder men in this generation have absorbed this great truth, but the younger—spurring at the unconquerable, lashing out against thorns with their heels, chafing because they are not led at once to slay the great dragon Difficulty—have it yet to learn.

And in this peroration I say that all men will never look upon the same question from the same side. The most contradictory and apparently impossible solutions are given to the simplest questions, even by those who conscientiously seek to change their views, and to be liberal in all their mental transactions. Color blindness exists, why not truth blindness? With the best disposition in the world, and the determination to find the truth if it is to be found, men embrace delusions daily, and the only code we can practice towards our neighbor is not to charge him with wilful distortion, but simply to remember that there are many men of many minds.

HOW I SERVED MY APPRENTICESHIP.

NUMBER V.

BY GEORGE SLOCUM.

"Now, George, supposing that engine ran that mile in 1 minute, each piston would travel 1,220 feet in 1 minute. Pretty fast traveling for a piston, ain't it?"

"Well, yes, I should think so," said I.

"She would have to be a mighty good steamer, too, to be able to supply so much steam at that pressure, at such short notice, and do it right along mile after mile. Mind you! we are talking and figuring about cubical contents; bulk of steam, you know; without taking into account friction in the pipes, and passages in cylinders, and condensation; we leave all these out of our calculation,"

"She would'nt have to do it, would she?" said I.

"Why, no; she could'nt do it," said Jones.

"What then?"

"Why, the practice is to 'cut off' the supply of steam from the boiler, after the piston has travelled 3, 6, 9, 12 or 18 inches, and let the expanding steam drive the piston to the end of the stroke. That is what those notches in that sector are for. When the engineer is pulling out, he 'drops her down in the corner'—or nearly so,—and when he gets her going right smart he keeps 'hooking her back,' and by the time she is flying, he has got her 'hooked back' into the 3 inch notch."

"What's 'hookerback;' what does that mean?" said I.

"Oh, never mind that now; we'll talk about 'hookerback' some other time. I've got to get these frames out this week," said Jones.

"That engine pulls the 'Limited,' don't she, the train made up of heavy Pullmans' and fast time?"

"Yes. Now 'get,'" said Jones.

"Windy Jim" was a character to be found, I suppose, in every railroad shop where a large number of men are employed. "Windy" was the link-man, and sometimes he was rushed and required extra help, although he had a good, smart boy working with him. Windy was a good mechanic, but a tremendous blow-hard, and that was why the shop hands christened him "Windy Jim." He had built hundreds of locomotives from the rail up, and thousands of shop-tools of all descriptions. He had turned more shafting in ten hours than any man he had ever seen or heard tell of, and had tapped larger and smaller holes, and chipped longer key-ways. The fine drilling he had done would make a watchmaker turn green with envy. Besides all these accomplishments, Windy could weld cast-iron, and drill holes through chilled cast-iron and the hardest kind of hardened steel, just as easy as rolling off a log. One day the foreman came along, and said to me: "You go down and help Windy Jim awhile." I reported to Windy without any unnecessary delay, and found him all tore up, as he termed it. He set me to work drilling holes in some new links, and when I got that job done, he showed me how to lap out holes in some case hardened work. I did'nt get the right kink on this job until I had myself slobbered over with oil and emery. I worked for three days only, with Windy, but during that time he nearly talked me to death, telling me about the stacks of links he had fitted up, and the scores of years they had run without requiring an overhauling. I gave Windy the shake the first chance I got.

"Been helping 'Windy Jim?'" said Jones.

"Yes," said I.

"Learn anything?"

"Not much. Say ———, what is the radius of a link?"

"The distance from the center of the main axle to the center of that slot that the link-block works up and down in," said Jones.

"'Tis, eh? Well, how do you get that distance?"

"You measure from the center of the main pedestal jaws to the center of the rocker box. You can see it here on this drawing," said Jones.

"Well, what's the center of the saddle-pin set over ⅝ of an inch for? Why aint it over the center of the link-block slot?"

"It is claimed that it lessens the slip of the link."

"Why is the saddle attached to the link so high up on some of those links I saw down at Windy's bench?" said I.

"It is to prevent 'knuckling' of the link, and get as many centers as possible in line. You see the saddle is put just about where the engineer has the link-faces in contact with the link-block most of the time when in the forward motion. This brings the saddle-pin center and rocker-arm pin center on a line with each other, and prevents 'knuckling' to some extent," said Jones.

"Is the link-motion hard to understand?"

"It's a pretty tough problem, and if you want to thoroughly post up on it, I would advise you to study algebra, so that when you read those books on valve and link-motion you'll be able to understand the formulæ and equations."

"Algebra is a hard study, aint it?" said I.

"Nonsense! Where there is a will there's a way. You can make it hard or soft; it all depends on yourself," said Jones.

"I wonder if a fellow could learn it by himself?"

"Well, I'll tell you about that. You see Tom Lovelace over there? Well, sir, he is a very good algebraist, and he never learned a bit of it in school; not a bit. He picked it up, a little at a time, here and there, and when he could, while serving his time. It took him several years to do it, but he never got discouraged, nor tired of it. He was bound to learn algebra, and he did. After he learned algebra, he studied Haswell, and Auchincloss on Link Motion, and other technical works; and to-day, I don't care what questions you may ask him embracing figures, he will pick up a piece of chalk and give you answers algebraically proven. He does it so quickly, too; forms equations, as they are called."

"Must be way ahead of arithmetic?" said I.

"Well, I should say it is. I tell you George, if you want to be a thorough machinist—you are young yet—just pitch in, and get all the algebra you can. Go clear through it; don't stop half way; go clear through, if it takes you five years, or ten years, for that matter. Then you can study geometry and trigonometry, logarithms, and the calculus, and all those 'away up' branches. All this need not cost you a great deal in money, but it will take lots of time and patience, and, in my humble opinion, you will enjoy it more than ratting around of evenings, and bumming around with the boys, playing billiards and pool, swilling beer, or loafing around saloons, and such places. I tell you, George, the educated machinist is going to be cock-of-the-walk before many years; and the machinist who can figure, as well as chip and file, and run a lathe or a milling machine, will have the longest pole, and of course he'll knock off the most persimmons."

THE STEAM ENGINE INDICATOR AND ITS USE.—No. 11.

BY WILLIAM BARNET LE VAN.

LEAD.

By *lead* is meant the width of the opening of the steam-ports before the beginning of the stroke of the piston. On the steam side of the valve it is called *outside-lead;* on the exhaust *inside-lead.*

The lead and the period of admission should be the same for each end of the cylinder, for each point of cut-off, and, if possible, in locomotive engines in the back as well as the forward gear.

It is found necessary, especially with high speeds of piston, in order to insure good action of the steam, that the maximum cylinder pressure should be attained at the very commencement of the stroke. If the steam-port is not opened until after the piston has commenced its stroke, especially where there is but little compression, some appreciable time would be consumed in filling the clearance space and the steam passages with steam. In locomotives where the slide valve is worked by the ordinary link-motion, the steam-port will not open rapidly enough to enable steam of the maximum boiler pressure to fill the space after the receding piston, unless the valve begins to open the steam port *before* the piston begins its stroke; that is before the end of its preceding stroke. The Baldwin Locomotive Works, allow from $\frac{3}{16}$ (0·1875) to $\frac{1}{4}$ (0·25) inch lead according to the class of locomotives, but in ordinary cases from $\frac{1}{16}$ (0·0625) to $\frac{3}{16}$ (0·1875) of an inch will be sufficient.

When the maximum cylinder pressure is attained at the commencement of the stroke, the admission line of the indicator diagram—the piston being at the end of the stroke—will rise in a vertical line (see diagram 6), but if the maximum pressure is not so attained the admission line will deviate slightly from the vertical (see diagram 11.)

Lead and compression both regulate the steam admission. If the clearance space at the beginning of the admission is already filled with compressed steam, a less amount of lead is necessary and *vice versa.*

In locomotive engines with the shifting link motion, however, not only the lead but also the compression increase rapidly as the link approaches mid-gear or half stroke; this is not a drawback, as the increased compression is calculated to facilitate greatly the attainment of the full pressure of steam in the cylinder at the commencement of the stroke.

Furthermore, it should be remembered that a good admission of the steam depends, not only on the amount of lead, but also on the commencement of it, or, in other words, on the period at which the valve opens the connection with the steam chest preparatory to the next stroke of the piston.

THE MEAN EFFECTIVE PRESSURE.

The mean effective pressure is the difference between the mean or average propelling pressure, and the mean or average back pressure. This pressure is best obtained from indicator diagrams. To arrive at it correctly we divide the length of the card into ten or more equal spaces so arranged that there is a half space at each end (see dotted lines figure 8, current number). Ten is a convenient number, but this is immaterial; any other number may be used; the more numerous the spaces, of course, the greater the accuracy.

THE TERMINAL PRESSURE.

This term is sometimes applied to the pressure at the exhaust point when the steam is released, but as it is an indispensable factor in the calculations; it is properly defined as the pressure that would exist at the end of the stroke if the steam had not been released at that earlier point. A continuation of the expansion curve, as at g, in diagram 12, see dotted line, will explain the method of finding it; diagrams, figures 9, 10 and 11, show the exhaust has taken place at the end of the stroke; hence in those diagrams terminal and exhaust pressure are the same. This pressure is measured from the extremity of the curve to the vacuum line, $V\,V$, hence it is the *absolute terminal pressure.*

THE INITIAL PRESSURE.

The initial pressure is that pressure which acts upon the piston at the beginning of its stroke up to the point of cut-off, and is always less than that of the boiler, because as soon as the steam leaves the boiler it begins to condense. It can receive no more heat from any source, but it must impart heat to everything, and supply all loss resulting from radiation. A portion of the steam is always condensed as it enters the cylinder, from coming in contact with the surfaces which have just been cooled down by being exposed to the colder vapor of the exhaust steam; more especially is this so in slow running engines where little or no compression takes place.

INITIAL EXPANSION.

Initial expansion is the expansion that takes place during the admission of steam before the steam is cut off. The steam line, $k\ e$, in diagram figure 11 shows considerable initial expansion, which is desirable in a "throttling" engine; from the fact that *saturated* steam becomes *superheated* during the process of "throttling;" but is not desirable in cut-off engines.

WIRE-DRAWING AND THROTTLING.

When steam is reduced in pressure by passing through a contracted passage, as in a stop-valve partly closed, or in the common "throttle-valve," it is said to be "throttled," and is shown by the fall of the steam line, k to e, as exhibited in diagrams 7 and 11, Article No. 3 and 6, current volume.

The term "*wire drawing*" is almost identical in meaning with throttling, but refers especially to the slow cutting off of steam by an ordinary slide valve, the result in the diagram being a gradual slanting downwards of the steam line until it passes imperceptibly into the expansion line. Diagram Fig. 17 is an example of this, and the dotted lines show the effect of a quick cut-off obtained by means of an expansion valve.

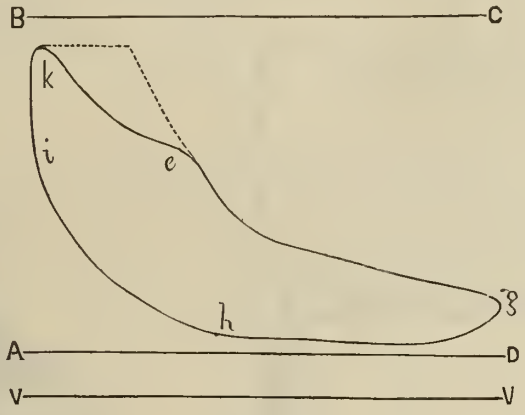


Fig. 17.

With the ordinary valve-gearing, espceially the shifting link in common use in locomotive engines, or when a single eccentric connected directly to the valve-rod is used, it is impossible to obtain an early cut-off without a certain amount of wire-drawing. If, under these circumstances, an earlier cut-off than half-stroke is attempted, wire-drawing becomes excessive.

The above diagram, Fig. 17, taken from one of the most advanced types of locomotives, exhibits considerable wire-drawing. The dotted line shows the pressure that might have been obtained with the same amount of steam more rapidly introduced into the cylinder, indicating a loss from this cause alone of about *ten per cent.* of the whole power of the engines.

Modern, automatic cut-off valve arrangements are so designed as to avoid wire-drawing with high rates of expansion; the commonest and simplest being by means of double eccentrics, one of which is operated by the governor so as to give a sufficiently rapid and early cut-off; see diagrams Figs. 6, 8, 9 and 10, current volume, which show a perfectly steady steam line up to point of cut-off, with expansion through the rest of the stroke.

It is an established fact that "wire-drawing" and "throttling" are accompanied by direct loss due to the slight cooling which takes place during the process, and by indirect waste owing to the increased proportion of work expended in overcoming the back-pressure.

Aside from the economic loss, there is the no less serious objection to contracted passages; that, as the cylinder pressure is reduced (and, therefore, the power of the engine in the same proportion), a large size engine becomes only equal to one of less size, weight and cost, with more liberal steam passages.

THE VALVE-GEAR OF MARINE ENGINES.

The old-fashioned side-lever marine engine had two eccentrics, two gab-levers, and two hand-wheels. The eccentrics were loose on the shaft, in the sense that they could make a partial rotation round it until stopped in either direction by snugs. When the eccentrics were in one position the engines went ahead, when in the other they went astern. To reverse the engines the gabs in the eccentric rods were lifted off the gab-pins in the valve rocking shafts, and the valves were then raised or lowered by hand until the crank had made half a revolution, when the crank shaft turning in the eccentrics brought the snugs in contact with the driven faces on the eccentrics. The gabs dropped on the pins and the engines were reversed. The handling of large engines so fitted was slow, but only because the slide valves required much power to move them. With the aid of modern appliances the valve could be handled with the greatest ease and rapidity.

The modern compound engine has five eccentrics, three links, and a reversing wheel and screw, or a small steam or hydraulic engine, according to the size of the machine. Heterodox as the statement may seem, we have no hesitation in asserting that the old-fashioned method of reversing was far better than the new. In the first place, let us ask ourselves what is the object served by the link? The answer is, that its sole purpose is to enable the engines to be reversed. It must be clearly borne in mind that with compound engines it is never used as an expansion gear. Compound engines, as usually made, when of small size, have an invariable rate of expansion. Of course this would not be the case if the link were used to alter it; but as we have said it never is so used, save very rarely and for very brief periods, when the engines are slowed down. Normally the reduction in speed is effected far more easily by the throttle-valve. In large engines the fifth eccentric is employed to drive a special expansion slide; and should any alteration be required in the point of cut-off it is effected by shifting the link of this eccentric in a way too well known to need particular description. Now if it could be shown that nothing objectionable was entailed by the use of the link-motion, no more need perhaps be said on the subject. But this cannot be done. A link-motion for a compound engine is a costly affair to begin with, and it very speedily gets out of order; not to such an extent to entail any risk perhaps, but enough to spoil diagrams to some extent, and to give trouble to engineers. The die, or its equivalent, although brought right under the end of the valve spindle, is played upon by the link, and is not easily kept tight in the link. We have three distinct places to deal with, all liable to wear and become loose, viz., the joint between the eccentric rod and the link; the die, which readily becomes loose in the link; and the joint between the die and the valve rod. If the link-motion were dispensed with, then there might be but one joint, that between the valve rod and the eccentric, to wear or to be attended to. There would be little or no lost motion between the valve and the eccentric. There would be less noise, less lubrication, and less risk. The link would have to be held in place by rock shaft arms and a screw. Now, it is practically impossible to prevent shake in these things. The oblique action of the link on the die tends forcibly to shift the link or to bend the valve stem, and very heavy parts only can impart anything like the proper amount of rigidity. If the strain were always in one direction, it would be easy to deal with; but it is not. Even with piston-valves, the weight of the link-motion in large engines must be estimated by tons. The fittings must be of the best possible kind, and the cost is very heavy. Two of the five eccentrics are of no more use on a voyage than a fifth wheel would be to a coach. It is not remarkable that some engineers begin to think that they can get on better without the link than with it. But it is questionable whether anything more is wanted than such a modification of the old shifting eccentric as will permit the engines to be handled rapidly; and this presents not the slightest difficulty. The unlocking of the eccentric rod and the shifting of the valves, and the dropping in of the gab again, can all be done by extremely simple steam or hydraulic machinery, in no way more complex or costly than that now in use for working the link-motion. Nothing more is needed than a modification of the hand-gear still employed extensively to reverse large oscillating marine engines.—*London Engineer.*

THE GENERATION OF STEAM.

Concerning this subject, always of vital interest to those connected with its production and use, Mr. William Anderson recently lectured before the British Institution of Civil Engineers. We quote a portion as follows:

It was shown that the temperature of the furnace depended upon the supply of air. A minimum supply would give the highest temperature, but it was found necessary to add an excess in order to make combustion perfect. It was pointed out that the limit to high temperature in a furnace was the imperfection of the material of which boilers were constructed. It was shown, from the fact that the steel was capable of being melted in boiler furnaces, that temperatures so high as that were not injurious, but that, when the melting point of steel was greatly exceeded, the plates began to suffer severely.

Next, the temperature of the chimney end of the boiler was examined. It was stated that, by the adoption of feed-water heaters and the use of forced draft, [not for the purpose of augmenting the steam production irrespective of economy, but with a view to promoting economy,] the temperature of the smoke could be lowered to about 100° F. above that of the feed-water. The law of conduction through plates was then explained, and it was pointed out that even joints in a bar of uniform material interposed a certain amount of resistance, and the fact was illustrated by an experiment. The loss was much greater when there was a joint between dissimilar materials, such as between the gases of the furnace and the boiler plate, and between the boiler plate and the water. At first sight it would appear a matter of common sense that a boiler which contained its own furnace must be a better generator than one with an external furnace formed of brickwork, but brickwork was an extremely bad conductor of heat, while it was a very good radiator, absorbing heat from the gases and returning them by radiation to the boiler surfaces. This action was strongly pronounced in the case of the reverberatory furnace and in the brick arches now commonly introduced into locomotives.

The gases forming the products of combustion were very bad absorbers and very bad radiators of heat. Pure dry air and nitrogen were absolutely incapable of absorbing or radiating heat. They were not in the least affected by the passage through them of the most intense heat rays. Carbonic acid was a somewhat better radiator, while the vapor of water was a good absorber, and, therefore, a good radiator.

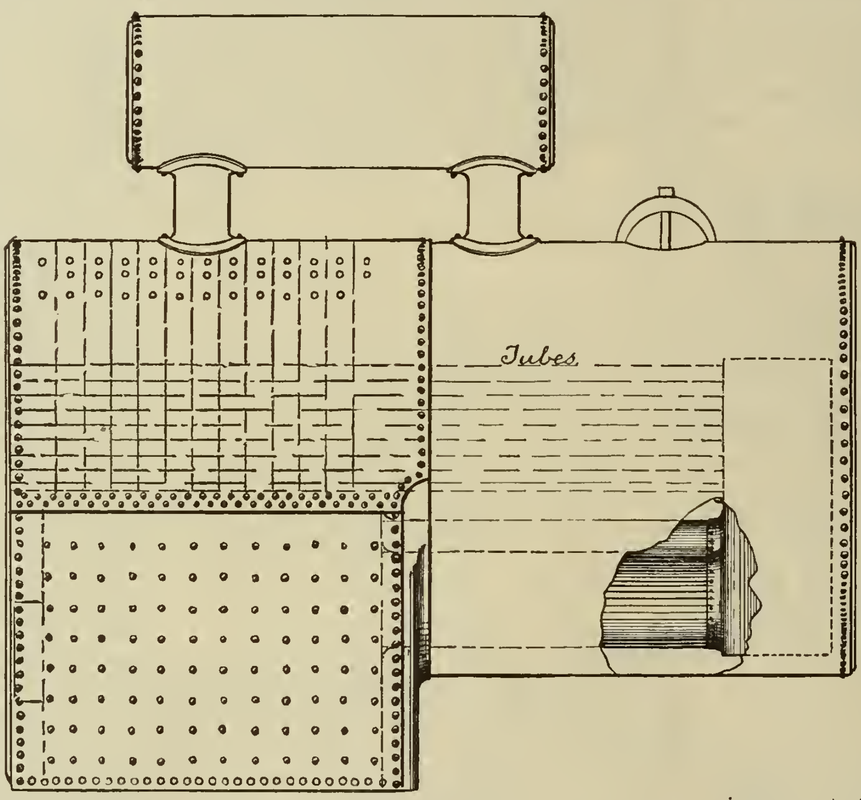
It was then demonstrated that the products of combustion consisted mainly of air and nitrogen, and consequently, taken as a whole, the products of combustion were bad radiators. Little or no economical advantage was derived from making the combustion in a boiler perfect, because the colder luminous flame was a good radiator, on account of the white-hot particles of carbon it contained, while the hotter and non-luminous flame was a bad radiator and carried a great deal of the heat into the chimney. This circumstance was illustrated by an experiment, by which it was proved that an intensely hot, non-luminous, Bunsen flame had little more effect upon an air thermometer than a smoky, luminous flame, burning the same quantity of gas; but that the moment a spiral wire was hung in the Bunsen flame it commenced to glow, and the radiation from the wire immediately had a powerful effect upon the thermometer.

A different class of boiler was required for consuming flaming-fuel, compared with anthracite and coke, which burned with very little flame. In the latter case tubular boilers were preferable, but, unless the combustion was perfect before the gases reached the small tubes, the gases cooled down so considerably that the flame was frequently extinguished. This fact was illustrated by an experiment which showed that when pieces of $\frac{1}{2}$-inch gas-pipe of various lengths were placed over an ordinary gas-flame, the shorter tubes allowed the flame to pass through, while the longer ones extinguished it, and the gas could be relighted at their upper ends. Water, being a very bad conductor, could not be heated by direct radiation or conduction.

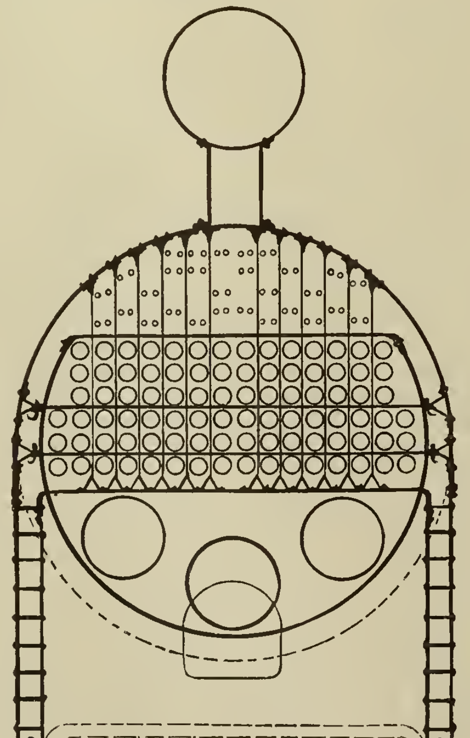
TYPES OF AMERICAN STEAM BOILERS.

NUMBER V.

We present herewith drawings of a boiler used in some localities for tugboats. In the limits of a newspaper it is not possible to give entire sheets or every detail, and we have therefore omitted the smoke-box, it being easily constructed by any one. Our contributor says:



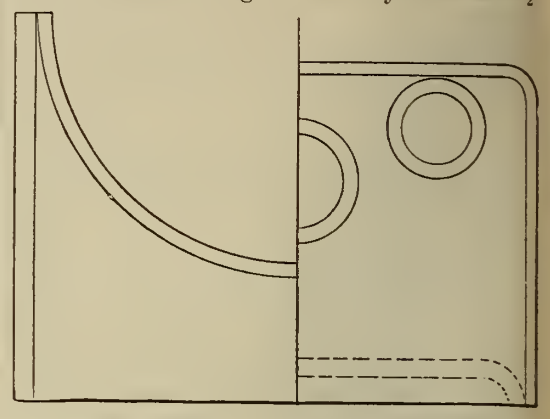
SIDE ELEVATION.



FRONT ELEVATION IN SECTION.

The dimensions of boiler are as follows: 72″ diam. by 144″ long. There are 78 tubes, 3″ diam. by 10′ long. The boiler is braced from the crown-sheet to wagon-top and the braces are 8″ apart, but set so that they will draw on every 5″ on crown-sheet. The holes in crow-feet will be 5″ apart, so that there will be circulation between the legs. The stay-bolts are $4\frac{1}{2}''$ and $4\frac{3}{4}''$ apart. The main flues are intended to be lap-welded. These are better than riveted flues; one flue is 16″ and the other two are 14″ diam. by 56″ long. The wagon-top is 71″ × 134″; two side pieces are 48″ × 67″; shell-sheets (3) are $71'' \times 116\frac{1}{2}'' \times \frac{3}{8}$; fire-box crown-sheet is 59″ × 74″; two side sheets are $59'' \times 42'' \times \frac{3}{16}$ (?); two fire-box heads, 48″ × 69″; 5″ allowed for flanges.

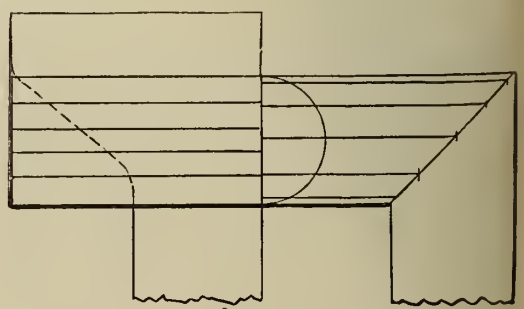
The front-head is $77'' \times 95'' \times \frac{1}{2}''$. This and the front fire-box head will be cut out and flanged (one out and other in) at draft-hole to lap over each, and riveted. The bottom of front-head on leg will be flanged to let leg outside of it at the hand-holes. The back-head is 77″ diam. by $\frac{1}{2}''$; two smoke-box heads are $55'' \times 69'' \times \frac{3}{8}''$; throat-sheet, $77'' \times 54'' \times \frac{1}{2}''$; back smoke-box sheets, $17'' \times 124'' \times \frac{3}{16}''$; one, $70'' \times 17'' \times \frac{5}{16}''$. This boiler, except tubes and flues, is of steel.



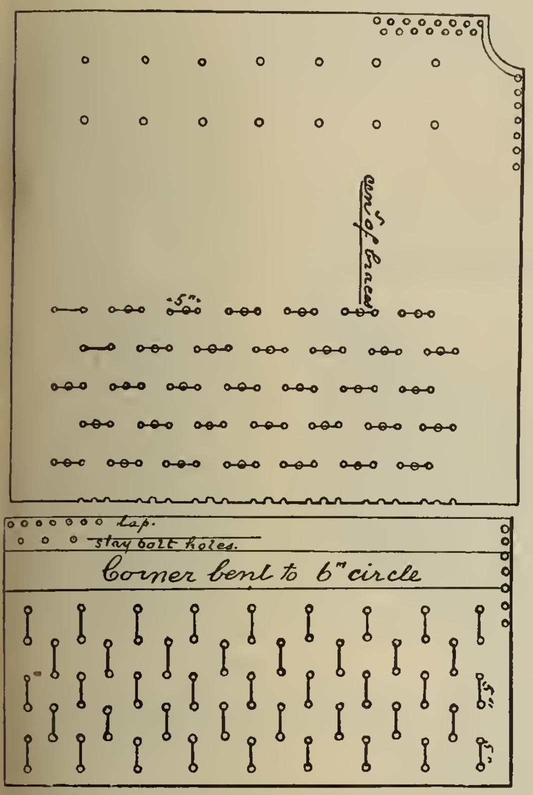
THROAT SHEET. FLUE SHEET.

In getting out the back smoke-box I need not explain in detail, as I have done it before. All that is needed is to draw a diagram of the back head, lay off the centers of holes whatever distances they are to be, and then strike from center, cutting their marks on smoke-box through to the outside shell, measuring with a steel rule or a piece of hoop-iron; get the distances of holes both on smoke-box and shell, on crown-sheet of either smoke-box or fire-box, then lay off the brace-holes, or centers of braces. Then take a square and strike on the curve of shell, and we shall get the centers by measuring on the curve. On boilers of the same kind as this, the layer-out must be very exact with his lines, or else his braces will come in the way of the tubes.

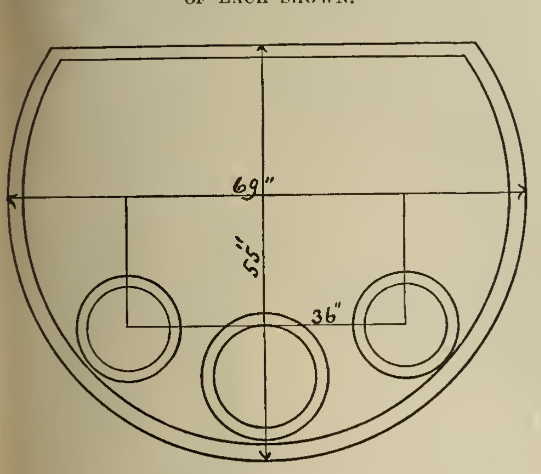
In getting the leg out I think the best way is to make a miter-joint, as shown. It makes a good corner. I lay it out the same as for an elbow, flanging the long end in and the short end out. They will then fit in each other nice and snug. I have made a great many in that way, and have never had any bother in getting the corners tight.



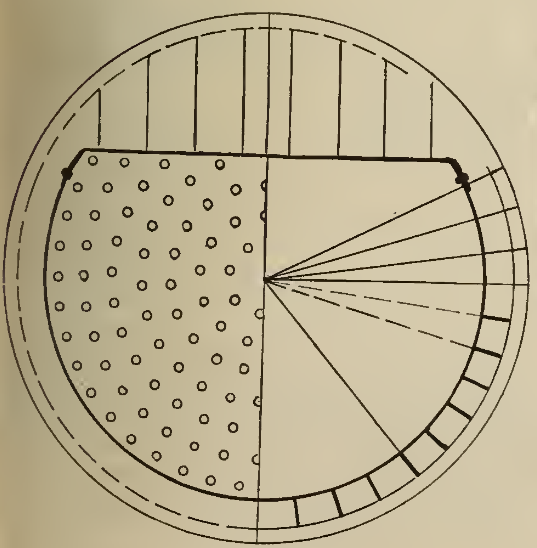
The material for the legs will be as follows: One piece, 75″ × 9″; two pieces, 71″ × 9″. This allows 1½" on each end of back-leg to be flanged in. On side-legs only one end wants to be flanged on each. The front end will slip over the front-head leg-piece. The dome is horizontal, 24" diam. by 72" long. The sheet will be 71" × 80" × ⅜"; two heads are 28½". The two connections, if made of boiler-plate, will be 18" × 28"; door-frame, 9" × 50".



WAGON-TOP SHEET. FRONT OF CROWN SHEET. HALF OF EACH SHOWN.

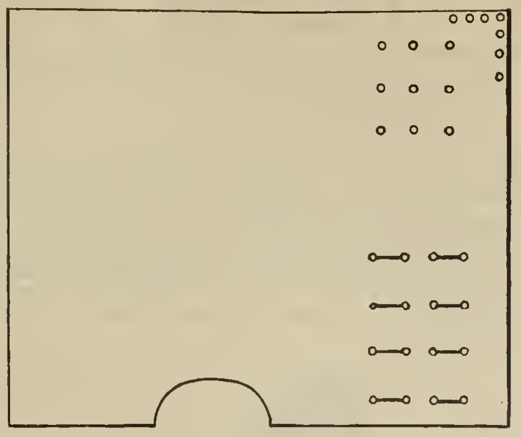


BACK SMOKE-BOX HEAD.

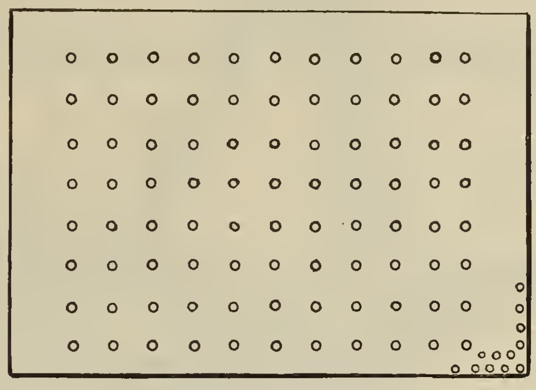


BACK HEAD.

ANOTHER SCHEME for reaching the North Pole is by means of a newly invented submarine vessel, which, from published accounts, is like numerous others which have preceded it. The North Pole has already cost more in human life and treasure than the discovery of it will confer upon mankind when found. It is about time to organize a society for the prevention of the discovery of the North Pole.



TOP SHEET OF SHELL.



SIDE OF FIRE-BOX SHEET.

VERY SUGGESTIVE STATISTICS.

The work done by the Hartford Steam Boiler Insurance Company, as shown by their reports, affords some peculiarly interesting reading. The report for November says: The total number of boilers examined was 5,024; the number inspected internally reached 1,765; the number tested by hydrostatic pressure, 364. The number of defects reported was 3,024, of which 650 or 21½ per cent. were considered dangerous; 46 boilers were condemned. The following table exhibits the defects in detail: Cases of deposit of sediment, 385; of incrustation and scale, 500; of internal grooving, 18; of internal corrosion, 92; of external corrosion, 132; broken and loose braces and stays, 19; settings defective, 130; furnaces out of shape, 100; fractured plates, 115; burned plates, 94; blistered plates, 207; defective riveting, 362, defective heads, 20; serious leakage around tube ends, 361; serious leakage at seams, 173; defective water-gauges, 52; defective blow-offs, 28; deficiency of water, 8; safety-valves overloaded, 22; safety-valves defective in construction, 46; pressure-gauges defective, 158; boilers without pressure-gauges, 2. Total, 3,024.

STEAM-BOAT INSPECTION RULES.

The annual convention of the Board of Supervising Inspectors of Steam Vessels adopted important amendments to the rules governing the construction of safety-valves, at their recent meeting in Washington. The changes made are based upon experiments made at Boston and Philadelphia, and are as follows:

Lever safety-valves to be attached to steam boilers on steam vessels shall have an area of opening of not less than one square inch for every two square feet of the grate surface in the boiler, and the seats of all such safety-valves shall have an angle of inclination to the stem of 45 degrees. Spring-loaded safety-valves, constructed in a manner so as to give an increased lift by the operation of the steam, after being raised from their seats, or spring-loaded safety-valves constructed in any other manner so as to give an effective area equal to that of the aforementioned safety-valves, may be used in lieu of the lever valve on all boilers on steam vessels, and shall be required to have an area of not less than one square inch to three square feet of the grate surface of the boilers, and each spring-loaded safety-valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to one-eighth of the diameter of the valve-opening, and the seats of all such safety-valves shall have an angle of inclination to the stem of 45 degrees. This rule shall go into effect and be in force from and after July 1.

The board also decided that in view of thorough tests made of the life-preservers in use on steam vessels, and in view of the fact that many of them failed to come up to the standard adopted by the board, requiring a buoyancy of 24 pounds to 6 pounds of good cork, local inspectors should be directed to examine all life-preservers and strictly enforce the rules of the board relating thereto.

The Secretary of the Treasury, by a resolution of the board, was requested to appoint an Assistant Inspector, whose duty it shall be to examine and pass upon all life-preservers before their use shall be allowed on steam vessels. This has has been done for the purpose of protecting the traveling public and vessel-owners against fraud and imposition in the manufacture and sale of inferior life-preservers.

A communication was received from the Steam-boat Owner's Association of the Port of New-York, tendering the board a vote of thanks for passing a rule requiring all persons to have not less than three years' experience before a license as engineer or pilot can be issued to them.

In view of the manner in which the boiler of the Riverdale was inspected prior to its explosion the board adopted the following rule:

Local Inspectors, at the annual inspections of steam boilers, shall examine in a thorough and careful manner, either externally or internally, all parts of the shell of every boiler, and the masters and owners of every steam vessel shall afford every facility necessary to enable the Inspectors to carry out in the most effective and efficient manner the provisions of this section.

CAVEATS.

When a person has conceived of an invention, and is proceeding to work it out and perfect it, he is apt to fear that some one else may think of the same thing and patent it before he does. This most frequently happens when the invention is one for which there is an urgent and recognized public need, in which event it is a common occurrence for several minds to be busied with it at the same time. It is to meet such cases as this that the law provides the remedy known as a *Caveat*. This word means literally "Let him beware," and, as used in law, means generally a notice given to an officer not to do an act until the party giving the notice shall have had a hearing. The caveat provided for by the patent law is a notice to the Commissioner of Patents not to grant a patent to any other person, for the invention in question, until he has first given the person filing the caveat an opportunity to prove his claim to the invention. The invention is identified by means of a drawing and description, which must be "as full, clear and exact as the inventor is at the time able to give," and must be prepared according to certain forms, and attested by oath. The opportunity to prove his right to the invention, which the law requires the Commissioner to give the caveator, is a notification that a patent on the invention is claimed by another person, and a delay of three months, during which the application is suspended. Within this period of three months, the caveator must complete his invention (if he has not already done so), and must file his application for the patent. If he neglects to do this, the applicant will be granted his patent, unless there be some other reason for withholding it. But if the caveator files his application in time, the two applications will be placed in "Interference," and each party will then be given an opportunity to take testimony to prove when he made his invention, after which the patent will be granted to the one who is adjudged to have been the first inventor.

Caveats are required by law to be kept in strict secrecy at the Patent Office, and no one has access to them but the sworn officers of the department. Certified copies may be obtained from the office on the caveator's order, and these copies are positive proof that the invention, as disclosed in the caveat, was made at the time the caveat papers were executed. In this way caveats have frequently proved of value as record evidence of an invention, in cases where the date of the invention has been questioned.

The duration of a caveat is one year from the date of filing, but it may be renewed from year to year by paying each year the government fee of ten dollars.

When an invention is already completed, and has been found to operate successfully, we advise that a patent be at once applied for, unless the inventor is unable to meet that expense. In such cases, to apply for a caveat first would entail, in the end, an additional expense of about twenty-five dollars, and would have no compensating advantage; it would serve only to gain time which would not be needed.

A caveat is only useful when the inventor is not ready to apply for his patent immediately, and wishes to gain time in which to experiment, or to bring his invention to the attention of capitalists. It affords, practically, good protection against the piracy of his invention by others, and enables him to exhibit it to strangers with as much safety as though he had already filed his application.

Foreigners cannot file caveats. This privilege is restricted to citizens, and to aliens who have declared their intention of becoming citizens.—*Patents On Inventions* (*Quarterly.*)

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PERMANENT INKS.

Ink-making has now become quite a chemical art. There are so many kinds in the market that a choice is puzzling. It is very desirable that manufacturers should state the composition of their inks—*i. e.*, of the coloring matter they contain. This might be done without betraying any trade secrets. We could then choose our ink for its purpose. For documents of a permanent character, and subject to the possibility of intentional obliteration, the ink should contain more than one kind of coloring matter; as, for example, the old tanno-gallate of iron plus indigo or aniline black, and perhaps a little copper salt. No single chemical agent could bleach all of these, and neither paper nor parchment can stand a series of chemical solvents. The aniline inks now largely used are of very questionable durability. It is uncertain whether they can endure the action of time alone. Supplemented with the old-fashioned iron salt, which has proved its durability, they are safe. It should always be understood that the indelibility of any ink largely depends upon the nature of the surface to which it is applied. The more absorbent the paper, the more difficult is its removal, as it penetrates below the surface of such paper. If the paper is highly glazed, by covering it with any kind of varnishing material the possibility of removing the whole surface, varnish, ink, and all, is increased.—*The Gentleman's Magazine.*

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CONVENTION OF AMERICAN INVENTORS.

A most remarkable convention will be held in Cincinnati, March 25, in the Great Music Hall and Exposition building of that city. During the past few years the great monopolies of the country have made strong efforts to destroy the present wise and beneficent patent laws, and there have been none to combat the representations made. To this end inventors have determined to form a permanent organization, solely for the purpose of being able by combined efforts to show Congress and the people that it will be detrimental to the interests of the country to accede to the demands of monopolists. There is a universal feeling among inventors that something must be done to protect their interests, and the convention to be held will seek to adopt some united form of action, or form State associations. All inventors and patentees are interested in this movement, and all who can attend, and desire to do so, should at once address the chairman of the Executive Committee, J. S. Zerbe, editor of the *American Inventor*, 188 West Fifth street, Cincinnati, Ohio, who will forward each applicant the badge to entitle the holder to admission on the floor as a delegate. The citizens of Cincinnati, with their usual liberality, have subscribed a liberal guarantee fund to meet the expenses of the convention.—*Industrial World.*

BOOK NOTICES.

HUDSON'S TABLES. Tables for calculating the cubic contents of excavations and embankments, by an improved method of diagonals and side triangles. By John R. Hudson, C. E. New York: John Wiley & Son.

The title and title-page above given, indicate the character of this work, which will be found useful to civil engineers and contractors.

STEEL AND IRON, comprising the practice and theory of the several methods pursued in their manufacture, and of their treatment in the rolling mill, the forge and the foundry. By William Henry Greenwood, F. C. S., etc.: 97 diagrams from original working drawings. Cassel & Company, limited, London, Paris and New York.

This work is an exceedingly useful one to the student who would keep up with the progress of the manufacture of iron and steel as pursued in Europe at the present day. As a guide to American practice it is of little value, the only reference to this latter being items gathered from sources which the author does not reveal in his work. The drawings are very clear and well executed.

MESSRS. BURKE, FRASER & CONNETT, 10 Spruce St., N. Y., issue a handy volume of reference to patent laws, inventions, etc., which contains a great deal of useful information to those interested in this line of business.

REGISTER OF THE CORNELL UNIVERSITY. We have received a copy of the above for the current year.

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TO THE AGE OF STEEL.

It seems necessary to remind the *Age of Steel* that it is discourteous in questioning our good faith in the matter of the letter from a boiler maker published in our last issue. The writer of the letter is the author of the articles on American Steam-Boilers now being published in this paper. We object to the word "putative" in this connection, and see no warrant for its use.

Our contemporary is quite welcome to its views on the cost of iron and steel boilers, and it must try and be reconciled to the fact that we think our sources of information on the point in question quite equal to its own.

We are not in the habit of making false assertions and do not like that style of communication.

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WELDING OF WROUGHT-IRON.

Mistakes have been made in this most useful property of iron. Some of the errors are overheating, overworking, and lack of proportionate heating and working. In a welding state wrought-iron approaches fusion without reaching it. In a cupola the object is to drive the iron to a fluid state as rapidly as possible, and a piece of pig-iron in a cupola melts and runs from the outside, while its core is only at a red heat. Such uneven heating will not do for the weld; the iron must be evenly heated clear through, and not be merely at a white heat outside. A soaking heat is necessary for a weld, and this is why sand is thrown over the iron while at a white heat. The sand is not a flux, it is a silicon protection, allowing the interior of the iron to be heated, while protecting the outside from burning, and defending it from cooling.

There can be no hurry about heating for a weld; no forcing of blast; a steady, quiet, roasting heat is necessary if the piece to be welded is above three quarters of an inch in diameter. There must be quick work about the weld itself, but not too much of it. In this latter part of the work lies the most frequent error. The edges of the weld are sometimes hammered down until almost cold and every blow given after the weld-heat is gone drives scale into the iron to weaken the weld. Herein is the fault, in some cases, where a weld is discovered in after use by torsion or tension. A true weld will never show its line of junction by weakness. But a weld that is forced after the first cool stage, although it may "stick" for the present, will not support the integrity of the entire piece when put to a working strain.

Ordinarily less care is taken of the "jump weld" in progress, than of the "scarf weld," although, from the less amount of welding surface exposed, it would be considered that it was an absolute necessity to be more careful. In the "jump weld," or the "butt weld," as it is indifferently called, the ends to be united are upset by heating, and hammering against them to produce a swell sufficient to allow for the burning and scaling of the heat and hammering. The two end faces of the bar, after proper heating, are brought together and fastened by light taps on the other ends of the bars. This fastening is enough for one heat; the united bar should be immediately returned to the fire and reheated before the joint is hammered down to size. The reason is that all the outside of the upset is comparatively cool when the central portion of the bars are "stuck," and should be again heated to the welding heat before being hammered on to the subjacent portions. There are smiths who boast of being able to make a butt weld on a two-inch bar at a single heat; circumstances must be favorable indeed when this can be done.

No less care is necessary in making a scarf weld; the edges of the scarf, being thin, are sure to cool before the weld can be perfected. The general practice of welding by hammering is not the best, and yet for miscellaneous work it is at present the most feasible. If some bright mechanic would construct a quick-acting press with adjustable or changeable jaws or dies to fit sizes and shapes, jaws that could be heated and used warm, he would greatly facilitate the work of welding, which should consist of proper heating and equal compression from all sides simultaneously, something that is impossible under the hammer.—*Industrial World.*

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THE CABLE which is used for hauling cars over the Brooklyn bridge has stretched 100 feet since it was put up; approximate length is 3200 feet.

◆

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

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EGBERT P. WATSON & SON, 150 NASSAU ST., N. Y.

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Twenty-five cents a line for each insertion under this head.

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USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.
W. BARNET LE VAN, 3607 Baring Street, Phila,, Pa.

INDEX PLATES FOR LATHES, and Pattern Name Plates for Machine Tools, &c., engraved in a superior manner. Finished castings at reasonable prices. JOHN BEOKER, 28 Oliver Street, Boston, Mass.

NEW SCIENTIFIC BOOKS ON STEAM, the Steam Engine, Mechanics, and Engineering. Send for catalogue before purchasing. F. Keppy, Publisher, Bridgeport, Conn.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., corner Fulton and Dutch Streets, New York. Send for price list and catalogue.

New York: Weekes & Melville, Printers, 25 Beekman St.

THE MECHANICAL ENGINEER.

New Series. Vol. VII.—No. 6.
Enlarged 1883.

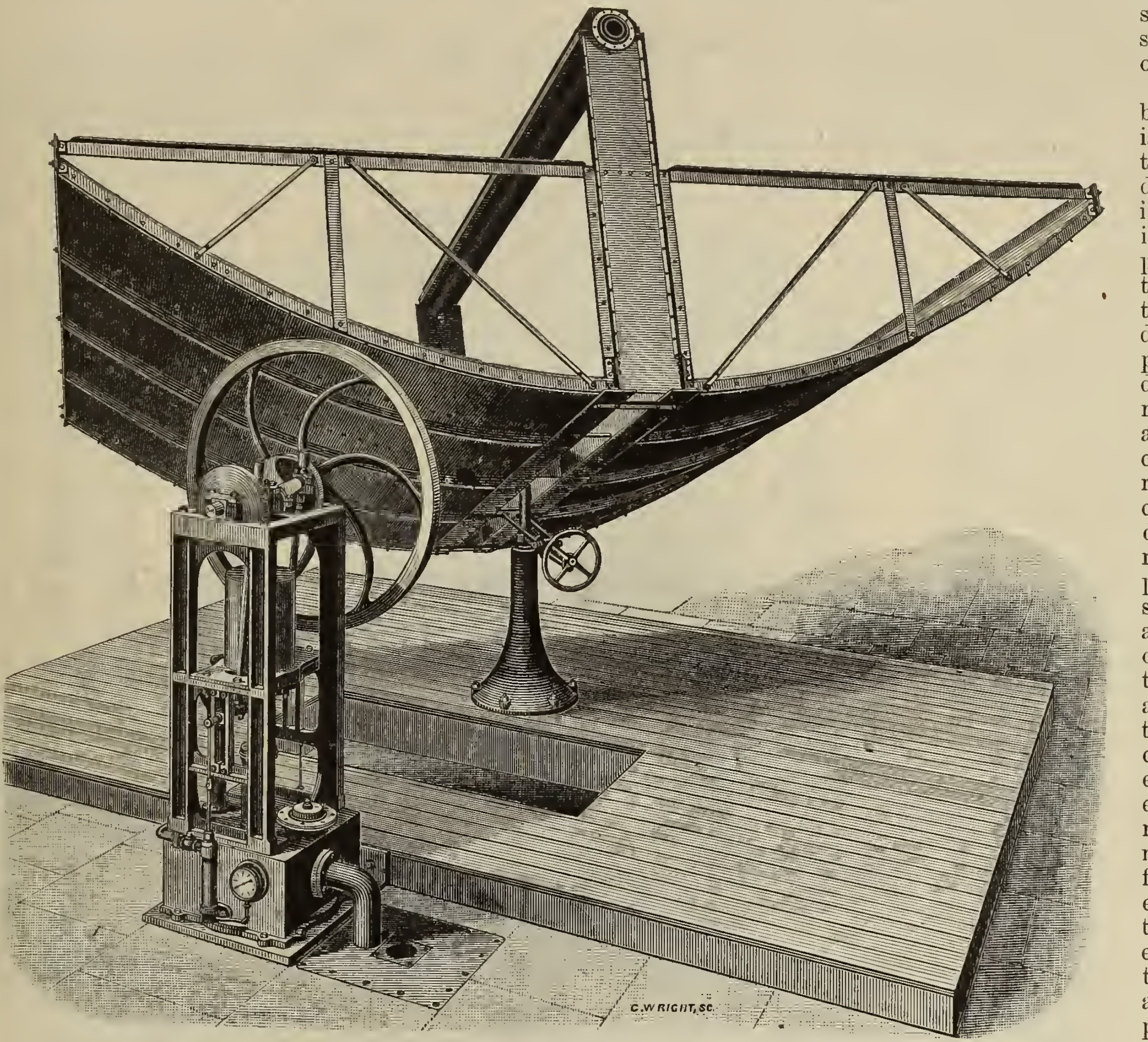
New York, March 22, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

THE SUN-MOTOR AND THE SUN'S TEMPERATURE.

By J. Ericsson.

The annexed illustration (Fig. 1) represents a perspective view of a sun-motor constructed by the writer, and put in operation last summer. This mechanical device for utilizing the sun's radiant heat is the result of experiments conducted during a series of twenty years; a succession of experimental machines of similar general design, but varying in detail, having been built during that period. The leading feature of the motor is that of concentrating the radiant heat by means of a rectangular trough having a curved bottom lined on the inside with polished plates so arranged that they reflect the sun's rays towards a cylindrical heater placed longitudinally above the trough. This heater, it is scarcely necessary to state, contains the acting medium, steam or air, employed to transfer the solar energy to the motor; the transfer being effected by means of cylinders provided with pistons and valves resembling those of motive engines of the ordinary type. Practical engineers, as well as scientists, have demonstrated that solar energy cannot be rendered available for producing motive power in consequence of the feebleness of solar radiation. The great cost of large reflectors and the difficulty of producing accurate curvature on a large scale, besides the great amount of labor called for in preventing the polished surface from becoming tarnished, are objections which have been supposed to render direct solar energy practically useless for producing mechanical power.



ERICSSON'S SUN MOTOR, ERECTED AT NEW YORK, 1883.
By Courtesy of Capt. Ericsson.

The device under consideration overcomes the stated objections by very simple means, as will be seen by the following description: The bottom of the rectangular trough consists of straight wooden staves, supported by iron ribs of parabolic curvature secured to the sides of the trough. On these staves the reflecting plates, consisting of flat window glass silvered on the under side, are fastened. It will be readily understood that the method thus adopted for concentrating the radiant heat does not call for a structure of greater accuracy, provided the wooden staves are secured to the iron ribs in such a position that the silvered plates attached to the same reflect the solar rays towards the heater. Fig. 2 represents a transverse section of the latter, part of the bottom of the trough, and sections of the reflecting plates; the direct and reflected solar rays being indicated by vertical and diagonal lines.

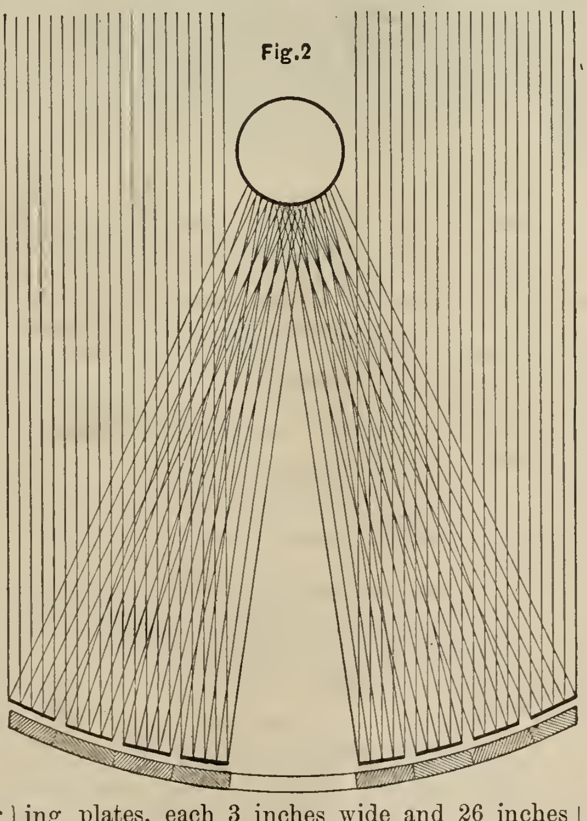


Fig.2

Referring to the illustration, it will be seen that the trough, 11 feet long and 16 feet broad, including a parallel opening in the bottom, 12 inches wide, is sustained by a light truss attached to each end; the heater being supported by vertical plates secured to the truss. The heater is 6¼ inches in diameter, 11 feet long, exposing 130 × 9·8=1274 superficial inches to action of the reflected solar rays. The reflecting plates, each 3 inches wide and 26 inches long, intercept a sunbeam of 130 × 180=23,400 square inches section. The trough is supported by a central pivot, round which it revolves. The change of inclination is effected by means of a horizontal axle—concealed by the trough—the entire mass being so accurately balanced that a pull of five pounds applied at the extremity enables a person to change the inclination or cause the whole to revolve. A single revolution of the motive engine develops more power than needed to turn the trough, and regulate its inclination so as to face the sun, during a day's operation.

The motor shown by the illustration is a steam engine, the working cylinder being 6 inches in diameter, with 8 inches stroke. The piston rod, passing through the bottom of the cylinder, operates a force pump of 5 inches diameter. By means of an ordinary cross-head secured to the piston rod below the steam cylinder, and by ordinary connecting rods, motion is imparted to a crank shaft and fly-wheel, applied at the top of the engine frame; the object of this arrangement being that of showing the capability of the engine to work either pumps or mills. It should be noticed that the flexible steam pipe employed to convey the steam to the engine, as well as the steam chamber attached to the upper end of the heater, have been excluded in the illustration. The average speed of the engine during the trials last summer was 120 turns per minute, the absolute pressure on the working piston being 35 lbs. per square inch. The steam was worked expansively in the ratio of 1 to 3, with a nearly perfect vacuum kept up in the condenser inclosed in the pedestal which supports the engine frame.

In view of the foregoing, experts need not be told that the sun-motor can be carried out on a sufficient scale to benefit very materially the sun-burnt regions of our planet.

With reference to solar temperature, the power developed by the sun motor establishes relations between diffusion and energy of solar radiation which show that Newton's estimate of solar temperature must be accepted. The following demonstration, based on the foregoing particulars, will be readily comprehended.

The area of a sphere whose radius is equal to the earth's mean distance from the sun being to the area of the latter as $214{\cdot}5^2 : 1$, while the reflector of the solar motor intercepts a sunbeam of 23,400 square inches section, it follows that the reflector will receive the heat developed by

$$\frac{23400}{214{\cdot}5},=0{\cdot}508 \text{ square inch of the solar surface.}$$

Hence, as the heater of the motor contains 1274 square inches, we establish the fact that the reflected solar rays acting on the same are *diffused* in the ratio of 1274: 0·508=2507: 1. Practice has now shown that, notwithstanding this extreme diffusion, the radiant energy transmitted to the reflector by the sun is capable of imparting a temperature to the heater of 520° Fahr. above that of the atmosphere. The practical demonstration thus furnished by the sun-motor enables us to determine with sufficient exactness the minimum temperature of the solar surface. It also enables us to prove that the calculations made by certain French scientists indicating that solar temperature does not exceed the temperatures produced in the laboratory are wholly erroneous. Had Pouillet known that solar radiation, after suffering a *two thousand five hundred and seven fold* diffusion, retains a radiant energy of 520° Fahr., he would not have asserted that the temperature of the solar surface is 1760° C. Accepting Newton's law that "the temperature is as the density of the rays," the temperature imparted to the heater of the sun-motor proves that the temperature of the solar surface cannot be less than 520 × 2507=1,303-640° Fahr. Let us bear in mind that, while attempts have been made to establish a much lower temperature than Newton's estimate, no demonstration whatever has yet been produced tending to *prove* that the said law is unsound. On the contrary, the most careful investigations show that the temperature produced by radiant heat emanating from incandescent spherical bodies diminishes inversely as the *diffusion* of the heat rays. Again, the writer has proved by his vacuum-actinometer, inclosed in a vessel maintained at a constant temperature, the observations, that for equal zenith distance the intensity of solar radiation at midsummer is 5°48 Fahr. less than during the winter solstice. This diminution of the sun's radiant heat in aphelion, it will be found, corresponds within 0°40 of the temperature which Newton's law demands. It is proposed to discuss this branch of the subject more fully on a future occasion.

The operation of the sun-motor, it will be well to add, furnishes another proof in support of Newton's assumption that the energy increases as the *density* of the rays. The foregoing explanation concerning the reflection of the rays (see Fig. 2), shows that augmentation of temperature takes place during their transmission from the reflector to the heater. Yet we find that an increase of the number of reflecting plates increases proportionably the power of the motor. Considering that the parallelism of the rays absolutely prevents augmentation of temperature during the transmission, it will be asked: What caused the observed increase in mechanical power? Obviously, the energy produced by the increased *density* of the rays acting on the heater. The truth of the Newtonian doctrine, that the energy increases as the density of the rays, has thus been verified by a practical test which cannot be questioned.

It is scarcely necessary to observe that our computation of temperature—1,303,640° Fahr.—does not show maximum solar intensity, the following points, besides atmospheric absorption, not having been considered: (1) The diminution of energy attending the passage of the heat rays through the substance of the reflecting plates; (2) the diminution consequent on the great amount of heat radiated by the blackened surface of the heater; (3) the diminution of the temperature in the heater caused by convection.—*Nature.*

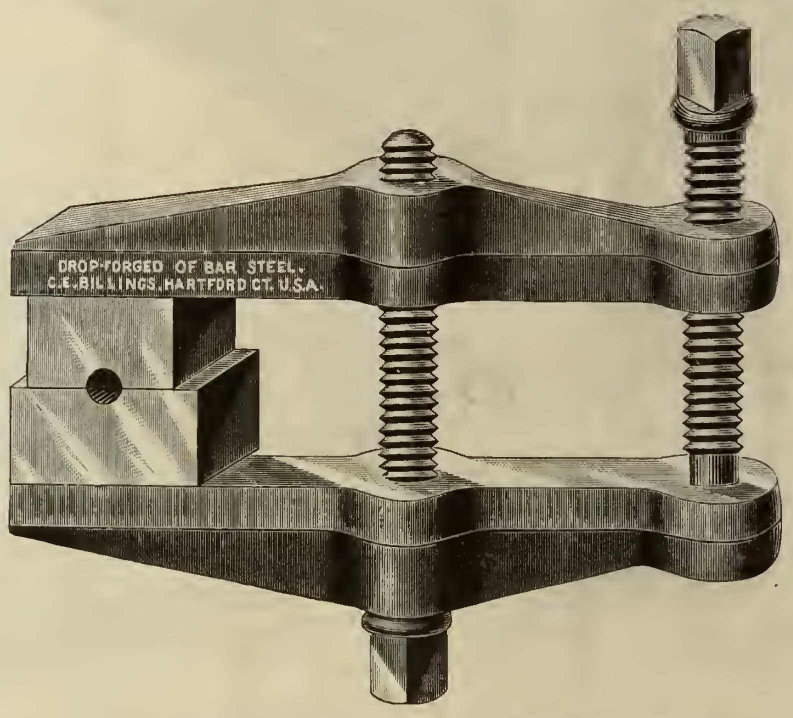
IF HISTORY REPEATS itself so do mechanical contrivances. A curious verification of this is found in a recent illustration of a gear cutting device used in the Dickson Locomotive Works at Scranton, Pa., for cutting a huge spur-wheel 43 feet in diameter. This identical arrangement, and the same cutting tools have been in use, for the same purpose, in the Columbian Iron Works, Brooklyn, New York, since Jan. 1882, over two years. It is the invention of Mr. Edwin S. Taylor, who modestly says it is possible that it was in use long before he made it.

PRESIDENT RUSSELL, of the National Marine Engineers' Association, Pittsburg, has issued the following card:

Brothers: Among the sufferers from the high water in the Ohio are many marine engineers and members of the Marine Engineers' Beneficial Association; and while we may not be able to discover them individually, your aid can be received if forwarded to the managers of the relief fund. Therefore it is my request and desire that the various associations, either collectively or individually, contribute as liberally as possible towards relieving their distressed brethren residing in the flooded districts.

AN INDISPENSABLE TOOL—THE BILLINGS & SPENCER CO.'S CLAMP.

The average clamp in machine-shops consists of two pieces of flat iron, more or less crooked in shape, and burred on the ends as the shear left them. The hole is in the center, or thereabouts, and there is sometimes a quarter of an inch of stock outside of it and sometimes more, as chance may favor. The operation is as follows: When such a clamp is put on the work the burr bruises the surface of it and the bolt, if screwed up, bends the clamp and shifts the work. Then the machinist gets angry and goes into the pattern-shop and appropriates the first wooden clamp he can lay hands on when the foreman is not looking in his direction. With this he can at least do something, but not much, for it is awkward, clumsy, and the hand-screws seem to be about twelve feet long.


DROP-FORGED OF BAR STEEL.
C.E.BILLINGS.HARTFORD CT. U.S.A.

The clamp shown herewith is an indispensable tool and one that will pay for itself the first time it is used, This is so apparent that we hardly think it necessary to point out its good features. The engraving shows it to be well designed for its work, stiff to resist buckling, and square as to its faces. It will hold so firmly that a good feed can be put on the drill without fear of shifting the work. As the legend on the side indicates, it is drop-forged from bar steel, and that means it is well made of the best material. Prices will be furnished by the Billings & Spencer Company, of Hartford, Conn.

THIS IS WHAT NOT INFREQUENTLY HAPPENS where motion is taken from an engine by gears:

> "An accident in the rolling mill of Wallace & Sons, at Ansonia, will delay a portion of the mills this week A tooth broke out of one of the large gear wheels, causing the breakage of four large gears."

The cost of this work would pay for belting a long time.

CHIEF NAVAL CONSTRUCTOR J. D. Wilson, is reported as saying that the *Chicago* (new cruiser) will not make over 15 knots an hour in a heavy sea, and he thinks she will fall much below that. This is a perfectly safe hazard, for no seaman would drive a ship at this rate under such circumstances, even if she were capable of it.

A RECENT NUMBER of *Engineering* contains an engraving of a compound engine, which may be called self-moving, inasmuch as it is without valves, the passages being so arranged that the pistons act as valves for the adjoining cylinders. This is an old device in this country, and was experimented with at some length in the Hicks engine of '74, or thereabouts. This in itself is antedated by the self-moving steam pump of Norman Wheeler, built at the Morgan Iron Works in 1853 or '54. In this latter the exhaust steam lifted the live steam valve, a performance which in itself seems rather paradoxical, but was, nevertheless, done.

SOME INDICATION may be given of the general state of trade by the following orders received within the last thirty days by the Babcock & Wilcox Company for their Water-Tube boilers: E. E. Greenfield, Sons & Co., Confectioners, New York, 164 horse power; F. O. Matthieson & Weichers, Sugar Refinery, Jersey City (6th ord.) 720 horse power; Washburn & Zerfas, Scranton, Pa., 61 horse power; Saginaw Manufacturing Co., Saginaw, Mich., 250 horse power; Paine Lumber Co., Oshkosh, Wis., 416 horse power; Northern Pacific Terminal Co., Oregon, 720 horse power; Butler, Macdonald & Co., New York (for export) 5th order, 208 horse power; Oliver & Roberts Wire Co., Pittsburgh, Pa., 2d order, 832 horse power; Public Baths, City of Mexico, 15 horse power; Sperry Electric Lighting Co., Omaha, Neb., 125 horse power; Studebaker Bros. Mfg. Co., South Bend, Ind., 4th order, 480 horse power; New York Produce Exchange, New York City, 624 horse power; Owen Pixley & Co., clothing manufacturers, Utica, N. Y., 30 horse power; B. B. & R. Knight, Grant Mills, Providence, R. I., 3d order, 272 horse power; D. B. & R. Knight, Natick Mills, 4th order, 720 horse power; Cincinnati Corrugating Co., Cincinnati, O., 73 horse power; W. P. Orr, Philadelphia, Pa., 104 horse power; Union Metallic Carriage Co., Bridgeport, Ct., 276 horse power. Total, 6,090.

Over fifty-three per cent of the horse power are from parties who have previously had these boilers in extended use.

RUNNING A LOCOMOTIVE THROUGH DEEP WATER.

A correspondent of the Cincinnati *News Journal* gives the following description of a railway experience during the recent flood:

"At Newton the train entered the water. Preparations had been made by banking the fire of the engine and laying in a good stock of steam. Deeper and deeper grew the water. A man stood on the platform beneath the headlight, and with a boat-hook turned aside driftwood which otherwise would have got under the wheels. The anxious passengers saw with dismay that the train was going slower and slower. The engine was like a mighty swimmer straining against weakness occasioned by buffeting with the waves. The piston-rods grew less vigorous at each stroke, and the exhaust made a noise almost human. Just this side of Batavia Junction the train stopped. After being three feet deep in water it was now only two feet. The engine took a rest, and another fire was made. One hundred and forty pounds of steam were got up. Then the train started again.

The water came over the second step of the coaches and covered the trucks. Three-quarters of a mile took eight minutes and a half to make the distance. When the engine struck dry land it had forty pounds of steam left, and the fire was out."

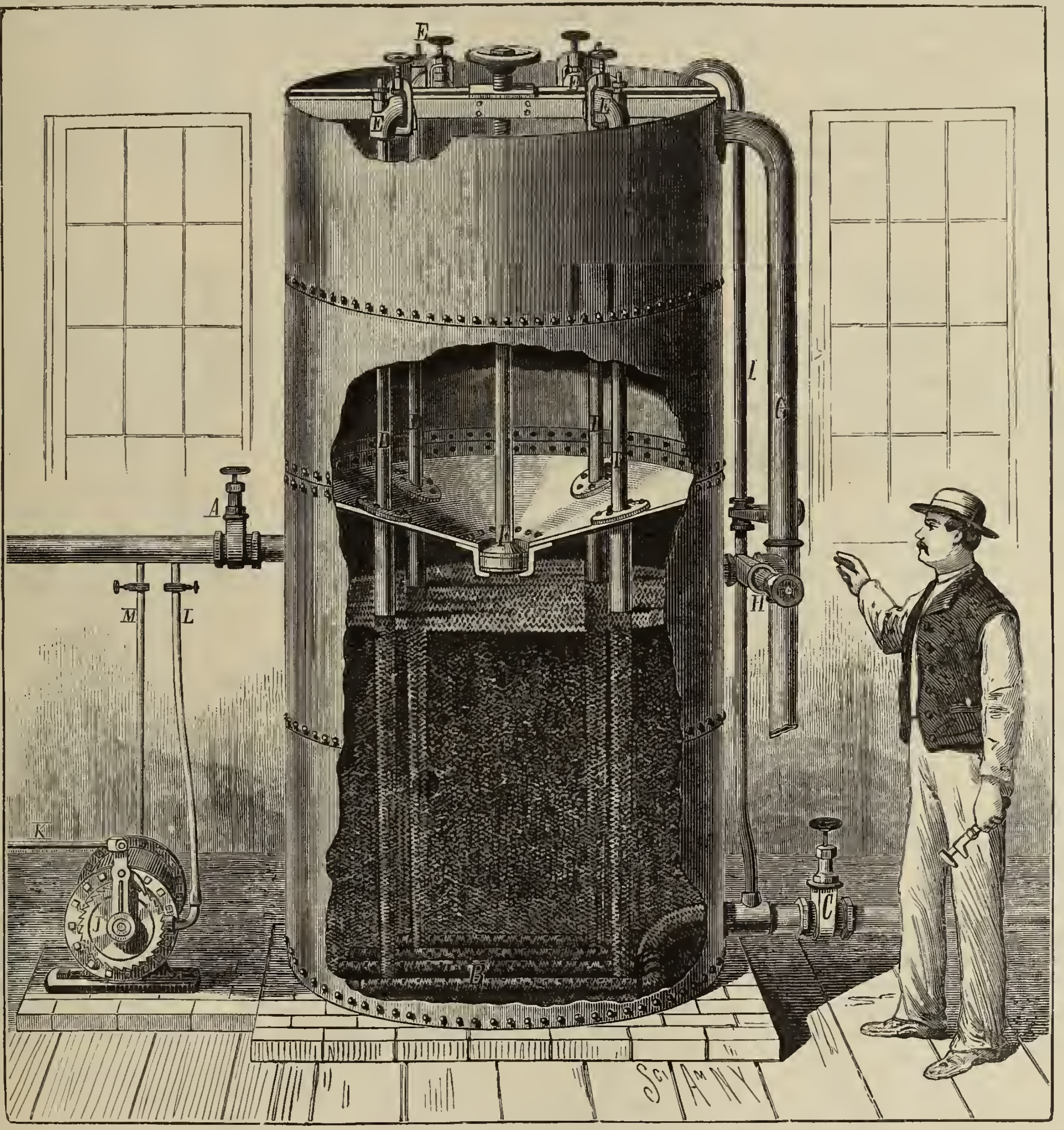
THE LARGEST COTTON MILL in the world is said to be the Ponemah, at Taftville, Conn. The old mill is 750 feet long by 75 feet wide, the new part 500 by 100 feet in dimensions. Both parts form a continuous structure.

NEW FILTERING APPARATUS BY THE NEWARK FILTERING COMPANY, NEWARK, N. J.

Pure water is one of the necessities of life, both from sanitary and commercial reasons, but in some portions of the country it is not obtainable naturally, and recourse must be had to artificial processes. The Newark Filtering Company, of 171 Commerce street, Newark, N. J., have for several years past been perfecting an apparatus for the purpose in question, and have succeeded in filtering water commercially, so that the cost of the operation is merely nominal. There are many ways of filtering which have been tried only to be abandoned; the quantity obtained being so small, in comparison with the time expended, that the methods were impracticable for manufacturing purposes. The Newark Filtering Company's apparatus accomplishes the desired end by the simplest methods, and while the process is rapid it is also perfect as to the results.

The reader will readily understand this by a brief allusion to the engraving herewith. In this the fluid to be filtered enters through the valve, *A*, and after passing through the filtering medium is discharged by the perforated pipes, *B*, and the valve, *C*, from whence it is conveyed wherever it is to be used. The filter bed proper is composed of either sand, coke, animal carbon, charcoal, or other agent best adapted for any desired purpose, but as a rule, for general filtering, the inventor uses a mixture of sand and granulated coke.

When the filter bed requires washing, the valves, *E*, in the top of the discharge pipes, *D*, are opened, and the outlet is closed. The water entering by the supply pipe has then no means of escaping except through the discharge tubes, *D*. As the water rushes up through these tubes it carries the filtering material with it, and discharges it through the valves, *E*, into the upper tank, which is full of water. In this tank the water, as it receives the flow from the filter beneath, effects a complete separation of the impurities that have accumulated in the filter bed, and they flow away with the excess of water through the waste pipe, *G*. Within five or ten minutes, according to the supply of water, all of the filtering material is thoroughly cleansed and discharged into the upper tank.



NEW FILTERING APPARATUS BY THE NEWARK FILTERING COMPANY, NEWARK, N. J.

Now the filter below contains only water, while the tank contains the cleansed filtering material. To return this to the filter, the supply valve is closed, the discharge valve, *F*, and the waste valve, *H*, are opened. Immediately the contents of the upper tank commence descending through the valve, *F*, the filtering material settling in the filter, and the excess of water escaping through the waste valve, *H*. In this way the filtering material is speedily returned to the filter, receiving an additional rinsing by the water through which it falls, and settling in the filter clean as new and ready again for work. Then the valves, *E*, *F*, and *H*, are closed, the inlet and outlet valves opened, and filtration is resumed through a completely renovated filter bed. The water used in washing the filtering material being unfiltered will not immediately issue perfectly clear, and it is therefore discharged through the pipe, *I*, into the upper tank, where it remains for use in the next washing. By the time the tank is filled, the water comes from the filter perfectly clear, when the valve in the pipe, *I*, is closed, and the filter discharges bright, clear water for consumption.

In some cases chemical agents are used in very turbid liquids, to assist in throwing down matter held in suspension, and facilitate the final filtering. These agents are introduced by the auxilliary injector shown on the left, a detailed description of which is omitted. The chemical agents used are those well known in the trade, and are wholly harmless to the fluid filtered, both from sanitary and commercial aspects.

The results obtained by this apparatus, as a whole, are exceedingly satisfactory, and may be understood when we assert that Mississippi water has been turned out of it as clear and bright as spring water. This result has never been practically attained by any other process that we know of. During the last summer one of these filters eight feet in diameter was erected at the New Orleans Water Works, taking the water directly from the Mississippi river, and delivering 150 gallons per minute as bright and clear as could be wished.

The company have also erected at New Brunswick, N. J., in the Norfolk and New Brunswick Hosiery Mill, three filters, each 6½' diameter, with a capacity of 500,000 gallons of filtered water in twenty-four hours. This water is taken from the Raritan, a shallow river, which is sometimes as muddy as the Mississippi. These filters are exactly as shown in the engraving. Even sewage water can be rendered bright and inoffensive by these filters.

From all that we can learn the results here stated are not experimental trials, but regular duty, which can be relied upon daily. The importance of them to very many interests is too apparent to need comment from us. It should be borne in mind, however, that filtered water is not distilled water; many persons do confound the two, and will not use filtered water under the impression that it is deprived of its natural constituents, and is therefore more or less injurious. Filtered water is only natural water with the dirt taken out of it.

Parties having further interest in this matter are invited to correspond with the Newark Filtering Company, Newark, N. J.

INDEPENDENT CUT-OFF VALVES FOR LOCOMOTIVES.

In an interesting monograph upon the subject of high speed on the present roadbeds, Mr. W. Barnet Le Van alludes to the matter mentioned in our caption as follows:

> "What valid reasons are there for not using independent cut-off valves on locomotive engines? They were used years ago with great success both in this and other countries, and were found very efficient. The advantages of independent variable cut-off valves, as compared with the ordinary valve controlled by the shifting link motion, are that the former open and close more quickly and with less friction; they waste less steam, as indicator diagrams show, in the steam ports; they waste no steam by wire-drawing, and they give a maximum mean pressure, a minimum back pressure and, practically, no compression; they measure out, for each stroke, exactly the amount of steam required to keep the speed of the engine at its prescribed rate, no matter (within certain very wide limits) what may be the resistance. If greater resistance comes upon the engines the steam is admitted for the full stroke of the pistons; the ordinary amount of work can be done by the admission of one-eighth to one-fourth stroke, according as the engines have been proportioned to their average work, and if a small amount of work is to be done, the pistons get just steam enough to keep them moving at the prescribed speed the train is moving. That an independent cut-off valve gear has more parts than the ordinary slide-valve with shifting link, admits of no dispute, and it is, to a certain extent, complicated. Yet the moving parts are subjected to a very small amount of strain, and are not more liable to get out of order than the slide-valve."

So far as complication is concerned it cannot be urged as an objection to the use of independent cut-off valves. The fixed link, and one connecting-rod from an eccentric, or return-crank, comprise the "outfit," and these are certainly not open to the charge of complexity.

Mr. Le Van is undoubtedly correct in his conclusion as to the benefits to be realized by independent cut-off valves, in lieu of performing that service by the link, as is now commonly done, but we fear that neither in his day, nor ours, shall we see it generally adopted. Some individuals, with the courage of their opinions have adopted (re-adopted, perhaps we might say), the independent cut-off valve, notably Mr. A. J. Stevens, of Sacramento, Cal., but to hope that master-mechanics generally will do so is asking too much. The link is handy, it is in place, the engines are all adapted to it as regards steam-chests, and, in short, it is so firmly established that nothing can depose it; not for the present at any rate.

The Marine Record of Cleveland has an account of a new engine "invented" in that city which, by the aid of supplementary steam valves, gets more pressure in the cylinder than there is in the boiler, and publishes indicator cards to prove it. The result aforesaid seems too good for even the inventor to believe, and he somewhat deprecatingly observes:

"A trial made with one steam port and chest showed as good results as could be gained from any ordinary steam engine now in use, but by turning on the steam on the opposite side an additional power was produced of at least fifty per cent, which can only be accounted for by the concussion caused by two currents of steam coming together from opposite ports, or by the liberation of latent heat not heretofore utilized by the old way of applying steam to a cylinder, as either of the steam ports were of sufficient size to more than supply all the steam necessary when run separately. This improvement can be applied to any engine now in use, the only change necessary being that of cylinder and valve gear."

Our friend must see that if he "liberates his latent heat" he gets water in his cylinder, which certainly will not exert much force, and also that he cannot get more out of any thing than there is in it. When one obtains such results from an experiment it is the safest way to discredit it, promptly.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

THIS LETTER IS PRIVATE.

Editors Mechanical Engineer:

If you had come to me in Ohio about thirty years ago, and asked me to tell you about the "boiler of the future," I would have done so promptly and willingly; but now I am in two minds about it. In fact I don't think I *will* tell you just now. You see a man can forget a good deal in thirty years, and find out a great many things that are not so, besides. I have moved since then, and from living in "the huckleberry district" have become economical, and a little averse to telling all I know; still more averse to telling all I don't know, from Western principle, which still lingers, as an odor, at least.

But I am free to talk about some boilers of the past —one of them, anyhow. I came across this one at first, in a drawing, which was so well executed that a prodigious circulation was plainly shown, if not exactly proven. It was a sectional boiler, and so well contrived that its inherent tendency was to put itself together and come apart spontaneously for repairs; which, by the way, it would never need in the nature of things. Whether it would tend to assemble after being repaired I have never found out; that was beyond the domain of the manufacturer. But when he weighed the coal, measured the water, and let the steam blow off, the roar and efficiency were bewildering; those who heard and saw were convinced and said a boiler with such a circulation ought to exclude all other types and circulations, inasmuch as in several direct experiments it had disposed of n pounds of water per f pounds of coal, with no stimulus of competition. Some coal-man wanted to know if all the water "disposed of" was made into steam or—but he did not want to be convinced. Grumblers, doubters, and persons who asked questions about other people's affairs abounded in those days, and were too numerous to be ignored. So they are now. Yet that man's impertinent question really annoyed some of us who knew all about such matters, and, as his questions showed that he had no means of, or brains for, knowing anything, we could not see why he should presume to raise queries, or be allowed to propound them, to our contempt and disgust!

Well, one of these boilers went together in a place where no man would go, if he could avoid it, to show what it could do, and to help a decrepit common boiler which was overworked. The old boiler was helped so well that it never needed to be fed afterwards, but it did need frequent blowing off, for the pipe of the new boiler led into the dome of the old one.

When the coterie of hard-headed conservatives fully sensed what this meant, they thought of the coal-man's question and took a gloomy view of the future!

Perhaps I will tell you about some more boilers of the past, and, maybe, about one or two of the present, in the near future.

Maine. Endoxus, Jr.

[As stated in our caption this letter is private, and of course no gentleman reads a private letter, merely because he has an opportunity to do so. Nevertheless if any one does read this, by misapprehension or otherwise, we trust that he will enjoy its spirit as much as we have. We hope, also, that the reader will bear witness to what the writer says at the close, and hold him to his promise. He is a man of high reputation, with a third of a century's experience in mechanical engineering, and is now at the head of a large marine-engine works, consequently his experience is most valuable.

The writer mentions—that in the event of a certain contingency—which we have provided for, he will tell what he has seen in some lines of the profession. We trust that the astute reader perceives that this is an obligation of the most binding character.—Eds.]

AN AMUSING COMMUNICATION ON THROTTLE VALVES.

Editors Mechanical Engineer:

In a late number of your paper I saw an illustration of what purports to be a *new* form of stop and throttle-valve for stationary and marine engines. I know how exasperating it is, whenever a new invention is illustrated and described, to have some fellow "pop up" and say that he either made, or used, just such a thing years ago; but so it is, and so it ever will be, until the end of all inventions and inventors.

Many years ago, Mr. Ethan Rogers of the Cuyahoga Works, Cleveland, Ohio, made a circular disk throttle-valve which was operated by a hand-lever, and used mostly on propeller and tug engines on the lakes. They were generally used on steam pipes from 7" to 9" diameter, which, filled with steam at 80 to 90 lbs. pressure, meant a pretty lively tussle between the engineer and the lever whenever the engine was to be started. Very often when the engineer had mastered all his strength for a final pull, the opening of the throttle would be so sudden that the engine would severely test the lines by which the boat was fastened to the dock before it could be checked. To obviate a necessity for this long and strong pull, and the consequent sudden opening of the throttle, some light-weight engineer (name unknown) invented the supplementary action of a stick of cord-wood on the end of the lever, and on the river tug-boats. Where the starting and stopping of the engine was a frequent occurrence the engineers became expert batters. About 15 years ago, after witnessing one of these hand-to-club contests, the writer made the further invention of placing a small auxiliary valve on top of the main throttle-valve, so that the first movement of the lever, opened the small valve, which had several ports through it and through the large valve. Through these ports steam enough would pass to handle the engine slowly. If more steam was wanted, a further movement of the lever would bring the small valve against a stop on the large valve, and it would be easily opened, because the pressure had been largely taken off it by the opening of the small valve. Thus the throttle could be readily handled, and the stick of cord-wood ceased to be a part of an engineer's "kit."

Now I know that the above-written statement, is, in fact, an illustration of what I said at the beginning, but it is nevertheless a frigid fact, as many an engineer on the lakes can testify.

Cleveland, Ohio. Cleveland.

[We find our correspondent's communication very amusing, but we don't know what would become of inventors and the patent office if every "new thing" was traced out to its original derivation, or reduced to its lowest terms. Nothing is more common than to find patents issued for devices which have been used since the time of the first artificer, almost. We have given up trying to find out why long ago.—Eds.]

AS TO LICENSES.

Editors Mechanical Engineer:

I have been a reader of your valuable paper for the past year, and I have learned a great deal from it. I would like to ask you a question. Can a young man get a Stationary Engineer's certificate if he thoroughly understands the management of engines and boilers? I have had charge of a 12 h. p. engine and 20 h. p. boiler for the past three years without any accident as yet. Should a person be expert in arithmetical calculations before he can get a certificate?

I think The Mechanical Engineer is the best engineers' paper printed. I get it from a newsdealer here at 10 cents a copy, but I would not be without it at 25 cents a copy. I do not say this so as to get you to answer my questions, but to do your paper justice.

San Francisco, Cal. E J. H.

[Our correspondent has omitted to give his full name; this was probably unintentional on his part, but it is a formality which should always be observed in writing to newspapers. Anonymous letters do not receive the same consideration that others do.

The question asked by our friend is one we cannot answer. He is entitled to a certificate upon the qualifications he mentions, but men do not always get their deserts. Sometimes prejudice intervenes, and certificates are unjustly withheld.

It is difficult to see how an engineer can get along in his profession without a knowledge of arithmetic. The mere routine he can manage easily enough, but if he wishes to make comparisons, or find out what his engine and boiler are doing, whether they are working economically or not, we don't know how he is to come at it unless he uses figures. We thank our correspondent for his good opinion of our paper and our efforts to interest the trade.—Eds.]

A SATISFIED MAN.

Editors Mechanical Engineer:

I read the ——— and other papers of that kind, and I willingly, in fact am anxious, to aver that The Mechanical Engineer being simpler in its treatment of scientific and mechanical subjects, thereby making them more readily understood, is *the* paper for mechanical engineers, of which craft I claim to be one. I hope the articles upon the Indicator will be continued indefinitely, and I would like to say that the controversy in your columns upon the subject of compression, in my opinion set many readers to thinking, and consequently was prolific of much good. I am a compressionist, if I may be allowed to use the term.

I hope we shall see something upon the merits, demerits, and peculiarities of the different American stationary engines, from practical engineers, or others, from their standpoint.

Boston, Mass. E. M. Sawyer.

[Mr. Sawyer's good opinion of our efforts is one of many we are regularly in receipt of, from every part, and this, in connection with more tangible evidence in the shape of renewals upon expiry, and new names from everywhere, leads us to believe that our methods of plain, straightforward communication, as between man and man, are endorsed by the profession. An editor is only a man and as fallible as other men. We never could see any reason why he should mount stilts and assume a prescience, or foreknowledge, that is more than human.

What our correspondent says about discussing the merits and demerits of different stationary engines would not work very well. Manufacturers are willing enough to have their merits discussed, but the demerits —no, sir. We printed a card once and stated it was taken from a certain engine. The paper had hardly time to reach the makers of the engine before we received a cast iron communication on the subject. The card was not a very good one, you see.—Eds.]

BY FAR TOO COMMON.

Editors Mechanical Engineer:

We shall be pleased to receive your paper as a donation to our Free Reading Room. It would be of great benefit to those desiring information from your State and city, and would thus aid us in our efforts to help young men. Will you not kindly advise us of your intention to send it, on the enclosed postal and oblige

Brooklyn, N. Y. J. Harry Gould, *Librarian.*

[We do not see any reason why we should comply with the above request, which is only one out of dozens from, literally, all over the world. Apparently some libraries exist only by the charity of publishers, and librarians seem to feel that compliance with their demands is a matter of course. Precisely what credit attaches to the Young Men's Christian Association for establishing a free reading room under these circumstances does not seem clear to us. It rather seems as if publishers established it and the Young Men's Christian Association claimed the credit therefor. In any event, the Young Men's Christian Association are able to pay for such literature as they deem necessary to their purposes, and they can procure The Mechanical Engineer upon the same terms as others, $2 per year. This library donation business is not by any means a deserving charity, in many instances, for the authorities count on stocking their rooms vicariously and devote the money which should be used for it to other purposes.—Eds.]

TEMPERING STEEL IN A WOOD-FIRE.

Editors Mechanical Engineer:

Will you (or some of your many readers) please tell me why it is that I cannot temper steel, such as chisels, drills, etc., in a wood-fire. My experience is that it makes no difference whether the fire is of hard or soft wood. The result is invariably the same, viz., tools too soft, even when I do not attempt to draw the desired color, but slack (or cool) off at once; the tool is still soft. I suppose that the wood-fire has some chemical effect on the steel. I would like to know what is the cause of my failures, and if it is possible to temper a tool in a wood-fire. Your constant reader,

Jno. Stables,

343 Harrison St., Petersburg, Va.

[We do not know the reason why steel will not harden in a wood-fire, if such is the fact. We have consulted a number of modern works on metallurgy, but find no reference to the subject in any way. If he heats the steel in the flame of a wood fire there may be a difficulty, as is stated, but we cannot see any, if the steel is heated hot enough. We shall be glad to hear from others on the subject, and have the fact established.—Eds.]

NUMBER 44 M. E. B. A.

Editors Mechanical Engineer:

I am in receipt of a letter from Bro. Wm. E. Elliott, Manistee, Mich., stating that he had instituted *M. E. B. A.* number 44 at that city, on the 24th inst., with 15 charter members. Bro. Elliott reports that he has no doubt but that this association will flourish, as the members and officers are all first-class engineers, well informed in their profession.

The officers of Number 44 are: President, Allen McKee, Vice-President, John Durr, Treasurer, Joseph Rumbell, Cor. Secretary, Wm. B. Lewis, Box 123; Rec. Financial Secretary, Wm. Nettle; Chaplin, Jerry Dinehart; Conductor, Timothy Hudson; Doorkeeper, Wm. Cavanaugh.

I send you a copy of the resolutions sent me by M. E. B. A. No. 6, of St Louis, with a copy of my reply to the same.

Detroit Mich. Jas. H. Reid.

[The resolutions aforesaid are very complimentary, but not more so than is just. They allude to Mr.

Reid's efficient service and his report when President of the *M. E. B. A.*; we are under obligation for an opportunity to read them.—Eds.]

WHY THE ROCKER ARMS ON LOCOMOTIVES ARE NOT IN LINE.

Editors Mechanical Engineer:

I would like to take the advice given in your last paper by Mr. Geo. Slocum in his article, "*How I Served My Apprenticeship*," and ask a question, that is: Why the rocker-arms on a locomotive are not in line with each other? I have often taken a squint at this and never exactly understood why the lower arm was nearest the driving axle. If you or Mr. Slocum will explain I am sure other apprentices will profit by it.

N.Y. An Apprentice in a Locomotive Shop.

[Rocker arms must stand at right angles to the line of motion. In the eccentric connection this is at an angle to the horizontal line, therefore the lower rocker-arm must be moved out of line with the upper.—Eds.]

IS THIS FAIR CRITICISM?

Editors Mechanical Engineer:

I am interested in the apprenticeship papers, but I would like to ask "George" if the "Limited," made up of heavy Pullman's and fast time, ran when he was serving that apprenticeship, or is serving it?

Ohio. George Nash.

[This is hardly pertinent, nevertheless we print it. Mr. Nash—if that is the correct signature—thinks he has detected an anachronism, or discrepancy in dates which is worth noting. In reply to his question we may say that George served his apprenticeship since the Pullman cars came into use.—Eds.]

THE PIONEER OF CIVILIZATION.

From D. C. Cregier, Eng., Pres. *Western Soc. of Engineers*, we have a copy of the *Journal of the Association of Engineering Societies*, which contains, among other things, a report of the financial status, by which it appears that there is a balance on the right side in the treasury. The President in his address to his confreres says this also:

> "It may be claimed, that in the domain of practical thought and action the engineer of to-day stands in the front rank. He has become the pioneer of civilization. The material monuments throughout the land, the wealth of communities, and the colossal fortunes of individuals attest his skill, courage and devotion in the pursuit of his calling, and stamp him as an important intellectual factor in the success of men and in the general progress of our time.

Sound in theory, precept, and assertion.

THE "LOWER RANKS."

Even in trade-papers we sometimes come across the expression "lower ranks," as applied to mechanics. What does it mean? Certainly not that a man's calling makes him low. There is no such thing as "a rank," or "classes" in this country, if these terms are applied in an objectionable, or degrading sense. The "lower ranks," to retort with the same expression, are found in jails and poorhouses. They are men too vicious to be at large, and men too lazy to work; as mechanics are not of this character manifestly they do not belong to the "lower ranks."

The Manhattan Elevated Railway Company of this city is using phosphor-bronze in its main axle boxes, and finds it exceedingly satisfactory. Formerly, many broke when made of cast iron, but the substitution of phosphor-bronze remedied that trouble. Pound for pound phosphor-bronze costs more, but when the labor of fitting the brass into the cast-iron pedestal-box is considered, there is little difference in the cost of phosphor-bronze and the regulation box, while the former is far stronger and more durable. The Philadelphia and Reading Road, New York division, are also using it for slide valves, and find a great economy in wear and repairs.

The *Northwestern Lumberman* says: "Formerly it was supposed that to ascertain how old a tree was, it was only necessary to count its rings, or what was assumed to be its yearly growth. But men who do not think they are bound to believe what their grandfathers did, have made investigations, and assure us that from these rings the age of a tree can be told about as accurately as the age of a cow can from the number of wrinkles in her horns. This refers more particularly to a very old tree, although a man is liable to be fooled on a young one. Just how many years the monarchs of the forests have stood seems to be one of the things past finding out."

THE AMERICAN LOCOMOTIVE THE BEST.

The *English Mechanic* says: "Although the average speed of trains in the United States is 20 per cent below the mean speed of trains in this country, all things considered, the service controlled by the American engineers compares favorably with any in the world. The American engineers at first copied English builders, and made locomotives with single drivers; but, as is their wont, they quickly made improvements, and we are not disposed to dispute the dictum that the American locomotive of to-day is one of the most perfect pieces of mechanism wrought out by the hand and mind of man."

The *English Mechanic* should not say such things; it is very impolitic, and calculated to awaken the ire of its contemporaries at home.—Eds.

HOW TO WORK BY THE DAY.

A Detroiter who was taking a newly arrived Englishman around town the other day happened to pass a carpenter shop, and the Englishman remarked that he had always heard that American workmen were rather slovenly and careless.

"We will go in and see," was the reply, and they entered and sat down to wait for the boss. The carpenter was using his brace and bit to bore holes in a frame of some sort, and after each hole was bored he had to insert a wooden wedge. When he had bored a hole he would walk off two feet and hang up his brace, which would be wanted again in about two minutes. After whittling out each wedge he would turn and place his knife on a shelf, and every time he wanted his hammer it was on the bench six feet away.

"Ah! I find I was sadly mistaken," said the Englishman, as they finally departed. "That man had as much order and system as any workman I ever saw in England. He must have occupied four-fifths of his time walking back and forth for and with his tools."

"Yes, he was working by the day, you see!" explained the citizen as they walked on.—*Detroit Free Press.*

A well known technical writer of this city was recently asked his opinion of a certain make of machine-tools, and his answer was so unfavorable, and accompanied by such unnecessary detraction, that the querist was surprised, and thought he had better see for himself. He did so, and the result was that he bought $3,000 worth of tools; but our disparaging friend received no commission therefor, and is remembered by the machine makers—to whom the report was given—not as one who loves his fellow-men. Moral.—$300 is too much to pay for the pleasure of slandering manufacturers.

Most people think that sleeping car charges are sufficiently high in this country, but, in comparison with those made in Europe, they are merely nominal. According to a paragraph in the *Railroad Gazette*, the charge for 21 hours' accommodation in a sleeping car on the South-eastern Railway of England is $17.10, in addition to the regular fare. The conclusion we arrive at is that the passengers who use such accommodation at the price, belong to the class who are said to part very easily with their money.

The direct result of a notice of this paper in some good-natured Canadian contemporary, unknown, has been a large influx of letters from one Province. These letters all refer to some "guide" we are said to publish. If we only knew what the notice said, what paper it was published in, and what guide it is we publish, we should be in less of a fog than we are at present.

The steamer *Great Eastern* has been purchased by the English Government for a coal hulk, to be stationed at Gibraltar.

QUESTIONS ASKED CANADIAN ENGINEERS.

The *Kingston News* says: A candidate for third-class engineer must have served an apprenticeship of not less than three years in a marine engine shop, and been employed on the making and repairing of such engines; or, if he has not served such apprenticeship, he must prove that he has been employed for no less than three years as a journeyman mechanic in some workshop on the making and repairing of such engines. In either case he must also have served twelve months in the engine room of a steamboat as engineer on the watch; he must be able to describe the boilers he has been accustomed to watch, their weak points, (if any), the feed-water arrangements, steam-pipe, valves, and safety-valves, and their capacity and efficiency; he must have sufficient knowledge of the condition of the boilers to know if they are safe at the working pressure carried in them; he must know the method of lining the engine, setting the valves, and adjusting the connections; he must write a legible hand, and know the first four rules of arithmetic. A second-class engineer, besides the qualifications of a third-class engineer, must have twenty-four months' experience in the engine room of steamboats of not less than thirty nominal horse-power, as engineer on watch.

Messrs. Hofmaster and Arthurs, in the employ of the Penn. R. R., have invented a method of lubricating locomotive piston-rods which has been patented, and a right to use purchased by the company aforesaid.

The patent is on a chamber in the gland for containing waste and suitable lubricating material, which surrounds the piston rod and extends through the upper edge of the flange; this is widened to increase its capacity for holding the material, and to provide for filling the chamber without having a removable part to the gland; accomplishing the desideratum of making the gland in one piece, and increasing the capacity of the chamber.

In Fall River a saving of $404 per month has been recently made in one of the mills by the employment of a capable engineer who re-organized the steam plant.

The *American Manufacturer* says this, and we are glad to see it lending a hand to the craft. If it will only talk up capable engineers, and talk down the incapables, the manufacturers' millenium—where every one makes large profits—will soon come.

What is the matter with this man? We allude to a communication from a civil engineer, going the rounds of the press, wherein he says the extension leg in the regulation case of instruments is unsatisfactory and won't work. To remedy this defect he says he makes a rat-tletrap out of two corks, and a water-gauge brass rod, and has a device which suits him much better.

Dear, dear, what a lot of cranks there are still extant!

The indicator cards shown in our last issue, as taken by Mr. N. W. Williames, were traced *seventy times*, instead of seven, as we stated. This is quite a difference, and we regret that the error should have occurred, for the variation in the expansion line is very slight, when the number of revolutions is taken into account.

On her last passage to this port the *Servia* had great trouble with the crank-pin of the high pressure cylinder. The babbitt was melted out three times during the voyage, and so much bother was occasioned that the return trip will be made without babbitt on the brasses. It is to be hoped the crank-pin will not be melted this time.

A curious car is now building at the Atlantic Works, East Boston. It is of steel, ten feet in diameter, fifty-four feet long, and perfectly circular.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors,

150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

AS TO THE MATHEMATICAL FACULTY.

Some time since we ventured, in a book review, to criticise the practice of some writers for mechanical engineers who couched their calculations in mathematical expressions unfamiliar to those who had not had liberal educations. Thereupon a contemporary took us to task severely, saying that a so-called practical journal ridiculed mathematics, and that it had only contempt for such a journal. This made us feel very badly; first that we should be accused of a disrespectful bearing and carriage toward mathematical subjects, and secondly, that our contemporary felt contempt for us. After meditating upon the matter many weeks and trying to see our error but failing therein, it was some alleviation of our suffering to light upon this passage in the London *Engineer*. It occurs in an article on the "*Education of Engineers*" and seems to be so incendiary and subversive, that we hasten to quote it, in the hope that some one will feel contempt for it also, and shoot the arrows of their wit at it. The passage is this:

> "But let us ask the great mass of mechanical, or civil engineers, how often they find themselves called upon to make use of the higher mathematics, (which are supposed to replace Latin and Greek) in the pursuit of their calling? The immediate practical value of one is about as great as that of the others. Fortunately, or unfortunately, a very moderate acquaintances indeed with mathematics will enable the engineer to build steam engines, and railways, and ships; and the nature of the work which he has to do appears to be so far antagonistic to mathematical methods of thought that the executive engineer, as we may call him, finds it far more advantageous to employ a mathematician to make his calculations for him—when these present difficulties—than to make them himself. No matter how expeditious a man may be, calculations take time to carry out; and the engineer in large practice will soon find that it is better to spend twenty guineas paid to a professional mathematician, than as many hours of his own far more valuable time. * * * * It is a noteworthy fact that our railways, docks, canals, steamships, mills and mines, have all been given to us by men comparatively ignorant and untutored. No book learning made Rennie or Stephenson, or Brindley, or Trevithick what they were. The combined literary knowledge of the whole of them would not enable one student to pass out of College; but they were men who could think. No book knowledge, nothing in short that can be acquired by reading, will enable a man to take charge of other men and construct a railway, or a steam engine. But reading will so enlarge his mind and strengthen and develop his mental muscle, that he can adapt himself to circumstances; and while it is certain that no mere book learning, or cramming, will make an engineer in the present day, it is equally certain that without education a man can never expect to be aught but the servant of others."

We make no comment upon this, but can it be gainsaid that the mathematical faculty is as distinct and peculiar as the poetic or artistic? It would be just as sensible for an artist to feel contempt for men who cannot color, or draw, as it would be for a mathematician to despise men who cannot calculate readily. There are a great many who cannot. There are engineers of ability in the world to-day, who cannot do more than add up a column of figures, who cannot do that twice alike, or swear to the result at any time. Incredible as this may seem it is fact; but what of it? It simply shows that the mechanical faculty is as distinct and separate as any other mental qualification. On the other hand there are thousands of mathematicians who cannot comprehend mechanical motions, and can no more solve a problem in that line than the engineers can in mathematics. Plenty of mathematicians can give the solution of any problem, but to apply the solution to any practical use—there they stop. Their figures lie inert and dead, as useless as so many bird tracks in the sand; it is rarely that the mechanical and mathematical faculties are combined in one person.

Let us not feel contempt for any one whose intelligence does not travel in the mathematical, or any given line. It is a narrow judgment, and a superficial view which says that this shall be the test; that he is a weak brother who cannot achieve higher mathematics, or is unfamiliar with things which are only A B C to us. Men arrive at the same terminus by different methods, and the pencil of the mathematician is not so swift as thought, inspiration, or that other sense—mechanical intuition. Mathematicians deal with quantities, but it remains after all is said, for the engineer to dispose of those quantities to the best effect.

CONCERNING SCIENTIFIC SOCIETY PAPERS

The *Railway Review* has some very sensible remarks upon publishing papers, and the proceedings of engineering societies. It argues that the public should know what is being done promptly, and that the publication of papers months after the delivery of them in session, gives "a general flavor of mild decay," though our contemporary does not use this precise expression.

Without specifying any one society it seems to us that our contemporary has stated the case exactly. What societies of engineers need, to attract membership, is publicity.

Without increased membership they degenerate into mutual admiration societies. Those to whom the gift of extemporaneous speech is given exercise it when the spirit moves them. After a while their experiences are told, and the meetings are not so interesting as they would be with new men and fresher experiences. Again, the proceedings of societies obtain no circulation through the journals published by such societies. They are dead and buried therein. If published in the papers of the day they are read by all. They stimulate thought and directly assist the progress of the time. They develop the truth. Mr. A., in his society, states a fallacy. His associates possibly overlook it, or omit to observe the error, but the outsider, moved by no consideration but an ardent love of truth, bears down and establishes a fact in the place of fiction.

One point our contemporary will permit us to add to its consideration of the matter discussed, and that is the want of business management which characterizes all societies we have had any dealings with.

Secretaries, in our experience, consider their duty done when they have mailed a few copies to the older journals in existence. When it comes to those comparatively new, like our own paper, they receive an occasional copy only.

The inference in the mind of some may be that we are taking an opportunity to air a personal grievance in this line, but nothing is further from our intention. We have no grievance, but our experience explains the absence from our columns of records of societies, or any publication of their doings.

The secretary of any society should be paid for his work, and when so paid should perform the duty attaching, precisely as if he was in a counting-room. No laxity or remissness should be tolerated. A society which has a secretary of this kind is to be congratulated.

THE TRACTABILITY OF STEEL.

It would be difficult, we think, to find a metal in so general use as steel, concerning which such diverse opinions prevail as to its treatment. It is not a great stretch of fact to say that nearly every shop which uses steel to any extent manipulates it in a different way. No trouble is experienced, although the same steel in another shop may have been worked by directly opposite, or at least widely varying processes.

We have seen, to be more specific, cast-steel worked at heats which even the manufacturers of it condemned as injurious, but which did it, apparently, no harm; and individuals in various shops are, at this day, pursuing methods of hardening which they only can practice successfully.

It is fortunate for steel makers that this is the case, for in any other event, if steel could only be worked by one process, it would be far less popular, for there would be individuals unable to master its secrets.

We hope that we have not given the impression that we think cast-steel can be worked haphazard without injury—for that is very far from our intention, but it is unquestionably true that, for the same carbonization, very different methods of treatment prevail.

Much of the trouble found with steel shapes, forgings, etc., arises from defective methods of working it. Mr. J. D. Campbell, of the Manhattan Elevated Railway Company's shop in this city, recently showed us an instance of this. The crank-pins on their locomotives are of steel, and they used, when forging them, to shoulder down the bearings to within an eighth of an inch of the finished size. The breakage in use was excessive, and in pursuance of an idea Mr. Campbell split a pin lengthwise and found an entirely different structure, or crystalization at the shoulders. This was the point of fracture. Taking a hint from his observation, the bearings were only slightly fullered out on the pins, leaving a greater quantity of stock to be turned off in the lathe. The result was almost total cessation of the trouble, or so near it that not one has broken in three years.

It is the experience of all steel makers that lots are often condemned for no intrinsic fault in the material itself; the trouble laid in the manner of handling it. Some steel-workers are willing to admit this, but others are so stubborn that they can see only one thing—the steel cannot be worked by their methods, and is therefore worthless.

This is proven by sending the same lot of steel to other parties who find no trouble whatever in using it. For the matter of that the condemned stock is often shipped directly back to the same parties who complained of it, mixed up with other stock, without detection.

For a metal of such marked characteristics, steel is certainly one of the most tractable metals in the shop.

WAS THIS ANSWER CORRECT?

A correspondent recently asked us to give him by mail the relative speed in feet per minute of articles ground when revolving between centers: the relative speeds of work and wheel. We could not do this for we did not know, and answered that work varied so much in dimensions that we did not see how any law could apply. Further: that the emery-wheel was only a revolving tool and that the speed which answered for turning the work ought to answer for grinding it. We don't know whether we were correct or not, and will thank any who will inform us.

THE MASTER AND THE PEDANT.

The difference between the master and the pedant is shown most forcibly in Ericcson's contribution to *Nature*, published on our first page, on the subject of the "*Sun Motor and the Sun's Temperature*." In a space of a few columns, including cuts, the master has presented a clear and readable account of his invention, in itself a somewhat abstruse subject. The calculations are within the reach of any one, and the argument is so plain that it can be accepted or rejected upon its merits.

With such an opportunity for the display of erudition what would a pedant not have done? He would have blackened countless pages with diagram upon diagram; he would have gone from incoherency to incoherency, ending in hopeless obscurity.

This monograph of which we write is perfect of its kind. If all who have new, or unusual, inventions to describe would use it as a model they would greatly lighten the labor of readers.

AN IMPORTANT MATTER.

If engineers are to be licensed, in order to be guaranteed as safe and desirable persons to be in charge of steam machinery, then it is a matter of importance that they should be honestly examined as to their capacity. Pique, or personal dislike, should not have any bearing on the subject. Inspectors should be chosen solely for their undoubted qualifications, and, beyond all, their personal integrity. In a word, "square men," so-called, are needed as inspectors in every instance.

The chances of life bring men into antagonism sometimes, and cases occur where inspectors are called upon to pass upon the qualifications of individuals with whom they have had disagreements. It is manifestly improper, and a gross abuse of position to permit such personal disagreement to have any influence in granting licenses. A personal enemy of an inspector should receive every chance of proving his ability, to the exclusion of all other issues. Also, the practice of asking catch questions, or those which have, practically, no bearing upon the candidate's fitness should never be indulged in.

Trifling in such positions is beneath the office and purpose of an inspector, who is solely and only a public guardian, appointed to deputize individuals to hold places where life and property are exposed to danger.

As to licensing engineers there is, in our opinion, no sort of doubt as to its necessity. No man holds a more important post, and so soon as it is made a universal law, and examinations are honestly conducted, the status of engineers will be higher, and steam power will be cheaper.

WHY IS IT that steel can be melted in a crucible without being burned, but cannot approach the same temperature in an open fire without being burned? In the crucible the steel is not exposed to the air. Is this latter the destructive element in the open fire?

TALKS ABOUT THE STEAM-ENGINE.—No. XI.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

RULES FOR STEEL CONNECTING RODS.

If a steel connecting-rod be used, its great tensile strength and its greater resistance to crushing render other rules necessary.

To resist tension safely we have this rule:

Take the square root of the steam-pressure in pounds per square inch.

Take the diameter of the steam-cylinder in inches;

Multiply these two together and divide the product by 95·2.

The result will be the diameter of the rod required in inches.

If this result is less than the length of the rod in feet multiplied by three-fourths of an inch, we must use the rule for buckling which is, when the length of the rod is greater than four cranks, *the same as the rule for wrought iron rods, save that we divide by* 10422000 *instead of* 6916000.

Taking the same example as before we have to resist pulling apart:

95·2)199·68(2·10 inches.
1904

928

The length of the rod is 10 feet, $10 \times \frac{3}{4} = 7\frac{1}{2}$.

Therefore we must use the formula for buckling. We have:

10422)2359296(226·3 app.
20844

27489
20844

66456
62532

39240

The square-root of 226·3 is 15·04.

" " " 15·04 is 3·88 inches, which is the proper diameter at the neck.

In the case of steel it will usually be necessary to compute dimensions by the rule to prevent buckling, both for piston and connecting-rods. We can, therefore, state the relation between the two as follows:

For connecting-rod=4 cranks, its diam.= 1 times diam. piston-rod
" " " " 5 " " " " 1·12 " " "
" " " " 6 " " " " 1.28 " " "
" " " " 7 " " " " 1·38 " " "
" " " " 8 " " " " 1·44 " " "

We must recollect not to use these ratios where the rules for buckling are not required.

It is, however, most certain in the case of steel that the rule for buckling must be used.

It is worthy of note to the constructor that shortening the connecting-rod is productive of a great saving in weight, for since its cross-section is proportioned to the square of its diameter, we observe that a rod eight cranks long has about twice the area of cross section, as well as twice the length of the rod four cranks long, and therefore will weigh four or more times as much.

Some times the stub-end of the connecting-rod is solid with its strap, a key only being used to adjust the brasses. This arrangement is very safe, but offers difficulty as to the flanges of the brasses.

English engineers have a way of bolting the brasses, by means of large longitudinal bolts, right against the end of the connecting-rod, and find no difficulty in making a good and tight job.

American engineers, however, for the most part, use straps which surround the boxes and are keyed and bolted, or merely keyed to the connecting-rod.

I have already explained how to properly proportion the key and will now take up the strap.

The only stress put on the strap is one of extension, and, for economical reasons, it is best to have have it of uniform cross-section throughout, rather than to try to work it out to theoretical shape to save metal, but not labor.

By adjusting the key it is assumed that the engineer gets the proper pressure of the boxes on the pins, the strap drawing the boxes solidly home around them. It seems very doubtful if he ever does it exactly right; in some cases, where boxes need filing, the only reason the straps do not give way at once is because no increase of stress is put upon them by starting the engine, since no increase can occur until the boxes are pulled so hard as not to press on the stub-end.

It is no uncommon thing to see keys and boxes sprung out of shape by brutal driving.

For a wrought iron strap the rule is:

Divide the total steam pressure in pounds on the piston-head by 5,000 *lbs.*

The result will be the cross section of the strap in square inches.

The area should be divided between the two legs of the strap, and the cross section should equal this at the key-way, which is the weakest point.

The same rule holds good for a steel strap, save that the divisor is good instead of 5,000 *lbs.*

It is possible to split the strap, or to start a piece out of the back end, if metal enough to equal the strength of the key is not left between it and the end of the leg.

That is to say the key-way should not be placed nearer the end of the strap than its own greatest length.

For example: for a wrought-iron strap.

Let the boiler-pressure be 40 lbs. per square inch.

Let the diameter of steam cylinder be 32 inches:

32 squared = 1024 ·7854
1024

31416
804·25 15708
40 7854

Total pressure 32170·00 lbs. 804·2496
5)32·17

6·43 sq. inches for both legs; or 3·22 sq. inches for one leg.

Assume the width of the stub-end to be 5 inches, and the thickness of key to be 1 inch.

The thickness of strap required is:

4)3·22

0·805 of an inch.

For a steel-strap we would have, under the same conditions:

9)32·17

2)3·57

4)1·78

0·49 of an inch.

In most cases it will be found that straps are much heavier than is necessary, and they are thickened up about the key and then thinned down to the bend, where they are swelled in a gradual and graceful way calculated to impress the observer with the refinement of knowledge to which the design has attained, *as regards straps.*

Straps are bolted to the stub-end in some cases and the key used only to set the brasses on the pins.

When there is scant clearance for the piston, it is important that the connecting rod should not be changed in length by keeping up the boxes as they wear.

The proper positions of the cross-head should be marked on the guides at the start, and then the connecting-rod can always be brought to length by keying the boxes with the crank on the dead point.

A key with a uniform taper on both sides, and two gibs, has been assumed to obviate this difficulty, but as the crank-pin on the dead point is immovable, the piston will have to come to it in keying up.

If we arrange the key at one end to shorten the rod in keying up, and the other end to lengthen the rod, we can adjust for wear of boxes if we have the cross-head marked.

Keys placed on both sides of the crank-pin boxes are sometimes used to make the adjustment all at one end.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER L.

The saying that it is an ill wind which blows no one good has been fully verified in our own shop lately, for we have never been busier than during the past three months. Notwithstanding the reports of dull times, and slackness all over, we have done more in the last three months than in the six which preceded them. What seems still more incongruous is that it is because of the slackness in trade at large that we have been so busy. The mills about us have taken the opportunity to overhaul their works generally, and, not having shops of their own, have given us plenty to do. I never would have believed, if I had not seen it, the length of time a machine will run after it won't run any longer, and I think some of the editorial articles I have seen in this paper, commenting upon the curious apathy to making repairs shown by some steam-users, are fully borne out by recent experiences. One party told us that they had great trouble in getting a uniform speed, notwithstanding the fact that the engine ran regularly, as far as could be observed, and they wished us to look into the matter and see if we could not remedy it. At that moment we were standing under a line-shaft fifty feet long, which was full of pulleys from end to end. Scarcely two of them ran true.

"I don't wonder your speed is irregular," said I; "for there is every reason that it should be."

"How so," said the superintendent!

"Look at these pulleys," said I in reply; "no machine driven by them can run regularly."

"Moulton, you're a crank, I guess," said the superintendent. "What has that got to do with irregular speed? No matter whether the pulley runs out or not, the circumference of it describes the same circle, and has the same velocity at any given point around the shaft, therefore the speed of the belt is the same."

I looked at the man to see if he was joking, but he was in dead earnest.

"Well," said I in reply, "Mr. Jenks, you seem to be a little out of truth yourself on that matter. A pulley out of truth is an eccentric pulley, aint it?"

"Yes," said he.

"The circumference is not equally distant from the center, all round, is it?"

"No, it aint; but what are you driving at? It is plain enough, without so much circumlocution, that a pulley out of truth has no influence on the speed."

"I thought myself it was plain enough, but it does not seem to be so to you, but I mean to make you say it has, before I get done with you; just let me finish, please. A pulley out of truth has various circumferential velocities. When the belt is on the part furthest from the center it goes faster in feet per minute than when it is on the part nearer to the center; as a matter of course the speed is irregular."

Mr. Jenks thought for a moment and said, without any further allusion to the subject:

"Just come this way a moment; I want to show you a new passage we have cut through to the other mill." This was his graceful way of acknowledging an error.

This is merely an episode, and not what I started to talk about. The dullness outside is shown in other ways than by giving us plenty of work. It has brought an influx of traveling men—salesmen—to our little town, who are very anxious to sell us exceedingly small bills of goods. They will take any order at all, and we can pay when we get ready. One of these gentlemen came into our place recently, and made us substantially such an offer, and I replied to him that I thought he was taking a great risk for one thing, and for another that we did not do that kind of business.

"What kind of business do you do?" said the salesman.

"We pay cash," said I; "then we know who the money we hold belongs to; ourselves or our creditors."

"That is a very good plan," said the salesman, "and I had just as soon sell you a large bill for cash, as a small one on long time."

"No doubt," said I; "but you can't sell us any, for you have not stated the facts about your goods. You have misrepresented them."

"How so?"

"You said these parts were hardened steel, when they are not."

Our commercial friend caught up a smooth-file—we were in the shop—and drew it over the edge of his goods.

"What do you call that," said he, triumphantly; "aint that hard enough for you?"

"Yes, it is hard enough, but you are young yet, and don't know so much as you will if you keep on learning. That is not steel; it is iron; case hardened, and not very good case hardening either."

Our friend was very cocky at this, and wanted to make me a bet that the material was steel; he swelled about the honor of his house, etc., at great length, when I interrupted him by telling him that that was all unnecessary; the goods were not only of inferior material, but they were also imitations of other goods, well made, by regular makers, who disdained to either misrepresent, or to try and teach machinists their own trade. I told him that he was not talking to a jobber in hardware, who did not know iron from brass, but to one who was in the business himself, and could make much better tools than these if they were needed. He still remained unconvinced, and either didn't believe, or made a very good affectation of unbelief, that his material was not steel. Finally I asked him if he knew steel from iron in the fracture? He said he did.

"Well," said I, "I never make bets, but I will tell you what I will do: I will break this thing across; if it is steel I will give you an order for two hundred of them; if it is iron you shall stand the breakage. Will that satisfy you?"

He said it would. So we went over to the anvil we dress tools on and I gave the thing one smart rap over the horn, and half went one way and half the other.

"There's your steel," said I; "now look at it."

He did look at it, and saw a piece of pot-metal, apparently, as I knew he would.

"All the steel there is in that," said I, "is the outside skin; that is steely where it was converted in case hardening. You have learned something that you did not know. I will tell you, my young friend, how you can learn something more. When you go into a shop to sell tools to machinists, don't know more than the law allows. There is a possibility that, without knowing anything especial about the business other than selling goods belonging to it, you may not be quite so well versed as those who have followed it for a living. Even if you have picked up some trade knowledge it does not necessarily follow that you can tell an old man his business. Like a good many other young men who are traveling, you think that if you only talk fast enough, put in a good many words to the square minute, you are doing business. What you need is to talk sense. A machinist does not care a straw how many of these things have been sold, or who has bought them. All he requires is that it shall do the work it is claimed to do, be of good material and well made, and sold at a reasonable price. He would just as soon be the first to buy your goods as the last one. Numbers sold have nothing to do with driving a trade. Another thing: don't argue with a prospective customer. An argument is a useless controversy, for no one changes his belief, or his views under compulsion, oral or otherwise. An argument is an effort to convince against the will, and in carrying it on you waste time for yourself and others. If you find a machinist who wants to argue with you when you go to sell him goods, let him do it all himself, and get an order out of him if you can. Any one can sell goods when a man wants to buy, but it requires business tact, discretion, and good judgment to sell when men don't want to buy. I hope I have not offended you by my plain speech." I said to our young friend; "there is no charge for it."

"No," said the salesman, "because what you say is so. I was told these goods were steel and supposed they were; if I had not been sure of it I would not have been so positive. I wish you would tell me, Mr. Moulton, how I can distinguish between iron case hardened, and hardened steel, so I won't fall into that hole again."

"I can't tell you, so you will never err, for it requires experience in judgment to say every time; but there are some surface marks by which case hardening shows itself, and these are the peculiar color, a fine tetter or freckle on the surface, sometimes a few small seams where the stock has opened under the heat, and a wavy mottle when the goods are not finished bright. If they are finished bright there is a vitreous, or glassy surface, which betrays case hardening. All these indications are of but little importance to you, but a machinist can tell ninety-nine times out of a hundred goods that are case hardened, from those made of steel hardened in fire and water. Call and see us again next time you come around, and maybe we will give you something more profitable than advice."

"I haven't lost any time," said the young man. "I know more than I did an hour ago."

THE STEAM-ENGINE INDICATOR AND ITS USE,—No. 12.

BY WILLIAM BARNETT LE VAN.

UNDULATIONS, OR WAVINESS OF THE EXPANSION LINE.

The waviness sometimes seen in expansion lines is caused by the inertia of the indicator piston, and in some cases by the use of a weak indicator-spring on high speed engines; see diagram, Fig. 18. The weaker the spring the more rapidly the steam will compress it, and consequently the greater will be the velocity of the indicator-piston in rising; but the momentum (which is proportional to the square of the velocity) carries the piston above the point to which the steam pressure alone would have compressed the spring. When the momentum has been destroyed by the spring, the spring then forces the indicator piston below the point where it and the steam would be in equilibrium, and it is again forced too high. These alternate up and down movements produced by the momentum, combined with the lateral movement of the card, gives the wavy line.

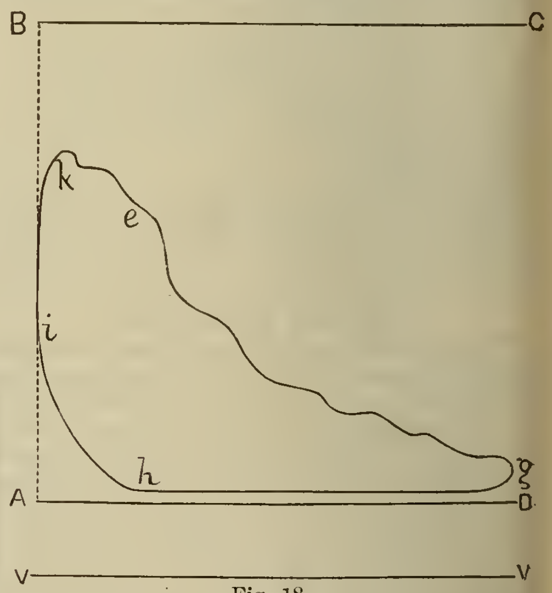

Fig. 18.

These lines are of great value, as they show precisely the degree of suddenness or violence of the action of the indicator. They may occur at the point of admission, of cut-off, and of exhaust.

The following reduced diagram, Fig. 18, taken from a high speed engine running at the Brush Electric Light Station, Philadelphia, Pa., in 1882, at 292 revolutions per minute, affords a beautiful illustration of this action.

To diminish the extent of these undulations the spring of the indicator should be stiff, and its mechanism light. These undulations when excessive make it extremely difficult to determine the mean effective pressure from the diagrams when measured by ordinates. To determine the area it is customary, and more accurate, to sketch a diagram freed from these undulations, over the actual diagram taken (as represented by dotted lines in diagram, Fig. 19), *midway between the crests and hollows* of the waves. This is better than drawing a line inclosing the same area with the wavy line.

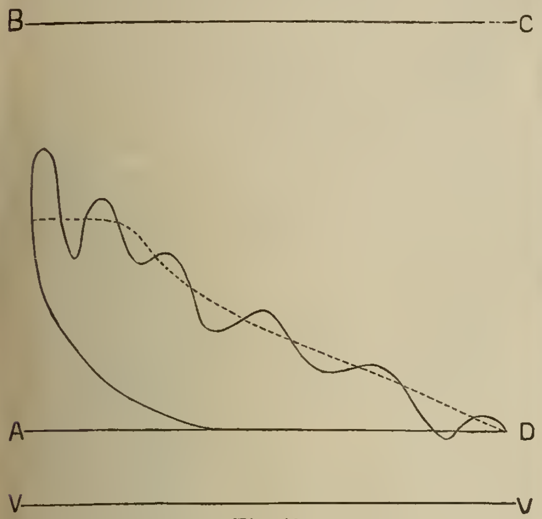

Fig. 19.

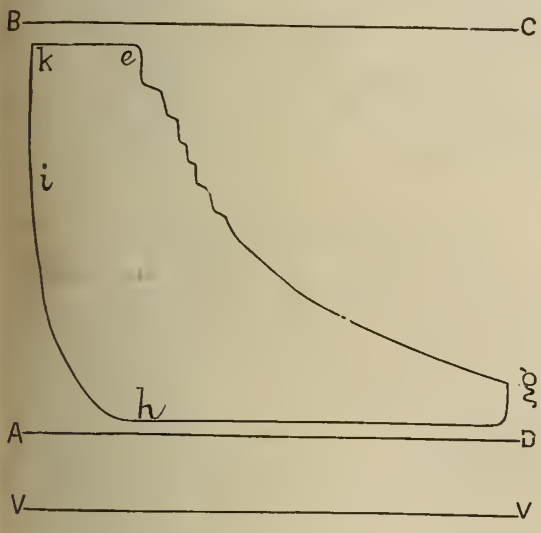

Fig. 20.

Where the fall of the expansion line is a succession of steps (see diagram, Fig. 20), it shows slight friction in the instrument and that there is no rise of the pencil; no reaction.

THE EXPANSION CURVE OF INDICATOR DIAGRAMS.

A correct curve does not *necessarily* show an economical engine, since the leakage out *may* balance the leakage in, in rare cases, and not affect the diagram. But the opposite is indisputable—that an incorrect curve necessarily, and infallibly, shows a wasteful engine, to at least the amount calculated upon the diagram.

As indicator diagrams represent the measure of force, or pressure of the steam in the cylinder at every point of the stroke, the actual card from an engine as compared with the theoretic diagram (other things being equal), indicates the working value and economy of the engine.

Therefore, they should truthfully represent the real performance of the engine. Diagrams vary in form, from various causes; namely, quality or condition of the steam, leakage, condensation, adjustment and construction; their influence being most noticeable in the expansion curve. This curve will not in practice conform exactly to the true theoretical curve. The terminal pressure will always, under the most favorable conditions, be found relatively too high, the amount being greater as the ratio or grade of expansion increases. Where this is not the case, and the expansion curve of the diagram taken coincides exactly with the theoretic curve, the conclusion cannot be otherwise than that the leakage is greater than the re-evaporation, but, in the present state of the arts, there are no practical means of working steam expansively, and of preserving the exact temperature due to the pressure while expanding.

When the expansion curve falls throughout its entire length, below the hyperbolic or theoretical curve, it is evidently due to leakage The expansion curve of the indicator diagram in all ordinary cases terminates above that of the theoretical curve down to coincide with the expansion curve at its commencement; see diagram, Fig. 22 at x; in fact sometimes far above it, due to the re-evaporation of the moisture in the cylinder. An engineer when indicating an engine should see to it that the piston and valves are tight. Unless they are so, the diagram will not indicate what the engine is really doing and the engineer cannot ascertain the causes of any peculiarities in the form of the diagram.

(THE END.)

HOW I SERVED MY APPRENTICESHIP.

NUMBER VI.

BY GEORGE SLOCUM.

"Say, Jones! that's a powerful crane, aint it? I notice that two laborers can swing on a pair of those cylinders without much trouble, and the shop-clerk told me that they weigh over 5,000 pounds. Any figuring about a crane, Jones?"

"You bet your life, sonny! There is one of the nicest little calculations you ever saw about that crane. Tom Lovelace showed it to me. Some folks figure it out in another way; but this is short and just as accurate."

"I notice that they shove one crank-pinion into gear, and sometimes they shove the other in, and then the first one is shoved out. How is that?"

"Well, I'll tell you all about it now, while I have a little leisure time. That crane can be worked single or double-geared. When the load is light and they want to raise it quickly, they shove the pinion into gear with the reel-wheel, and when the load is very heavy and greater leverage is required, they shove the other pinion into gear with the intermediate wheel, and the pinion on the other end of its shaft gears into the reel-wheel. This gives a wheel and two pinions between the power and the reel-wheel, whereas before it was only one pinion. Now take hold of this crank, it has a stroke of 15 inches, and turn it slowly until it makes one revolution, and I will measure the rise at the hook. Hold on! let's put it in single gear first. Now turn."

"Got it?" said Jones.

"Yes, sir; one revolution exactly," said I.

"All right. The hook rose just 3½ inches."

"Now, pull it into double gear," said Jones.

"When I throw one pinion in I throw the other one out; can't have 'em both in gear with this big wheel, at the same time, can I?"

"Why, of course not. Ready?" said Jones.

"Yes, sir."

"Now, turn slowly until I holler to stop."

"Whoa! Hold still."

"How many turns?" said Jones.

"Two; just to a hair," said I.

"Well, that's close enough. Now you see one revolution of the crank (in single gear) raised the hook 3½ inches. In double gear two revolutions raised it one inch. The crank in making one revolution describes a circle 30 inches in diameter, and 30 multiplied by 3·1416 gives us a circumference of 94·25 inches, nearly. Now, we divide 94·25 by 3½ and we get 27 nearly. Then the crank, or, we'll say the power, advances 27 inches while the load rises one inch, consequently one pound at the crank will balance 27 pounds at the hook, single gear. Now, supposing one man at the crank, or two men, for the matter of power say a dozen men, were to exert a force, or power of 100 pounds, they could lift 100 times 27 pounds, or 2,700 pounds, taking no account of friction or inertia. So, also, in the case of double gear, where it takes two revolutions of the crank to raise the hook one inch, we proceed and multiply 94·25 by 2, which gives 188·5 inches advance of power for one inch of lift. Now if we use the same power as before, we'll have 100 times 188·5, or, 18,850 pounds as the load lifted. You can see, therefore, how it is that two stout men, at that crane (in double gear), can raise a pair of those 5,000 pound cylinders 6 feet high, or high enough to clear the tops of these frames, and not strain themselves a bit in doing it, either."

"It seems to me," said I, "that it would take a mighty long lever to raise those cylinders so high with so little power."

"They would have to send a good ways for the timber to make it, if figures don't lie," said Jones.

"Suppose you give us the figures," said I.

"All right," said Jones. "We'll say that horse over there is 6 feet high, and we'll use it for a fulcrum. Now, it would take about 18 feet of the lever between the cylinders and the horse. The power is 100 pounds. Now as 100 is to 5,000 so is 18 to the length of lever, measuring from the fulcrum out. Then 5,000 multiplied by 18 gives 90,000, and this divided by 100 gives 900 feet, and 18 feet added gives 918 feet as the length of lever. I make no allowance for the weight of lever, neither do I notice the fact that the men should string along the lever when pulling, unless they pulled on a rope tied to its end; for I have no time to split hairs in figuring out these answers."

To-day the foreman is away, and the assistant being very busy about an engine that had a fit of the dumps, the boys had a pic-nic, throwing big wads of dirty waste at one another. Just as Jones had got through with his figuring and was rubbing the chalk marks out, some one let fly the big wad (at me of course), but it only grazed my face and took Jones alongside of the head.

Did he get mad, you ask?

Well, I should say he did. He just got on the war-path. The men all laughed at Jones, and that made him worse. He ripped and tore around and talked about doubling somebody up like a jack-knife and shoving him through a fire-box door.

This little episode had the effect of brightening old-man Jones' memory somewhat, for after he got cooled down, he beckoned to me to come over, and I did so.

"George," said he, "I forgot to give you a statement in proportion, that will answer for all such questions as this crane business, and it is this."

"Hold on until I get my book," said I.

"As the distance moved through by the resistance is to the distance moved through by the power, so is the power to the resistance."

I told Brown that I wanted a change to something else, that I guessed I had enough of cylinders, and didn't care about wasting any more of my time drilling holes.

"That's just where you're left, young man," said Brown. "Lots of folks think there is nothing in running a drill-press; all there is to be done is to slam the work on the table, fasten it down so it won't move, chuck in a drill and let her rip. Well, that's one kind of drilling, and maybe it will do for some kinds of work, but it won't do for cylinders, links, rods, swivel-winged cross-heads, and hundreds of other jobs. When it comes to grinding drills properly and knowing how to use them and setting up work, drawing holes, and making nice round, smooth holes, and all that sort of thing, I think there is a good deal in running a drill-press properly."

FACTS ABOUT BAND-SAWS.

To say that good sawing comes only by constant practice, would only be telling half the truth, for there are hundreds of sawyers who saw constantly year after year, and are only indifferent workmen after all their experience. It is, I suppose, in the same sense that a man may work with tools year after year at a bench and yet be a second, or even third-rate mechanic. A person must have the right qualities in him, naturally, and they must become a part of his life. Unless he has these he may saw till he is superannuated and still be a very ordinary sawyer.

One thing is certain, no man, however much taste or genius or years of practice he may have had, can do good work with a saw badly filed, improperly set, or that has one or more kinks in it. The very first thing of importance is to have your saw properly joined. It may be done fairly well, if care is used in the joining, with spelter and the blow-pipe. Care must be taken that the scarf is well and evenly filed, and nicely fastened together with a fine wire. Use borax for a flux, and saw into a good piece of hard-wood charcoal, enough to a little more than cover the saw. Use a spirit-lamp and blow steadily, so that the flame covers both sides of the saw alike. The charcoal will soon burn freely, and as soon as the spelter is fairly melted cease blowing, and let the blade cool off. Take off the wire, and with a fine file smooth the saw down carefully to the required thickness; if the job is well done the saw will break in a new spot before it will where it is joined. To use the blow-pipe and spirit-lamp well, a person needs considerable skill, and if any old sawyers read this, who have ever "blowed" a saw together, they will bear me out in saying that it takes a "heap of wind." Very much the better way is to join a saw with silver-solder and a pair of heavy, thick tongs. File up as before, but use no wire to hold it together. Heat the tongs hot enough to melt the thin piece of silver-solder put between the scarf. Press tightly and evenly on the tongs till you feel the solder melt. Remove the heavy tongs and have ready a light pair of cold tongs, and pinch together for a moment, and the job is done.

A person of ordinary capacity soon learns to join a saw in this way, and it is very much preferable in every way to the blow-pipe and spelter. Now comes the filing and setting, and if this cannot be done well you had better let a band-saw alone altogether. There may be, and is, among good sawyers a difference of opinion about filing. While some insist on filing from both sides and giving the tooth a small bevel, others just as persistently and honestly claim that a saw should be filed straight across, and only from one side.

Whatever may be the difference of opinion on this point, I find there is only one in regard to the set, and that is by whatever means the saw is set both sides *must* be set alike.

To a person just beginning to run a saw, I would say, whichever way you start on, stick to it. Ask the advice of some sawyer of good experience and reputation, and let him post you up, and then don't change your style for this or the other; if you do you never will succeed. Have a sensible way of your own, and stick to it.

If you have a keen eye in your head with a good stock of perseverance and a determination to do whatever you do well, you will eventually succeed, although you will find a great many hard spots before you get through the ordinary length of a band, or scroll-sawyer's life. —*J. Langdon in Builder and Wood-Worker.*

PRESERVING WROUGHT IRON FROM RUST.

The subject of our caption was recently discussed at a meeting of English Engineers, and a Mr. Matheson said, in regard to large surfaces and structures, such as bridges and buildings generally, that the means taken to protect wrought iron from rust were imperfectly understood. There appeared to be an attempt to preserve the skin of the iron as it left the rolling mill, and he ventured to say that that was a mistake. Wrought iron, in passing through the rolls, coming in contact with the atmosphere, was at once oxidized; it got a black scale or oxide upon it which must ultimately fall off; and although elaborate specifications were prepared for oiling or painting such wrought iron, that treatment only postponed the evil. Oiling wrought iron was, he thought, a better protection than painting, but even that did not fulfill the purpose intended. He believed there were only two, or perhaps three, modes of protecting wrought iron from rust. One was to keep it entirely from the air. Iron built into lime or brickwork or masonry would remain for centuries almost in the same condition as when it was put in. The second plan was that of Professor Barff, exposing the iron to superheated steam, but this was possible only with pieces of moderate size. A third plan was to remove the thin scale entirely before the painting was applied. The only place where he knew of its being done was in Holland, where the specifications of the engineers generally described, with great minuteness, how the iron was to be treated before the oil and paint were applied. The iron was treated as the galvanizers treated it in this country; it was dipped in baths of dilute acid, which removed all the black scale. After washing it was painted, and if the paint was renewed from time to time, the iron might be permanently preserved. He had taken down a bridge that had been put up twenty-five years ago. The upper boom of the bridge had been riveted and calked like a boiler, and was perfectly air-tight; and the inside plates, which had never been painted, were as good as the day when they were first put in, while some of the parts exposed to the atmosphere, and ineffectually painted, had deep pits bitten out in all directions, materially weakening them. The worst part was where the iron had been brought in contact with wood, the acid of which had so destroyed it that an angle iron ½ inch thick was worn down to a knife edge.

SOMETHING ABOUT ALUMINUM.

Aluminum, with one exception, is the most abundant metal known. The material, alumina or clay, from which it is produced, is not confined to any locality or country. It is found everywhere. It is more than half a century since the eminent German chemist, the late Friederich Wohler, who for fifty years was professor of medicine and director of the chemical institute at Gottingen, discovered aluminum and that it could be produced from common clay and from alum, and still it is among the least familiar of metals. Its usual price is $20 per pound, and until the past year it has only been known as "aluminum gold." After many experiments extending over a series of years, its manufacture was abandoned, except in one instance, to the French, who only produced it in inconsiderable quantities.

After more than thirty years' labor and at a cost of more than £250,000, an English chemist and metallurgist, James Webster, has discovered a method of making aluminum by roasting alum, instead of making it in the old way by precipitation. By the new process it takes only $\frac{1}{24}$ of the time required by the old method and costs less than $\frac{1}{10}$ as much. Instead of producing the alumina powder, by the old and slow method of precipitation, Mr. Webster burns the alum with pitch in a calcining furnace, prepared expressly for this purpose, the product being a gray powder, in appearance much like the ashes from an engine-furnace. This gray powder, according to all scientific authorities, is no more or less than burnt alum, 95 per cent. of alumina. The alumina thus produced is much better than that by the old method; it is much finer in texture and free from silica. At first it took twelve tons of alumina to make one ton of aluminum, but now ten tons of the former are sufficient for one ton of the latter. By the old process it took six months to do what is now done in a week. The discoverer has been producing 200 pounds of aluminum per week for more than a year, worth £208,000 per annum; the result has been that a manufactory which covers more than one-half an acre is kept busy night and day, with orders ahead. The present output is twenty tons of aluminum per week. From the results already obtained by the aluminum bronze factory it is evident that in a very short time this almost new and peculiar metal, which never oxidizes or corrodes, and which never tarnishes under any circumstances, to which can be given the color of gold, silver, bronze, or purple, and which differs from all other metals in that it is never produced direct from ore, but only by a long and elaborate process, must become an important factor in the manufacture of jewelry; and almost every article made from metal, from the screw-propeller or anchor of the largest steamship down to the tiniest tea-spoon may be manufactured from it, or its alloy.

The chief value of aluminum is in giving strength and body to alloys, bronzes or metals, so that they will not corrode. Thus far only enough of it is present in the bronze ($\frac{1}{1700}$ part) to soften or mollify the brittle nature of the bronze. To copper, tin or zinc it gives such properties as can be obtained by no other means, softening their nature while increasing their strength, preserving them from corrosion and rendering them more ductile and refined.

Piano-forte wires made from it will vibrate 10 seconds longer than the best now in use. The tensile strength of aluminum or bismuth-bronze being the same, only in the latter $\frac{1}{1800}$th part of bismuth is added, had been proved, by repeated tests, to bear a strain of forty-two tons to the square inch, or fourteen tons more than gun-metal, and twelve tons more than best Bessemer steel.

Aluminum bronze has been tried in dish-covers, pots, kettles, tea-pots, jugs, crucibles, dressing-cases, soap-dishes, brush-trays, and other toilet articles, in which the colors, gold, silver, purple and bronze, are very bright and never change. Octants, sextants, compasses and other instruments used for marine observations and service are made from the aluminum bronze and stand sea air as no other metal does. These instruments, if made of any other metal would weigh four pounds, when made of the above only weigh one pound. These bronzes are easily turned, filed away and worked.

Aluminum is nearly the same color as silver, and might be taken for it, were it not so much lighter, bulk for bulk. Until three or four years ago it ranked as one of the precious metals. Aluminum does not cheapen the price of the alloys, into which it enters, but the reverse, and until produced in much larger quantities than at present, it cannot be used where the cheaper brass and copper will serve the purpose as well.—*Springfield Republican.*

UNIFORMITY OF ROTATION IN ELECTRIC LIGHTING ENGINES.

The satisfactory performance of any electric lighting installation depends a good deal on the uniformity in the speed of rotation of the armatures of the dynamo machines and therefore on that of the engine by which they are driven.

High speed engines have in one respect the advantage over the slower running engines, namely, that two or three revolutions more or less in their speed will not be felt so much on the dynamo machine because the speeds more nearly approach each other. Often, however, when the engine is blamed, although it is a fact that it has sometimes deserved it, the fault lies not in the engine but in its size or in that of the boiler. Electric lighting on a large scale is even yet very young, and electricians have been gaining information as to the difference between electrical horse-power in the machine and horse-power in the engine, and their demands for indicated horse-power are greater now for the same work than they were when electric lighting was in its infancy. In not a few places engines have been put down which are not sufficiently powerful. They have done the work ordered, but the requirements have exceeded the electrician's original estimate, and hence the engine has had to run very closely indeed to its full power. When this is the case, and especially if it obtains with boiler as well as with engine, any considerable irregularity in the consumption of power makes itself felt in the engine with notable effect. The engine has no reserve, and governors have not the power of governing unless both engine and boiler are sufficiently master of the work. The governor must have something to draw upon.

In considering the complaints made by electricians on this subject, and remembering successful illustrations of electric lighting by temporary arrangements and with engines with but very modest pretensions as to refinement, we are much inclined to think that time and money are both likely to be wasted if either are further expended in scheming elaborate cut-off and governor gear. Some engines without anything of the kind have given electric lighters a good deal of satisfaction; some with every refinement have failed. Why? Simply because when the common engine has been used one of ample nominal power was selected to allow for contingencies. In the case of the refined engine the power required was carefully calculated and compared with indicated horse-power of the engine. Things are, in short, in such cases cut fine, and the power of the engine at normal speed and pressure is so near the work it has to do that it must be nursed and the firing performed by a skilful stoker. For electric lighting, as well as for other dead-pull work, strong, well-made engines are required, and the admission and cut-off of the steam should be tolerably quick and precise Very few of the engines employed for electric lighting, even when they have been destined to work approximately up to their indicated power, have had fly-wheels remarkable either for weight or diameter. Great weight is not to be adopted without due thought, for this will occasionally raise the temperature of the bearings and the temper of the attendant. Large diameter is not always convenient, so diameter and weight must be proportioned according to circumstannes. But whether it is obtained by greater weight or by greater diameter, we believe that greater energy-storing capacity in fly-wheels is much wanted for the purpose above mentioned. Large diameter may often be adopted without any inconvenience; and this is to be preferred because of the greater efficiency of an increment of radius than of even considerable weight. Increase of velocity is effective for fly-wheels used in the sense we are considering in proportion to the cube, not the square, of that increase; but increase in weight is only effective in simple proportion to that increase. The regulating power of a fly-wheel may thus be greatly increased where large diameters may be used, and this would, there is little doubt, do much to reduce the small range irregularities in the velocity of rotation of electric lighting engines.—*London Engineer*.

A WHISTLE HEARD FIFTEEN MILES.

Several times during the winter the attention of our citizens has been attracted to the peculiar condition of the atmosphere, which at times possessed astonishing powers for the transmission of sound. On numerous occasions the whistles in the manufactories at Sheboygan have been plainly heard here, a distance of not less than 15 miles on a straight line. This acoustic peculiarity has never been so noticeable as in the past few weeks. An acoustic phenomenon that would well be worthy the attention of scientists occurred between Sheboygan Falls and Sheboygan about six weeks ago. A telephone line connects two banks in Sheboygan, where there is also a telephone exchange. A residence two miles west of Sheboygan has communication with that city by telephone. At the time above mentioned a person standing at the audiphone of one machine could distinctly hear communications occurring between other parties on an entirely different line. Parties communicated directly with each other in this circuitous manner. This occurrence was supposed to be caused by the wires of the two lines coming in contact with each other, but it was found that nowhere in the entire distance of the two miles were the wires nearer together than eight inches.

HOW BRITISH SAILORS FARE.

A shipowner and captain says in the *Nautical Magazine* (England): "There are no agricultural laborers, possibly, in any part of England, who fare so poorly as British seamen in long-voyage sailing ships. Their breakfast in cold winter weather, off Cape Horn is composed of the weakest of coffee and dry biscuit; dinner of fat pork and pea soup, which is perhaps not so bad if the pork were less fat; tea, water-bewitched, and dry biscuits again, breakfasts and teas always of this description; but the following days' dinner is a pound and a half of beef, salt and hard, and something which the cook calls *pudding*, which has probably had as much to do in killing off sailors at forty years of age as any other distemper.

There is no reason whatever why our shipowners should not feed their crews as liberally as the Americans do, for they make more money, in proof of which they have all but driven the latter off the sea. Americans give their sailors all that we give ours, with the following additions: For breakfast, mush and molasses. For dinner, boiled beans with beef; and baked with pork. For supper, hash. All these additions are cheap in the United States, and very little less costly with us. Why! Indian corn is given to pigs in England, after paying freight across the Atlantic! It is astonishing, too, what a cheap mess beans are, and how nourishing and palatable. It is really high time that some improvement was made in the victualing scale of seamen. Now, when it is remembered that the officers in many long voyage ships fare little better than the men, can it be very much wondered at that there should be so much trouble and dissatisfaction in British ships?

Feed your men well, treat them decently, work them fairly hard, let them see that you have force at your back to carry out your orders, and you will soon have a good deal less of insubordination. It will vanish."

THE INFLUENCE OF BRIGHT-WORK.

Excellence of finish, as a rule, is synonymous with excellence of design as well as of workmanship. It is not a waste both of time and money to go to the trouble of getting up bright the ends of a cylinder, the sides of bolts and nuts, etc.; or finishing any part which does not directly affect the efficiency. We answer that time devoted to the "get-up" of a machine does pay, and if it does not affect efficiency directly it does indirectly, to an extent that many persons little imagine. There is nothing like maintaining a high standard of excellence all round. Slovenliness and neglect in one direction readly tend to slovenliness and neglect in others, and a man who is careless about the finish of an article is often careless about the design.

Give a man a rough unfinished engine to superintend, and we venture to say that its efficiency rapidly deteriorates, the bearings get neglected, the glands are not kept steam-tight, the vacuum is impaired, the attendant takes little or no interest in his work, and regards the engine simply as an ugly beast, whose only function is to provide him with an occupation, and considers that he has done his duty when he gets through his work with the least amount of trouble possible. Give the same man, however, a bright-looking engine, placed in a well-lighted room, and he is a different being, he takes a pride in his work. You see no leaky glands, no hot bearings, everything works quietly and smoothly. He strives not only to maintain the standard of efficiency unimpaired, but endeavors, if possible, to improve it, and the coal consumption, instead of getting greater, as in the previous case, frequently gets less. The influence of the man's surroundings has completely altered his character.—*Mechanical World.*

BLOW HOLES IN STEEL INGOTS.

Mr. Annable of Govan, Scotland, recently alluded to this subject at a meeting of experts in Manchester. We quote from *Iron*:

Mr. Annable, having quoted several authorities to prove that gases were occluded, as well as mechanically mixed with the metal, said they were told that the mechanically mixed gases tried to escape during the time the metal was passing from the fluid to the solid state, but as steel set so rapidly, a goodly portion of this gas was entrapped and formed blowholes. This appeared feasible, as cavities were more numerous near the top end of ingots than at any other part, and this seemed to demonstrate that, if the metal had remained fluid a little longer, these gases would have escaped. In practice, however, this was not the case, for metal that was not "dead melted" and contained these gases was always the longest in setting, and instead of going down the mould as contraction took place, did the reverse, began to come up, and, unless force were applied, would come over the top of the mould. As it seemed to be the mechanically mixed gases that gave us the blowholes, these were the gases that makers and users of steel were interested in, and to overcome the effects of which many methods had been adopted.

Having described several of the best known of these methods, Mr. Annable said his experience told him that, if the steel were well saturated with any of the five following proportions—carbon, manganese, silicon, phosphorous and sulphur—which were always associated with iron and steel more or less, the metal would sink down in the mould, and be found quite free from blowholes. He believed that iron founders found the same thing, that common iron was easier to deal with in casting than the other bands were. But this metal, although free from "blows," would not be suitable for everyday requirements, as we must have a definite composition for every purpose. Consequently the important question arose as to how they were to obtain these definite tempers without blowholes.

What was needed was a simple, practical method whereby they could produce all classes of steel free from blowholes. He had tried several methods with success. One was dead melting, but this did not always give the desired results when dealing with large masses of metal as they could not get rid of the metal before the temperature became reduced, and this gave rise to some changes. With small quantities, however, as pot-metal, dead melting was all that was required; it answered admirably, and could be depended upon. One method he had tried, and which he would recommend, was to cast the ingots in closed top moulds. These were run from the bottom, and inside each mould a small quantity of combustible material was placed, which was fired by the incoming metal. This at once expanded the air in the mould and created a pressure, as it could not readily escape by the holes in the top of the mould, which were only two, each ⅜-inch, while the head of metal they had in the runner counterbalanced the pressure, and the gases rushed out of the two small openings with a loud roar.

It was not, however, pressure to which he wished to draw attention, but to one fact, that the metal was being cast free from atmospheric air, to which Dr. Muller and others assigned the cause of blowholes. The metal was being cast in an atmosphere of carbonic acid, brought about by the combustion of the shavings which were placed in the moulds before casting began. Besides, they had all the ingot cast at one temperature, one density, and it would be found perfectly homogenous, which could not be said of those cast from these top, while it would be also free from blowholes. In addition, the "pipe" in the top of the ingot would be found much reduced, according to the length of the runner, as the ingots received a supply of metal from it during the time they passed from the fluid to the solid state.

Another method was to place the ladle on to the center runner, and then they excluded all air, besides using the weight of metal in the ladle to force the metal home against the pressure of gas set up in the mould. The open-topped mould, so much used for Bessemer and Siemens ingots, was objectionable in more than one sense. When the metal fell from the ladle to the bottom of the mould, sometimes eight or nine feet, it not only took down with it a stream of air, but in falling on the bottom of the mould the first twenty or thirty pounds of metal were splashed in all directions, and if they were to examine these splashes they would find them to be covered with a blue scale, which was oxide of iron. As they went on pouring the hot fluid metal, it re-melted the splashes, and quite a reaction took place in the steel at the lower end of the ingot; the oxide of iron gave up its oxygen, and attacked the carbon and manganese of steel, just the same as when ore was thrown into the furnace, and they could at any time see the brownish red fumes leave an open-topped ingot mould when casting. These fumes, which were the result of the chemical action below, became less and less as the metal got nearer the top.

He had stated that open-toppped ingots were not homogenous. To prove that this theory was correct, he had several ingots analyzed, and the result showed that at any rate carbon was eliminated by the reaction of which he had spoken, caused by the interference of the atmospheric air. Some might think he had exaggerated the effects of oxygen on molten or heated metals, but what he had said would be confirmed by the practical experience of any smith, as a small bar of iron or steel at a red-heat under the hammer would yield a thin film of scale at every blow. This scale was oxide of iron, and showed with what avidity oxygen attacked metals even at a red-heat. They might, therefore, assume that, with fluid metal broken up or disintegrated, as it was when falling some feet to the bottom of the mould, oxidization would take place at a greater ratio than when metal was only just red-hot. He had seen ingots cast in the manner just described. When brought under the hammer, the bottom end had dropped off at the first blow, after which the remainder of the ingot had hammered all right and given good blooms and billets. This he attributed to the manner in which the ingot was cast.

Pot-metal, which gave them all kinds of tools, they could get free. Castings also might be made free by conforming to certain treatment and chemical mixture, by skill and care in preparing the moulds, and by judgment in allowing for fluid contraction by giving the metal plenty of head large enough in diameter. As the bulk contracted in cooling, it would get its feed from the center of this column of metal put there for the purpose, and by making provision for that large amount of contraction in steel, this would take place without tearing the casting asunder.

The ordinary Bessemer metal was very frothy and lively when cast below 0·3, mild steel temper, and it was with difficulty that it was kept in the mould; but even should it be prevented coming over the top, it was not free from blowholes, which would be found to penetrate to half the depth of the ingot. Solid castings were being produced in steel, but the great difficulty arose where they had to make ordinary soft steel free from blowholes, and this led to enormous waste in manufacturing operations. The subject was, however, receiving the fullest attention, and he had not the least doubt but that the difficulty would be shortly overcome, and that they would be enabled te produce ingots and castings that would be as sound and free from cavities as though they had been forged under the hammer.

COMPOUND LOCOMOTIVES.

The compound locomotive does not appear to grow in favor. A few are at work in the United States and on the Continent, and about a dozen of Mr. Webb's engines are now running on the London & North-Western Railway. It may perhaps be taken for granted, that the number is sufficiently large to permit an opinion to be formed concerning their merits. The results obtained up to the present are not encouraging. Compound locomotives cost more, regularity in turning the crank shaft is of no consequence, and they have to depend solely on their powers of saving coal as compared with other engines. If they are not economical in the consumption of coal, they possess no advantages over other locomotives.

A great deal of interest has centered in the performance of Mr. Webb's engines. It has been stated in general terms that they burned 20 per cent. less coal than the ordinary London & North-Western engines; but no definite figures were given until very recently. On the 26th October, 1883, a compound engine took the Scotch express from Euston to Carlisle, a distance of 300 miles in round numbers. The engine and tender weighed when starting 62 tons 13 cwt. The gross load was 214 tons in round numbers. The average running speed was a little over 44 miles an hour. The engine has a pair of high-pressure cylinders, 13″ diameter, and one low-pressure cylinder 26″ diameter, the stroke of all being 24″. The diameter of the driving wheels is 6′ 6″. The total weight of coal used was 79 cwt. The evaporation was 8·5 lb. per lb. of coal, a very excellent result, seeing that the feed-water was not heated. The actual consumption of coal per mile was 28·25 lbs. The Gladstone, with an average load of 19·5 vehicles, and about 300 tons gross load, burns 31 lb. per mile. the evaporation being about the same as in Mr. Webb's engine, the speed over forty-five miles an hour. The line is much steeper and more difficult than that between London and Crewe.

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Taking into consideration the moderate dimensions of the train; the level profile of the road—the length of the continuous runs, and the good quality of the coal, as evinced by the performance of the boiler, it must, we think, be admitted 28·25 lb. per train mile is in no way an exceptional performance. It is a very good duty no doubt, but hardly so good as that of Mr. Stirling's single driver, outside cylinder engines on the Great Northern, which are reported to run from King's Cross to Doncaster with twelve coaches on a consumption of 26 lb. per mile. The figures given by Mr. Webb would obviously be far more interesting than they are if he had furnished the public with a statement of the normal consumption of fuel over the same road with his regular engines.

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It is not easy to get from the advocate of the compound locomotive a definite statement of the reason why an advantage should be gained. Compounding is not adapted to prevent condensation, to put two long cylinders of small diameter outside the frames of a locomotive is hardly the best way to secure that end; in any case, the condensation in a pair of inside cylinders is very small. Advantage can only be sought in the way of saving fuel; and this, it is clear, can only be had by expanding the steam more in the compound than in the normal engine. In one word, compounding is the same thing as putting in larger cylinders. The engines working the Scotch mail in the ordinary way have cylinders 17″ × 25″; their capacity is therefore 6·306 cubic feet. The three cylinders of the compound engine have a capacity of 10·962 cubic feet. Two cylinders 22·5″ in diameter would have the same capacity, and we may ask why they should not be used instead of the three cylinders adopted by Mr. Webb.

* * * * * *

When the engine was fairly running it could be worked at a high grade of expansion, and no doubt all the economy that can be derived from compounding would be had. However, we should be slow to advocate the use of two 22½″ cylinders instead of two 17″ cylinders for a passenger locomotive intended to work the Scotch express; but we should like to see what could be accomplished by a pair of 19″ cylinders, the proportions of the boiler remaining unaltered.

Mr. Webb has carried out a most interesting and instructive experiment. It is only to be regretted, we think, that he did not begin with freight engines, in which the steam is worked with much less expansion and to smaller advantage than in passenger engines. We understand that, apart from the data given above, the compound engines burn about 6 lb. per mile less than the non-compound. This, however, does not seem to be borne out by the result of the run from Euston to Carlisle, which we have given above, for we can scarcely think it probable that any modern English locomotive can want some 34 lb. of good coal to draw a train of but thirteen coaches over a road for the most part practically level.—*London Engineering.*

TELEGRAPHIC INANITIES.

Curious instances of the minute and searching investigation of the press into modern life are published daily in the papers. Whoever reads the telegraphic dispatches cannot fail to be struck with the pettiness and irrelevancy to general interests of much that is printed. Two drunken negroes, for example, quarrel in a Southern village, and immediately thereafter full particulars of the affray are sent all over the country. Possibly, by a stretch of fancy, such a matter might have trifling local interest, but we do not think it has national importance. Mr. Smith, in a fit of depression, resolves to commit suicide and his intention and effort are next morning printed in a thousand papers. Lately, in a Pennsylvania town, a person contracted a marriage which was distasteful to the family, who presently published an advertisement in the local paper discarding the offending member. It is conceivable that the friends of all concerned should array themselves for and against, but it is not so easy to understand how the domestic affairs of an obscure family have any interest to the country at large. Not satisfied with the bare announcement of the fact above noted, the details of the squabble, as it progressed from day to day, were duly recorded.

It is difficult, we say again, to see what bearing such items as we have mentioned above have upon the public peace and policy. They neither amuse nor instruct, but are simply a waste of time, space, and material used in the record of them.

NEW SHIPYARDS AND MARINE ENGINE WORKS.

According to the daily press of this ci[illegible] Bay Ridge S. S. Construction Co. have t[illegible]lowing board of trustees: Robert H. B[illegible]dell, John F. Ames, Warren Rosevelt, Samuel Mawhinney, Dr. W. J. Gillfilan. The company will begin active operations early in March of this year, and have 27 acres of land at Bay Ridge, with a frontage on New York Bay of 7[illegible] feet. The business of the company will be to build and repair steamships, sailing vessels and all kinds of craft. The National Marine Engine and Boiler Manufacturing Company will occupy adjacent grounds. It is proposed to put up 40 cottages for the mechanics on the company's grounds in the rear of the works. [illegible] large cob dock, 600 feet long and 80 feet wid[illegible]ficient to dock the largest ocean ste[illegible]ip, will, it is said, be begun as soon as th[illegible] of the plant is well under way.

The New England Shipbuilding Company has been formed in Bath, Me., with a capital of $500,000. They comprise the firms [illegible] Goss, Sawyer & Packard, and Goss & Sawyer, and a number of individual capitalists.

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

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Twenty-five cents a line for each insertion under this head.

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New York: Weekes & Melville, Printers, 25 Beekman St.

THE MECHANICAL ENGINEER.

New Series. Vol. VII.—No. 7.
Enlarged 1883.

New York, April 5, 1884.

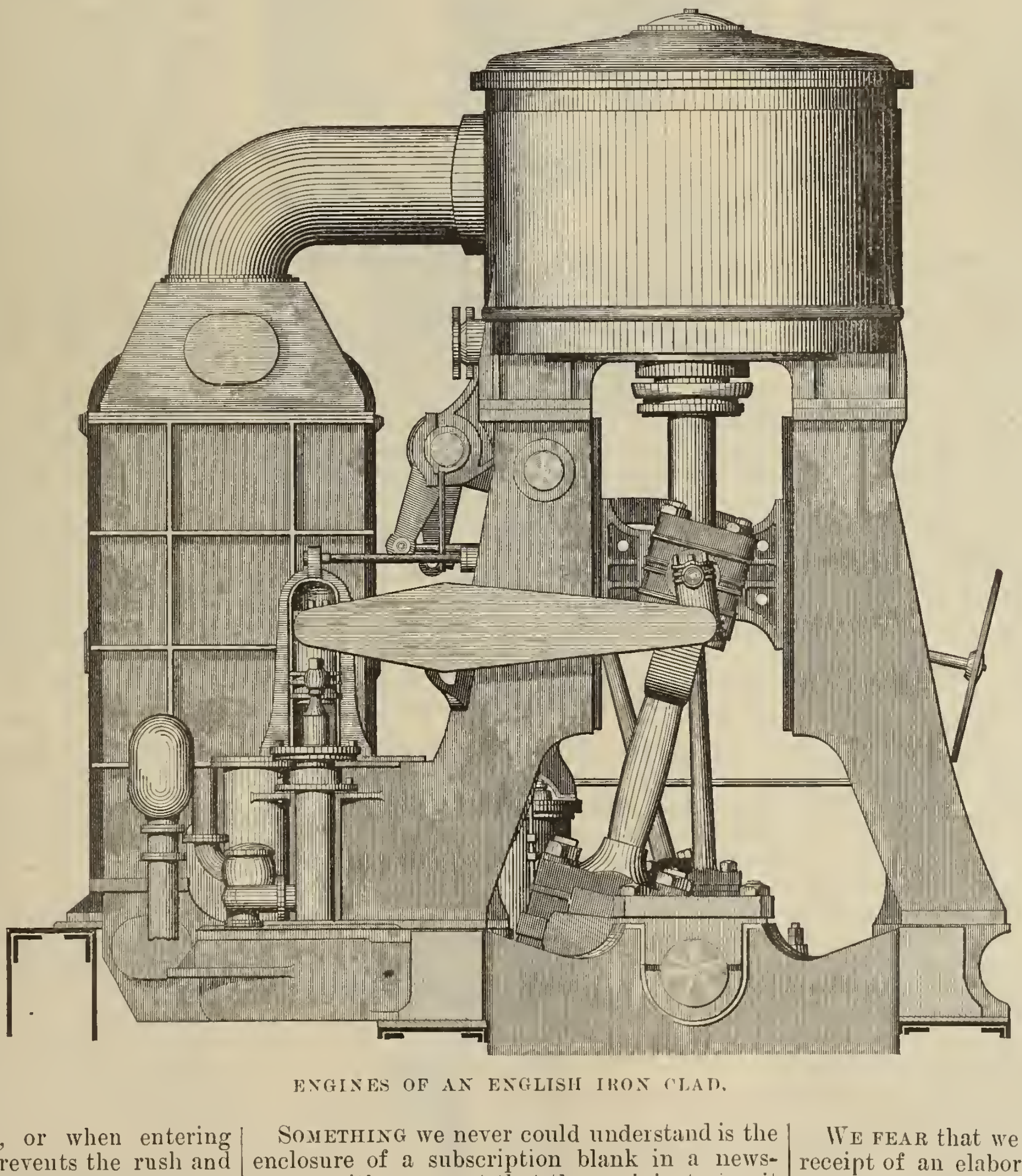
Single Copies, 8 Cents
$2.00 per Annum.

ENGINES OF AN ENGLISH IRON CLAD.

Our engraving taken from the *London Engineer*, shows the engines of the English iron clad *Colossus*, In regard to her our contempory says:

She is propelled by two sets of inverted three-cylinder compound vertical engines built by Messrs. Mandslay, Sons, and Field. Each set has three cylinders, the low-pressures being placed side by side. The high-pressure cylinders are 58in., and the low-pressure cylinders 74in. in diameter, while the stroke is 3ft. 3in. The total power contracted for is 6000-horses. The crank shafts are of iron, and are made in three parts, which are interchangeable, the cranks being placed at an angle of 120 deg. with each other. The propeller shafting is hollow, and is manufactured of Whitworth's fluid compressed steel; while the four-bladed propellers, which are 18ft. 6in. in pitch and 17·5 ft. diameter, are of manganese bronze. The surface condensers, of which there is one for each set of engines, are constructed so as to be capable of being worked as jet condensers. Each has a cooling surface of 6036 square feet, the water being circulated by means of independent centrifugal pumps and engines. They contain 8200 tinned brass tubes 7·5ft. in length and 0·75in. diameter outside. The pumps are also capable of pumping water out of the ship through a 13in. suction pipe. They are 3·75 ft. diameter, and on a separate trial raised 960 tons of water per hour, with 215 revolutions per minute and 35 lb. steam. In order to afford the general reader some idea of the complicated nature of a modern ironclad, and of the responsibility which devolves upon the engine-room staff working under the chief engineer, it may be mentioned that in the *Colossus* there are no fewer than thirty-six separate engines in addition to the main engines which propel the ship.

The whole of the auxiliary engines exhaust their steam into a separate auxiliary condenser, having a cooling surface of 900 square feet. This arrangement, with the special means fitted for allowing the steam from the boilers to pass into the main surface condensers when the ship is suddenly stopped at sea, or when entering harbor at reduced speed, prevents the rush and noise of steam passing the waste steam pipe on deck. The boilers are placed in four different water-tight compartments. In all there are twenty eight furnaces, having a total grate surface of 653 square feet, while the total area of the heating surface is 17,020 square feet. All the different uptakes are led into one funnel placed between the two turrets, and having a diameter of 8 ft. and 81 ft. 6 in. from the bottom of the furnaces. From these it will be seen that the heating surface is equal to 2·26 square feet per indicated horse-power, and the grate surface works out as low as 0·0869 per indicated horse-power.



ENGINES OF AN ENGLISH IRON CLAD.

HOW MANY LATHES turn work even approximately cylindrical? Not many. What with the nondescript centers made in the work, those in the lathe itself, the more or less wabble of the spindle in the box, the work resulting is very much out of round. This is nowhere better shown than where work is subsequently ground between centers. If it is smoked first to blacken it, the areas left black after a light grinding will surprise many.

* * *

PROBABLY THE SMALLEST STEAM ENGINE ever made for actual use is that shown in a recent issue of the *Iron Trade Review*. It was made to perforate paper patterns, and was only $\frac{3}{8}$th bore by $\frac{1}{2}$ stroke, making about 3,000 strokes per minute with five pounds of steam.

SOMETHING we never could understand is the enclosure of a subscription blank in a newspaper, with a request that the recipient sign it and send the money. A person intelligent enough to read a newspaper is quite equal to, and willing enough to write the few lines demanded for that service.

* * *

LAKE ENGINEERS are busy now, fitting out for the season. Bro. William Ponsonby is in Buffalo, getting the *Jay Gould* ready for service, and Bro. John W. Cook writes us from Detroit that he will soon be up and doing likewise.

It is many a long year since the hand that pens this paragraph handled a starting bar on the Great Lakes, the personal friendships then formed have not grown dull with age, but will be pleasant recollections as long as life lasts.

* * *

THE CHICAGO ASSOCIATION of Stationary Engineers No. 1 has appointed a new secretary, James T. Edwards, 74 Walnut street, Chicago, *vice* William Ponsonby resigned, to take charge of ss. "*Jay Gould.*"

* * *

THE SOCIAL STATUS OF ENGINEERS.

President Holloway, of the Cleveland Civil Engineers Club, made a fitting peroration to his recent address to this body. As reported in *The Iron Trade Review*, he said:

"Permit me to add before closing a few words in regard to the social and professional standing of the engineer. The progress of civilization, of art, and of science, depending, as they do, so much upon the wise and judicious use of knowledge in dealing with the material world, has of late years greatly enlarged the scope of the engineer's usefulness; while at the same time it has brought him into greater prominence. * * The pomp and pageantry of war are over, the general and the soldier are making their exits, and the engineer, with his more peaceful weapons, is the coming figure upon the horizon. Let each engineer remember that his chosen profession will be honored only as he honors it. The time is near at hand when engineers and engineering societies, will be called upon to give counsel and advice upon all questions of material progress in our country. The fact that the visits made by our leading national engineering societies, in the principal cities of our country, from Boston to Minneapolis, were greeted everywhere by ladies and gentlemen of the highest social standing and worth, is a tribute to a profession that numbers in its ranks some of the best minds of the country."

J. M. ALLEN, Esq., Pres. of the Hartford Boiler Ins. Co., has recently made some interesting experiments with boiler-rivets to determine the structure of them after riveting. These experiments were made upon machine-driven and hand-driven rivets, and the result showed that the material of the rivet was less injured by machine-riveting; with hand-riveting the metal seemed to be broomed, or broken up as to its fibers. The illustrations were printed directly from the rivets themselves, by planing them down flat and etching the surface with acids.

WE FEAR that we omitted to acknowledge the receipt of an elaborate card of invitation to a merry-making of the Chicago Association of Stationary Engineers last month, and hereby tender our apologies for the oversight. We are forcibly reminded of our neglect by another card of invitation to the first annual ball of the Stationary Engineers of Detroit, on April 15th. We don't know how to write up this sort of thing as well as a penny-a-liner would, but if good wishes avail anything this paragraph will have a certain value.

* * *

THE LATEST INNOVATION is a school opened in Sixth avenue, of this city, to teach young women mechanical drawing.

GENIAL SATIRISTS OF THE PERIOD.

The beauty of some forms of expression, as used by Western contemporaries, is that they do not mislead the reader, and leave him in doubt as to the writer's intention. Witness these current paragraphs which we have culled to point our remarks :

> "Our junior contemporary appears in a cover, and otherwise considerably improved. The design of the first cover-page is expressive, though the meaning of some parts of it is not exactly clear. For instance : the youth upon the tired-looking horse. Possibly this symbolizes the editor riding his favorite hobby (his own superior brilliancy and wit, the subject matter of about half his editorials.) The millstream figured in the upper right-hand corner would be a good place to soak the head of the witty and brilliant editor. There seems to be plenty of water."

This is fine of its kind. So is this from another source :

> "Our sprightly contemporary has a new cover, in comparison with which the original fig-leaf was a mere sham."

One more :

> "Because we criticised his very loose statements with reference to the speed of elevators, in a recent number, the very sensitive and exceedingly ill-tempered individual who writes the editorials for that paper accuses us of holding in contempt the milling trade. We hasten to inform the dyspeptic compiler of false figures that he is again in error. It was our high regard for millers that led us to point out his blunders ; our contempt is for the pretended expert who would, if he could, have the public believe that he is incapable of making mistakes."

This is a little one :

> "We see by the St. Louis *Miller* that Wendell Phillips is dead."

We have omitted to credit these excerpts because in reality the matters mentioned are none of our business ; but we wish the reader to observe that the faculty of writing mild and genial satire is still cultivated to some extent in the West.

ERRORS ABOUT ALUMINUM.

In our last issue we published something concerning this metal taken from the *Springfield Republican*, which paper had evidently copied it without credit. In the light of a recent communication to the *Locomotive* it appears that the statements made are erroneous, and we therefore hasten to correct them.

> Mr. Webster's process relates to methods of producing *alumina*, the oxide of the metal aluminum, not to the production of the metal itself; the statement, therefore, that Mr. W. has "discovered a method of making *aluminum* by burning or roasting alum," shows that the writer is unconscious of the distinction between a metallic oxide and a metal. To the chemist, or metallurgist, I may add, the happy idea of producing metallic *aluminum* by so simple a procedure as "roasting alum" will be a revelation.
>
> The *Republican* writer, after commenting on the cheapening of the cost of producing *alumina*, says that "the discoverer has been producing 200 pounds of *aluminum* (the metal) per week, for more than a year, the value of which is £4,000, or £208,000 per annum." There must be something wrong here. He says that "the usual price (of aluminum metal) is $20 per pound," which statement divided by *two* would be very near the truth.

* * *

A LETTER in the *London Engineer*, of recent date, has this paragraph; it seems to apply so well to this locality that we quote it:

> "So-called scientific research is rapidly becoming nothing but a method by which considerable incomes may be earned in finding out things of no earthly use to any mortal. The Institution of Mechanical Engineers ought to keep clear of this sort of thing, and its money ought to be spent on inquiries likely to prove of practical value to its members. There is no lack of subjects for investigation."

Quite so, but the difficulty lies in harmonizing views; what is of interest to one is not so to another, therefore the strength of societies is spent on random speculation.

* * *

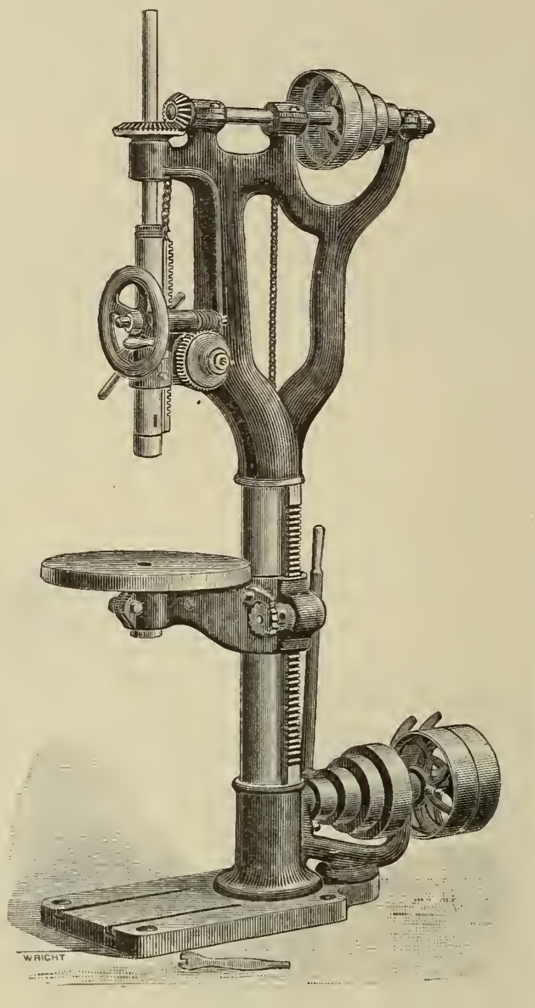
"BOUNCED" was formerly the word to express an abrupt dismissal, now "fired out" has superseded it. Volcanic expressions are scarce, and should be used economically.

* * *

WE ARE INDEBTED to the Hartford Steam Boiler Ins. Company for a bound volume of the *Locomotive* for 1883. The great utility of this publication is its rigid adherence to facts.

DAVIS'S NEW DRILL-PRESS.

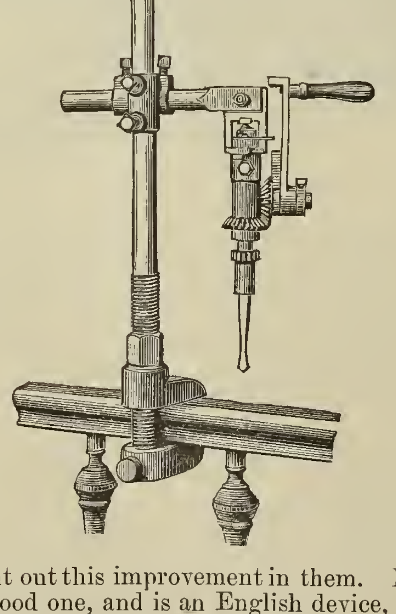
The drill-press here shown is a convenient one for nearly every class of manufacturer, and to some is indispensable. In general appearance it is similar to others of its class, but great pains have been taken to render it stiff and unyielding in all parts. The arrangement of feed, and facility for handling the spindle are such that work can be done rapidly and accurately under it. The spindle is of steel, also the worm and pinion, the rack is of Swedes iron. The table is 17½ inches, and a hole can be drilled in the center of a 20½ inch circle; taper shank drills are used in it; depth of feed 12 inches; all pinions and racks are cut out of solid metal.



Mr. W. P. Davis, of North Bloomfield, New York, is the maker, and he has been very successful in building good tools at a low price—the best evidence of this being that he retains as customers those who have once purchased. Price lists on application.

HANDY DEVICE FOR A "CRAB."

"Crabs," as they are called in this vicinity, portable drilling machines in fact, are indispensable in all large shops, and the use of them is so well known that we think it only necessary to point out this improvement in them. It is a very good one, and is an English device, which we find in *The Mechanical World.*



The improvement consists in jointing the end of the horizontal arm so that the vertical drilling apparatus can be set at any angle whatever. The bevel-geared arrangement is also exceedingly good, admitting of use in many places where a ratchet wrench could not be.

Useful as this tool is we must say, for ourselves, that from early associations connected with it, that we regard it with the liveliest antipathy, amounting, we may say, to detestation. It comprises in itself an amount of monotony and routine that would make a galley-slave object.

ABUSES OF FILES.

Technically speaking, there is not one man in a hundred that is capable of getting all the wear out of a file. Many will use up a file and do less work than others will accomplish with half the energy and file surface. If we examine the surface of a properly cut file closely, we will notice that the teeth stand perpendicularly, each one terminating in a smooth, even edge. If a bit of hardened steel be drawn across it in any direction a number of times, this surface or edge, though dulled, will be found to still retain its shape. On the other hand, if we rub it once in one direction, then in an opposite way, the teeth will present a jagged and uneven surface, and forever afterward will scratch and cut unevenly. Again, in the majority of files the teeth are cut diagonally with the blade, hence, by pushing at right angles with the work, part of the stroke is lost in overcoming the unequal angle at the point of contact; this portion of the stroke being lost, the same proportion of the filing surface is worn away without accomplishing the desired result, for the filings accumulate and extra force is spent in pulverizing them still finer as they come in contact with the sharp-edged pieces detached by the last stroke. The file soon becomes rough, scratchy, and ruined for fine work and finishing.

To file properly, the file should be shoved across the work so that the teeth will cut nearly at right angles; by this means the entire length of the tooth is worn equally, when the file has made its journey forward; if without raising it is drawn directly backward, the filings are effectually inclosed in a furrow by the edge of the tooth being bent forward over them; while if the file was lifted after the forward stroke is made, and not allowed to touch until again in the forward motion (by holding it an angle a trifle), the new filings will crowd out those left in the grooves. Thus the file will be kept clean and its teeth level and smooth till worn out, and even when refusing to cut, if laid away and allowed to rust a trifle, the teeth will acquire a new keen edge, but will not last long.—*London Trade Journal.*

A USEFUL DESIGN FOR A FILTER.

In tank-filters, especially those which combine a water-cooler and filter in one receptacle, a difficulty is often found in cleaning the filter. This is the case when the latter can only be purged by turning a current in a reverse direction from that in which it ordinarily flows.

In an English invention, this trouble is overcome by making the filtering material detachable, or in one piece, so that it can be removed bodily, thoroughly cleansed, and returned again. This is a very simple and practicable arrangement, and, unless our recollection is at fault, has been used in this county for some time.

* * *

SOMETIMES counting chickens before they are hatched results in disappointment. This is a case. The *English Machinery Market* says:

> "This year is likely to see important political changes on the other side of the Atlantic, which will have their influence on business here. It is not to be supposed that there will be free imports into the States, but a 'tariff for revenue only,' which is the leading cry of the Democrats, will open an immense additional field for the sale of English manufactured goods in the States.'

Well, it hasn't opened yet.

* * *

ECHOES FROM THE *Tech:* "A Freshman in the chemical laboratory asked an assistant if he might be excused from performing an experiment in which it was necessary to use a watch-glass, as he did not wish to take the crystal from his watch.

"It would be too little to say that the lady at the chemical supply-room was greatly surprised when a Freshman asked if she 'would give him a bath.' Further developments showed, however, that it was only a sand-bath that he meant."

NOT PROOF OF ANYTHING.

As an illustration of the superior economy of the compound engine over the ordinary low pressure or condensing engine, the experience of the Messrs. E. Sanderson & Co., of the Phœnix Mills, this city, is interesting and full of instruction. The mill is driven by a compound Corliss engine, which recently met with an accident which rendered it necessary to remove the low pressure cylinder for repairs, leaving the high pressure cylinder to do the work of the engine, being connected with the air pump so as to run condensing. With this arrangement it required four boilers, carrying steam at 90 pounds to furnish the necessary power. After replacing the low pressure cylinder and working the engine compound, three boilers with steam at 75 pounds pressure furnished all the steam required. It may be said that with only one cylinder the engine was too heavily loaded to give the most economical results; but on the other hand, when working compound, the engine was not loaded heavily enough to develop its maximum economy. The above is well worth the careful consideration of steam users wherever economy in fuel is taken into account.—*Millwright and Engineer.*

This proves nothing as to the relative value of the compound system, for the high pressure engine—turned low pressure for the time being—might very easily get away with one extra boiler and fifteen pounds of steam per square inch, by being out of condition. If the valves of the high pressure cylinder leaked, the steam would simply blow into the condenser all the time, much faster in fact, than it would exhaust into the low pressure cylinder, or the open air.

◆

PERFORATED FEED PIPES, having their delivery ends capped, are a source of continual trouble and annoyance. The small holes are very easily clogged with scale, and feed-pumps are very frequently broken in the effort to force water into the boiler. The perforations may be stopped in two different ways: Firstly, by the formation of scale around them, the hole gradually becoming smaller and smaller until entirely closed up; secondly, by the lodgment in the end of the pipe of small pieces of scale, which, having been formed in the heater or some remote part of the pipe, have become detached, and brought forward by the current of water and lodged in the end of the pipe. In a case which occurred recently, the feed-pump was twice broken in the effort to keep sufficient water in the boiler, before the cause of the trouble was suspected by the engineer. A steam-gauge placed between the boiler and feed-pump indicated something over 100 pounds as the pressure required in the feed-pipe to keep the boiler supplied with water when the steam pressure was but 60 pounds. Upon examination by the inspector, the perforations were found nearly closed by a formation of hard scale around them. The only remedy in such cases is to remove the perforated portion of the pipe, and discharge the feed-water through the open end. If the pipes are properly arranged, no harm to the plates or seams will result, even if cold water is used; and, unless the water be quite bad, it will be sufficiently well flushed by the incoming water to keep it quite clean for a long time.—*The Locomotive.*

◆

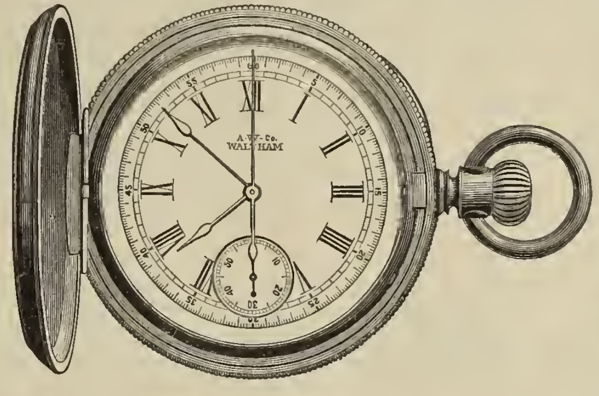
THE *London Engineer* says that:

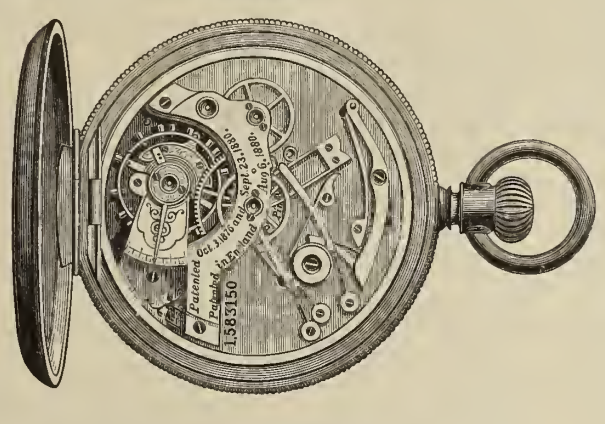
A company has been formed at Barrow-in-Furness, for the manufacture of rolled steel boiler-shell hoops, without a weld, up to 16 ft. in diameter, 1 in. thick and 4 ft. 6 in. wide. This will at once augment the strength of boiler shells by 25 per cent. for a given thickness of plate; only transverse seams will then have to be riveted.

THE AMERICAN WATCH COMPANY'S NEW CHRONOGRAPH.

We illustrate herewith a new fifth-second stop-watch, which is a recent production of the American Watch Company, Waltham, Mass. It is a well known fact that watches of this character are open to the objection of complication, which often leads to the failure of one or more parts. This complication entails great expense and very skillful repairers in case of injury.

The recording device, shown in figure 1, is attached to the top of the regular movement, and does not in any way interfere with regular time-keeping. In applying it, the center-pinion and the second-pinion are elongated; upon each pinion a small wheel is placed, and connected by a still smaller pinion. The additional wheel on the center-pinion connects with the independent center second-hand (shown in figure 2, pointing to XII.). This hand makes one revolution a minute, dividing in its course each second into fifths; at any one of which it may be stopped instantaneously. This stoppage is made by the crown (which is another name for the stem-winding attachment), or a small push-piece in the side of the case.




Patented Oct. 3. 1876 and Sept. 23. 1880.
Patented in England Aug 6. 1880.
1,583150

The operation is as follows: The fifth-second hand stands at 60, as shown, and at the moment of commencing to count, the stem-winding crown is pressed inward. It is unnecessary to look at the watch at all, either when starting or stopping, so that the whole attention can be given to an accurate count. A pressure on the same crown will stop the watch when the count is complete, and preserve the record. The minute hand has marked so many minutes and the independent hand the seconds or fifths of seconds. In this way a perfect record is given. When the record is taken, a third pressure on the crown causes the hand to fly back to 60, ready for the next counting. These watches can only be obtained from dealers.

◆

THE LONGEST RUNS without stopping in the United Kingdom, are between Grantham and King's Cross, 105½ miles in 2 hours and four minutes, an average of 51 miles an hour. This distance is done by four trains each day, all of which perform the journey within two hours and six minutes. The highest average speed attained on this line, 52¼ miles is between Grantham and Doncaster (50¼ miles in 58 minutes). The longest run on the North-Eastern is from York to Newcastle, 80¼ miles in 1 hour and 42 minutes; and the quickest (York to Darlington), 44¼ miles in 53 minutes—an average speed of 50.—*Temple Bar.*

◆

FIRMS WHO MAKE DRAWING TACKS with points $\frac{5}{16}$ths long should go into the upholstery business.

NEW PROCESS FOR SOFTENING WATER.

In some of the dyeing establishments in Germany water containing lime has been softened successfully by a new process. The principle of the invention is based on the fact that oxide of magnesia made red hot easily absorbs, after hydration, the free carbonic acid of natural water, and by thus depriving the water of the gas dissolved in it causes the carbonate of lime in solution to be precipitated. The magnesia itself is then dissolved, and joins the bicarbonate of magnesia which is in the water. At first the water cleaned in this way was blamed for attacking old boilers which were fed with it, and filling them with mud. It was, however, found that sulphate of magnesia in the pure water, when heated to a high degree, acted upon the carbonate of lime, of which the deposit in the boilers consisted, and formed gypsum and oxide of magnesia, so that the hard deposit was gradually transformed into mud. When this was blown off it not unfrequently happened that weak parts in the plates were exposed which previously were kept tight by the deposit, and this gave rise to the opinion that the plates were attacked.

How erroneous this supposition was is clear from the fact that the always present hydrate of magnesia is alkaline, and counteracts the effects of acid, which would act corrosively. At first, stirring was considered indispensable, but it was found that by taking an excess of a mixture of hydrate of magnesia, with a proper substratum serving as a filtering medium through which the water could pass continuously, the desired effect was obtained without any trouble. When proportionate quantities of finely powdered oxide of magnesia and sawdust are mixed with water it will be found that, under the action of heat, hydrate of magnesia is formed throughout the whole mass. After cooling, the hydrate of magnesia will be discovered so firmly united with the sawdust, so to speak crystallized into it, that it cannot be removed by mechanical means.

This preparation possesses thus the quality of filtering water in a high degree. By tightly filling cylinders of metal with this mixture, and forcing dirty water through, the water it is said, leaves the first cylinder not only deprived of all lime, but quite clear, the carbonate of lime crystallizing directly upon the sawdust. The action is so rapid that even water saturated to the fullest extent with lime or gypsum leaves the apparatus with these substances perfectly removed, it is said, after ten minutes' action.—*London Engineer.*

◆

A LATE FASHIONABLE STYLE OF NOTE PAPER is that with ragged edges. Crane Brothers have a machine, recently patented, for making these edges, the effect being obtained by tearing the sheets apart. This is to imitate old style paper, the edges of which were untrimmed. Envelopes are made with flaps having ragged edges to correspond with the note paper accompanying them.

A paper with the water-mark "Grecian Antique" is made. It is in imitation of the old hand-made paper, with the impressions of the wires of the coucher upon it. This is a remarkable imitation, and it would hardly be supposed that it could be done so well by machinery. It would be thought that a machine would make the impressions with too much of a uniformity. This, however, is not so, for the impressions of the wires are faint here and more distinct there, so that the similarity to hand-made paper is perfect.—*Paper World.*

◆

PERSONS HAVING COMPLETE VOLUMES of the early issues of THE MECHANICAL ENGINEER, say volumes I., II., III., IV., which they wish to sell, will please forward statement of price to us and condition.

◆

IN THE LAST THREE YEARS, says President Dennis, of the Atlantic Insurance Company, over 200 shafts have broken at sea, and he wishes to know if something cannot be done to prevent such accidents.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

HOW ALLEGED ENGINEERS BURST BOILERS.

Editors MECHANICAL ENGINEER:

In my opinion there are only three causes for boiler explosions—carelessness, ignorance and bad material.

I will mention some of the ways of managing steam boilers which I have seen, and which without doubt cause or assist explosions.

I have seen engineers about to clean boilers blow them off with 30 or 40 pounds of steam, "to blow the mud out." Then they would fill the boilers up again with cold water as quickly as possible with a hose, throwing water on the bottom and side-walls to cool things off in a hurry, so that it would be pleasant for Mr. Engineer to go inside the next day!

I have seen men fire up before the water was at its proper height, and have seen boilers in use when the engineers did not know where the water was, or whether there was any in the boiler.

I once saw an engineer chipping scale off with a hard and heavy sharp tool, so that every blow left a deep cut on the sheet.

I once saw an engineer trying his hand at caulking a leaky seam by wedging lead under the lap, and cutting a channel in the lower sheet at the same time.

Not long ago I saw a safety-valve joint leaking where it was bolted to the dome. The engineer had driven so many iron and wooden wedges in the joint to stop the leak, that shortly afterwards, not liking such treatment, the valve chamber suddenly left the boiler, and the roof went too.

Some engineers rely entirely on the glass water-gauge, simply because they don't like to use the gauge-cocks—"they leak so much." The same is true of the blow-off valve. It is well known that it is better for an engineer to start to work early in the morning to have time to blow off a gauge or so of water, and to raise steam slowly, instead of going late and firing hard, making things hum for awhile, after which he opens the fire-doors wide to check the fire. Through the day some carry steam and water high and low, as though they were trying to get in all the variations possible. Towards quitting time I have seen them frequently force in large amounts of cold water. Engineers who do such things surely have no idea of the tremendous strains they subject their boilers to. Such sudden changes of conditions bode no good, and yet people wonder that boilers continue to explode.

If boilers could talk what terrible tales they would tell! They would take the burden off from many engineers who are unjustly blamed; against whom the cry of "low water" was raised after an explosion, when the engineer was in his grave, past defending himself.

To conclude, I will say never carry any more pressure than the weakest part of the boiler will bear, and find out what that is, as most explosions are caused from over-pressure, and in 99 out of 100 explosions some one is to blame. They are not mysterious at all.

CANTON, Ohio. R. D. BRADLEY.

LETTER FROM YOUNG-MAN-IN-TROUBLE-WITH HIS-CUT-OFF VALVE.

Editors MECHANICAL ENGINEER:

Can you help me, through the columns of THE MECHANICAL ENGINEER? If I can only get light I am willing to expose my ignorance. I run a 20 horse-power engine, and my difficulty is this: I can't equalize the cut-off. I humbly confess trying three and one-half hours recently to set the valve so it would cut-off steam equally on both backward and forward strokes; the best I could do was 7⅜ forward, 9⅝ backward.

The cut-off is an independent valve, sliding on back of main valve, and driven direct by its own eccentric. I can move the valve along the rod (which is equal to lengthening the rod), and turn the eccentric on the crank-shaft on which it is fastened by set-screws, how am I to proceed? Have you any cut and dried rules?

I am not one that is easily discouraged; Mr. Editor. My hands are just raw from turning that fly-wheel, and I honestly believe, although "self-praise is no recommendation," that I've as much brains and common sense as the average man, above which grade I *do* want to rise; but this valve motion business well nigh makes me give up in despair.

I have been running small engines, never above 25 horse-power for over eight years, and thought I knew all there was to know until I had taken THE MECHANICAL ENGINEER a few months, and I've every copy from the start. Put me down as a smart Alec, but please assist me if you can in setting this expansion eccentric, and I'll never "cut you off" if you do.

MASS. WALTER BURDEKIN.

[We sympathise with our correspondent in his anguish, but can soothe him with the consolation that he has done all that can be done, as his engine is designed. He cannot equalize his cut-off so as to make it exactly alike on both ends, by reason of the ratio existing between the length of the stroke and the length of the connecting-rod. This is easily understood when we say that the angle the crank stands at, for a given position of the piston, is not the same on both strokes. For example, the piston stroke is 45 inches; ratio of crank to rod is as 1 to 6½. On the forward stroke the crank angle equals 131¼°; on the back stroke the crank angle equals 134⅜°; where does the piston stand on either stroke?

By reference to what is called the stroke table (*Auchincloss Link and Valve Motions*, p. 61), we see that this matter is clearly explained and the position of piston for these angles is respectively 38¼ inches from commencement of forward stroke, 37⅜ inches from commencement of back stroke. We cannot do better than refer our correspondent to this work, for further light, as it is an invaluable one to all concerned in making or running steam engines. When we were at school we used to fall back on the teacher in time of trouble and say that we didn't understand such and such things, and all the consolation we received was the reply, "that's the very reason why you should study it." Nevertheless, we hope we have been able to show our correspondent where his trouble lies.—EDS.]

WASHING HOT BOILERS WITH COLD WATER.

Editors MECHANICAL ENGINEER:

It is only a little over a year ago since we began to try and convince steam users that there are only two causes which destroy steam boilers, that is, dirt and carelessness. Now, all the technical papers are following our lead, and taking the credit to themselves. We must keep up the fire a little longer, and prove the truth of our assertions beyond peradventure.

Two different parties using steam here ordered batteries of tubular boilers; these were 54" diameter, with fifty 3½" tubes in each, with man-hole 9"x15" in the bottom; the iron was ⅜ths thick. Both boilers used the same water, and were within two blocks of each other. One set of these boilers began to show signs of distress very soon, by leaking at the seams below the water-line, so much so that the walls had to be torn down to repair them. The other battery has never given any trouble whatever. What is the reason of the first-mentioned battery giving out so soon? This is the reason.

They were run night and day, constantly; the only time for cleaning being between Saturday night and Sunday morning. Just as soon as the boilers could be touched the water was blown out, and the lower man-hole plates were taken off; then a stream of cold water was turned on from a hose. The result was as I have related above, and what might have been expected under the circumstances. The boilers are now in charge of a man who knows his business, and they won't need any more repairs in the near future.

SAN FRANCISCO, Cal. JOHN MAILER.

[Mr. Mailer is an engineer and an indefatigable worker in the interests of steam users; he is the patentee of numerous devices for higher economy, so his observations have the weight of experience behind them.

What he says about technical papers generally on the cause of disasters to steam boilers, and their adoption of our views on this matter, is cause for congratulation. We hope they will continue to do so, and spread the gospel of careful and intelligent management, insisting upon that as a great and saving merit. If our contemporaries will do this, and put all the "gas" cranks, and chaps with theories about boiler explosions in the waste-basket, they will do more good than they can in any other way. It is a singular thing that the majority of those who develop, or propound theories on the subject of boiler explosions have had the least experience with them. The longer a man deals with boilers the firmer is his conviction that good material, well put together, properly taken care of, and worked within its capacity, will never give way disastrously.—EDS.]

MECHANICS WHO READ AND THINK.

Editors MECHANICAL ENGINEER:

Through the medium of THE MECHANICAL ENGINEER useful information is disseminated, and by an unrestrained interchange of ideas we are inspired to think for ourselves and advance in our callings. Even though we may not reach the position we seek, we can say an effort has been made for the good of all.

I think that Mr. Moulton's articles, "*The Professor in the Machine Shop*," are full of interest, and have done more to encourage and inspire young men than much more serious writing. But few have the power to interest and amuse, as well as instruct the reader, consequently he finds the matter treated dry, and unless he is endowed with considerable patience, abandons his task with the impression that he does not possess the the requisite faculties to learn.

Some writers, instead of making things plain, have a knack of still further mystifying them, rendering them almost insurmountable. A man's ideas may be all right, but his rendering of them so bad that he is unfit to teach others. Writers on mechanical subjects, who are not practical men themselves, are greatly prone to this fault. Even teachers in technical schools err in this direction. It seems so hard for them to comprehend that those who have not had liberal educations, and have not had mental training cannot follow all their premises and deductions as soon as they are propounded.

To be a practical man is not to be an ignorant man. A person should be termed ignorant only when devoid of intelligence, or who, through indifference, will not reason for himself. Ignorant persons hold irrational views, but feel no mortification because they do not realize the situation.

It is evident that the mechanic who reads technical journals and literature connected with his vocation, is as a rule competent to do better work and more of it than a mechanic who "finds no time" to read such literature. If he finds no time for mental work, he is a poor mechanic (if I may use such an expression.) Mechanics who read and think are much more numerous than they were a few years back, and the multiplication of technical papers has much to do with this.

BEVERLY, Mass. SMOKE ARCH.

AS TO LICENSE LAWS.

Editors MECHANICAL ENGINEER:

I would like to say a few words on this question. We know well that, in order to do his duty to himself and his employer, an engineer should be endorsed in some way by responsible parties. What better endorsement is there than a license? How is an employer to know that he is getting a good man unless he is licensed? No man can get a berth as a marine engineer unless he has a good certificate, and it should be the same with all classes of engineers.

If I do not misunderstand one of your correspondents, he objects to the use of scientific works—"book engineering" is, I think, the expression. Are we who work for a living to go into experiments to determine the amount of water that each boiler we run will evaporate? How are we to know what has been done unless we read books? I read every useful work I can lay hands on, and am willing to admit that experience is the best teacher, but suppose we put a boy into an engine room, let him stay there ten years without any other opportunity to learn than his own observation, suppose we deprive him of reading books and trade-papers in that time, where will he come out in the end? He will know nothing at all except what he may have chanced to pick up; like as not half of that is wrong.

Licensing engineers is a good thing for good engineers, but it it a mighty unpopular move for those who are satisfied with what they know now.

CHICO, Cal. W. B. L.

BOILERS THAT PRIME.

Editors MECHANICAL ENGINEER:

Can you inform me how to prevent a boiler from priming, or, in other words, working water?

Your journal is the best I have ever subscribed for.

MEADVILLE, Pa. HOWARD DOWDELL,

[Boilers foam sometimes without priming; there is a difference in the two matters. Foaming is simply violent ebullition, or repulsion of the particles of water. Priming is the passing over of this foaming water into the steam pipes. Either one of these things is a great annoyance, and sometimes the cause is in the management of the boiler, but quite as often in its construction. Boilers that are driven, or worked hard, are very liable to prime, for the reason that their fire surfaces are very hot, and the water is violently repelled from them. Want of positive circulation causes priming, so do narrow water-spaces, dirt, and, not unfrequently, an improper location of the steam pipe. Want of steam room conduces to the trouble mentioned. Some boilers are chronic primers, and where this is the case the trouble lies usually in the proportion and construction. Priming can be obviated generally, even in the worst cases, by mechanical devices of one sort or another. The simplest of these is a dry-pipe, and it must be a bad boiler that will not work well with it.—EDS.]

A GRAND SUCCESS.

Editors MECHANICAL ENGINEER:

The entertainment in behalf of the library fund of the Stationary Engineers' Association No. One of Chicago, was a grand success, there being over four hundred present, who went away very well pleased with this method of acquiring a library.

CHICAGO, Ill. WILLIAM PONSONBY.

AIR-SPACE FOR BURNING SLACK COAL.

Editors MECHANICAL ENGINEER:

What percentage of air space should there be for burning slack coal?

LORAIN, Ohio. H. T. G.

[Best authorities say fifty per cent.—ED.]

CAN HE BECOME A MECHANIC BY STUDY?

Editors MECHANICAL ENGINEER:

I have worked one year as an apprentice in a machine-shop, when the company failed and shut down. I can do good work at chipping and filing, and you can imagine about how much I know of the business from your own experience. Now, I want to become a mechanic if I can. Can I become one without working any more in a shop, but by studying books on various subjects? If so, please let me know what I must procure.

PORT ARTHUR, Ont. W. J. C.

[We will answer our young friend's inquiry with pleasure, for the reason that he seems to need setting right on some points. One of these is the distinction between a mechanic and a workman. Between these there is a vast gulf. A man may be an excellent workman but a very poor mechanic, and *vice versa*. A workman concerns himself chiefly with mere manual dexterity, correct fits, smooth surfaces, good joints, etc., etc., but a workman who is also a mechanic looks beyond these, and while giving them their due share of attention, sees that the motion of the machine he makes is correct and properly designed.

Mechanics are born, they are not made.

The time our young friend has been at the trade is not long enough for him to have learned anything to speak of, and his attention should be turned to getting another situation, in a good shop, where he can serve the remainder of his time. While so doing let him study all the books he can obtain. If he already has a thorough knowledge of arithmetic, and what is called English branches, let him procure an elementary work on philosophy. Comstock's is as good as any. From this he can learn the mechanical powers, and the principles governing their action. But he must bear in mind one thing, and that is, that mere reading, or even memorizing, is not learning, and that a given period spent in reading mechanical books will not make him a mechanic. He must thoroughly digest what he reads, and master the principles which underlie the action of every part. This takes time, but he will find that the more he reads and studies the easier mental acquisition will be to him. It is greatly to our young friend's credit that he shows a desire to learn more than the mere routine of his trade, and it is a pity that he should not have an opportunity to develop himself, for he is wanted in the world.—EDS.]

CONCERNING SCREW CUTTING GEAR.

Editors MECHANICAL ENGINEER :

If the thread to be cut is a multiple of thread of lead screw (say lead screw 3 and cutting 3, 6, 9, 12 or or 15; or lead screw 4 and cutting 4, 8, 12, 16, etc.), the tool will always fall correctly into the thread, no matter where you close the nut.

If the lead screw and work each have a *whole number* of threads per inch, the tool will come correctly into place if you stop the lathe, open the nut, and run back any *whole number of inches*.

Whatever the threads are (even to the thread of a polical discourse), you can proceed thusly: Run up first time and stop the lathe when the tool has been drawn back; chalk top of face-plate, or observe some mark by which you can tell when it is same side up again; run the lathe backward to the place of starting in; stop the lathe, and make a mark, or stop of some kind, to fix that position of carriage. Now you have only to run up (forward) to the same place each time, stop with face-plate in same position, open the nut and run back by hand to the mark or stop, close the nut and go ahead,

Some fifteen or more years ago some one patented a device consisting of a small shaft revolving in a bearing attached to the right hand end of carriage, or feed-apron, on the inner end of which was a small worm-wheel that engaged with the thread of the screw. Its outer end carried a star-wheel. When the nut was closed and the carriage traversed by the screw, of course the worm-wheel and star did not revolve. Then a point of the star (which was held by friction) was adjusted to a mark on the carriage. Now, when the nut was open and the screw revolved, or carriage was moved, the star would revolve, and the return of the same point to the same position indicated the proper place to close the nut. Of course the number of teeth in the worm wheel, and of points in the star, must be so related as to indicate correctly. I believe the same worm-wheel was used in all cases, and different stars used for different threads. I think it is used some now, but not much.

The most economical way to cut *long* screws in general, is to have a tool-slide back of the center of the lathe, moving simultaneously with the front one, and carrying a second tool.

For instance, place the tool on front side, take a cut up towards face-plate, reverse the lathe so as to take up all backlash in that direction, set in the tool on back side to cut in same track as the other one, then go ahead and cut *both* ways. When you draw one tool out you run the other one in. Of course the lathe must run at same velocity back as forward.

Say! arn't you putting on airs in your old age, when you pretend not to know anything about the shop?

GRUMBLER.

[This letter contains information useful to our readers, and although written to us as a private letter we suppress the writer's name and give it to our friends. It is only necessary to add that the gentleman is at the head of a large machine tool works in Philadelphia.

As to putting on airs—no. There are a great many things we don't know about the shop, and when we don't we ask questions, and are under great obligation for concise answers like the above.—EDS.]

◆

THE OLDEST AMERICAN FIRM manufacturing gunpowder has been in existence nearly ninety years, during which time its name has not changed. Its founders were Frenchmen. It is not a partnership nor a corporation—simply a family. It is worth probably $30,000,000. The sons are educated to various occupations or professions in which they will be of use to the company. At the age of 21 they are taken into the business, but must sign agreements binding them to never ask for a division of the proceeds or estate. During their lives they are given all the money they require, and at their deaths the widows are handsomely pensioned until they remarry. Some of the young men become civil engineers, some chemists, some lawyers. A famous American Admiral was of this family. An employee is rarely discharged.

OUR INDUSTRIAL PROSPECTS.

(*Communicated.*)

The strongest factor in the industrial problem to-day is the enormous recuperative power and the steadily increasing consumptive capacity of our people. This dual influence has been at work over two years, and has finally brought the commercial and industrial interests out of deep trouble and possible dangers, and permanent prosperity is within the reach of patient and bold management.

The tide which set in against railway securities has turned in their favor. Two weeks ago the exportation of gold stopped and the shipment of bonds began. American railway securities have passed through a war of opposing forces and are once more sought for. This fact will be found ere long to be the basis of future activity in railway building. Just now new roads are cautiously projected and constructed. Foreign and home capital have long been distrustful, but that is about over, and confidence is re-established.

A second favorable condition and influence is, that our agricultural resources will soon be developed on a larger scale than ever, because of the expansion of railway construction during the past few years.

The third and associated fact, or influence, is that the demands for Northern manufactures for the South, consequent upon the general industrial awakening, will stimulate Northern enterprise in two ways, viz., to supply Southern requirements and to keep out of our way Southern competition. In some directions this will be no easy task. So rapidly have Southern textile interests been developed that a convention has been called of Southern cotton manufacturers to meet at Augusta in August, to agree upon a restriction in the interests of the trade and better prices and profits.

The downward tendency of prices has about exhausted itself, and has laid the foundation for an era of industrial and commercial activity greater than ever witnessed. It will necessarily be different from all others. The industrial activity of 1879–1883 was more or less unnatural. Production was unduly stimulated. Prices advanced abnormally, and profits were greater than was consistent with permanent results. The country is now paying the penalty. When it has been paid the improvement will come. The change will be healthful. Profits will not be such as to drag capital, and enterprise and labor headlong into the work of reproduction, regardless of consequences. The country needs more railroads, but they will be built with $33–$34 steel rails, instead of $50–$55 rails. It needs locomotives and cars, but they will be furnished at two-thirds the price paid in 1880.

The industrial condition to-day is satisfactory, even if but two-thirds the capacity is engaged. The country is practically free from debt, has an abundant circulating medium, values are about at par, speculation is held in check by abundance of all kinds of products of the shop, mill, mine, and farm. The intelligence of the people has been stimulated ; wrongs are more quickly arrested than formerly. Corporations are taught that if they have no souls, they must act as though they had. Combinations of capital are cheapening cost of production in all departments of industry.

Some Bessemer steel rail mills have several months' orders on hand; the large manufacturing establishments are feeling the reviving influence of increasing demand.

The coal trade is preparing for its best year. Anthracite coal companies expect to mine and sell 35,000,000 tons this year. Bituminous mines are being opened along the lines of some three hundred miles of railroad that have been constructed since last summer in the States of Pennsylvania, West Virginia, Ohio, Indiana, and Illinois, besides the opening of mines in Alabama. Cheap fuel is at the foundation of manufacturing activity and prosperity, and we possess this advantage. Mills and shops are following along the new railroad lines, and are gathering about them an industrial population which will expand as the manufacturing requirements of these newly developed localities develop.

Taking the most comprehensive view of our industrial prospects, there is every reason for anticipating a steady, quiet improvement, not in enormous profits, but in demand. High prices are ruinous.

NEW AND VALUABLE FEATURES IN STEAM PROPULSION PROMISED.

Several practical engineers have united with John Roach in forming the Rapid Steamship Company. The certificate of incorporation was filed in the County Clerk's office, on the 18th inst. It contains the names of Mr. Roach, John W. Handren, George H. Reynolds, Miers Coryell and Alexander Sanger as incorporators. The capital stock is $250,000, divided into 2,500 shares of $100 each. The purpose of the new company is declared to be to construct steamships and other vessels and mechanism and machinery for the propulsion of vessels, "especially auxiliary screw propelling power to that heretofore ordinarily employed, calculated greatly to increase the speed of vessels." It is not designed to establish any new line of steamships, but Mr. Roach and his associates hope to be able to develop new and valuable features in steam propulsion. A moderate-sized vessel is now being constructed for the company under the personal supervision of Mr. Reynolds. It will be ready for sea in about five months, and its equipment will include various new appliances owned exclusively by the new company.—

N. Y. Times.

THE GOOD TIME CLOSE AT HAND.

Our readers will notice on this page a review of the industrial situation, a matter which, we need not say, is of vital interest to all. The sanguine tone of this article, although quite in harmony with our own views and beliefs, may affect others who do not hold the same, unfavorably, and to reassure such we desired our correspondent to give reasons for his prognostications. We append a portion of his answer :

> "The small fry, I find, in all branches of industrial activity are half to three-quarters scared, and the same applies to some in commercial channels, but much of the complaint in the latter is due to the more stringent regulations of banks in reference to loans. Part of the pessimist's philosophy arises from the fact that the accumulations of goods of the past year have not yet been absorbed, and to the fear of lower prices.
>
> "My sources of information are railroad managers, bridge-builders, steel rail makers, iron manufacturers, large hardware concerns, persons representing large accumulations of trust funds, representatives of large manufacturing firms, and corporations who are not looking at the actual, existing situation, but from ninety days to six months ahead. I believe them to be right, and to be conscientious, but whether they are right or wrong the views I have given reflect *their* views, and I feel sure the outcome will show them to be correct.
>
> "I know of very large contracts having been placed within a few days for bridge-iron, steel-rails and for pig iron. I know of other negotiations hanging fire. My desire is to furnish a reliable market review of facts interesting to mechanical engineers, and in my next article will furnish all the evidences needed of the statements I will make."

Contemporaries who may see fit to quote these views will confer a favor by mentioning our name, not crediting an "exchange," or "a contemporary."

◆

IN OUR LAST ISSUE Professor Marks is made to say, in his rule for a wrought-iron strap:

> "*The same rule holds good for a steel strap, save that the divisor is good instead of* 5,000 *lbs.*"

This should read:

> "*The same rule holds good for a steel strap, save that the divisor is* 9,000 *instead of* 5,000 *lbs.*"

◆

SPEAKING of a new machine works, *Engineering* says:

> "All the shafting is 3 in. in diameter, and runs at 100 revolutions. The pulleys are wrought iron split drums; the specialty of this design is that the pulleys can be moved from place to place without difficulty, and are simply cramped on the shaft; no key-ways being required, excepting at couplings."

◆

THE INDICATOR SERIES just completed in THE MECHANICAL ENGINEER will be issued in book form by Van Nostrand, shortly, at the moderate price of fifty cents. The work will contain much new matter, in addition to that already published.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

BRIEF MENTION.

We take the liberty to direct the attention of our readers to the very valuable articles in this number on the compound engine, and upon one result of compression, by writers of eminence in the profession. We esteem ourselves fortunate in the receipt of this matter, that on the compound engine having been verified in practice.

Although the Presidential year is generally termed an "off one," or not to count, in the phrase of the time, our friends will perceive that we do not relax our efforts; rather do we put forth a little more, so as to make it equal to any other year. If we had not received substantial evidences of approval we should not have been able to do this, as our matter is by no means gratuitous.

Our next issue will also be full of interest. A most valuable illustrated article on "*Launching Ships Sidewise*," "a yacht-boiler," fully illustrated, with working drawings, together with communications from leading engineers everywhere make it a most useful number.

"CLOSE AND CONSCIENTIOUS WORK."

THE MECHANICAL ENGINEER has lately received a great many handsome notices from contemporaries all over the country, many of whom are in the same line of trade, or appeal to the same interests as it does. This universal good-will toward us is very gratifying, in a larger sense than a mere compliment expresses, for these notices are above and beyond the petty jealousies which sometimes afflict those who need this world for themselves alone.

It is invidious to particularize in these friendly exhibits, but one in particular has hit the mark so exactly as regards our intention that we cannot forbear giving it to our readers.

The *Iron Trade Review*, Cleveland, Ohio, says:

> "We wish especially to commend the double issue of THE MECHANICAL ENGINEER for February 16th. It is full of useful things for practical men, and, what is better, the paper is steadily good, betokening close and conscientious work on the part of the proprietors, Messrs. Egbert P. Watson & Son."

"Close and conscientious work" is the highest compliment our friends could pay us.

OF INTEREST TO ENGLISH DRAUGHTSMEN.

A correspondent in Belfast, Ireland, advises us that an American gentlemen recently told him what follows:

> "An American gentleman who went through our engine-works said that experienced draughtsmen were very scarce in the States and that any one going across could get a good appointment. Perhaps he made a mistake." * * * *

Our correspondent then inquires as to the truth of the American gentleman's assertion, and the probabilities of obtaining employment. We are in a position to advise him, and will thank such of our English contemporaries as may see this, to allude to it, as it may be the means of saving some of their countrymen who contemplate coming here from disappointment and hardship.

The statement accredited to an American gentleman that experienced draughtsmen are scarce in the United States is erroneous, there are a great many, and at the present time some of these are idle, with no hope of immediate employment. We do not know where the American gentleman obtained his information as to the scarcity of good draughtsmen here, but if he is at all familiar with our machine establishments he must know that they could not exist without expert draughtsmen. We do not allude to mere copyists, or artistic workmen; men who can make fine pictures of machines, but by expert draughtsmen, we mean those who can take rough pencil sketches (freehand drawings) from any one and reduce them to a practical basis as regards action, dimension and cost. This country teems with draughtsmen of both classes, and they receive from $2 per day upward, according to their services and the importance of their posts. Some receive $5,000 per annum, but these latter generally combine the functions of manager and superintending draughtsman in one.

Supposing that there was a lack of draughtsmen in this country, no foreigner could come here and step into an important position at once. However capable he might be in his own country, he would be useless here until he had learned our ways and methods of doing work. We cannot speak from actual experience in English shops, ourselves, upon this point, but we have conversed with many English workmen, and they tell us in substance what we have just said. The basis of cost is not the same in both countries to begin with; both stock and labor are dearer here, machine work is the rule, as compared with handwork, and our machine-tools in general—lathes and planers at least—are speeded higher than English tools. From this it will be seen that no reliable work could be done until the routine was mastered.

Aside from a mere acquaintance with methods of work, there is the no less formidable obstacle of social intercourse, or ways of dealing with others, above and below in position, to be acquired before work can go on harmoniously. Those not "to the manor born" would find it impossible (we mean impossible) to get on in an American shop. Affronts would be fancied on both sides where none were intended, and the result would be a stand-still.

We have given substantially this advice in an individual instance, and thinking it might serve others abroad, who have acquired erroneous views of American shops from what they have heard, we have concluded to publish it. If an Englishman comes to this country with the expectation of stepping into an important post at once he will be disappointed, for the reasons very plainly stated above.

ANNEALING STEEL.

Professor Hughes, an English physicist of high reputation, says concerning the annealing of steel:

> "The highest degree of softness in any variety of iron or steel is that obtained by *a rapid heating to the highest temperature less than fusion*, followed by cooling in a medium incapable of changing its chemical composition."

We have marked the italics, for the reason that we do not understand the statement. Most persons would expect steel to harden under such usage.

Further on in the same article he says this:

> "A wire, or piece of iron thoroughly annealed, must not be bent, stretched, hammered or filed; the hardening effect of a bend is most remarkable, and the mere cleaning of the surface by sand-paper hardens that surface by several degrees on the scale."

We do not intend to controvert this, or animadvert upon it; we simply place it on file, as a curious fact, or as a curious statement which may not be a fact.

◆

IN CONNECTION with what we said in our last issue concerning papers of scientific societies or meetings of professional men we have more to add. A certain society complains that we do not publish what is sent to us. It is true that we do not, and for these reasons: the reports are so very incomplete and fragmentary that we are unable to see their interest to the general readers. For instance, this:

> Mr. Tenchains spoke of the curves on railways, and Mr. Hotbox said that if a cure could be found for the heating of axles it would be, etc., etc.
>
> Mr. ——— exhibited models of the wire truss recently described by him.
>
> Prof. ——— presented a statement of the progress of the triangulation carried on in Pennsylvania by the United Coast and Geodetic Survey, and exhibited a map showing its present condition. The stations located are 27 in number, of which 19 have been occupied for the measurement of angles, etc.

These reports convey no information of any sort, but are merely records of incidents at certain meetings. Our space is too valuable for this purpose.

◆

THE NEW ENGLAND RAILROAD CLUB, an association of practical engineers and master mechanics of railways, recently adopted $\frac{3}{32}$ds of an inch to the foot as the proper taper for axles of cars, in the wheel seat.

◆

THE SCIENTIFIC AMERICAN informs an inquiring friend that rouge is red chalk!

SQUARE CORNERS INVITE FRACTURE.

It is well known that square corners in castings and details of machines under strain invite fracture, yet it is not uncommon to see them in daily use. A curious instance of the danger arising from square corners was related to us recently by a railway master mechanic of a near-by road. A strap on a side-rod had broken, and while repairs were being made the other side-rod was inspected. It was found that this was cracked, and that the point of fracture began where the planer-tool had jumped in while planing off the chamfer on the rod. Where the tool stopped there was, of course, a short square shoulder, and the jar and vibration at high speed had sought this spot as the most favorable one for destructive effects.

Our informant also advises us that they frequently break steel piston-rods, and that in every instance the fracture commences in the corner of the key-way. These corners are square, and the inference is that they invite, if they are not the actual cause of breakage.

CUSHIONING AND SOME OF ITS RESULTS.

Norman W. Wheeler.

GOSS MARINE IRON WORKS, BATH, ME.

The benefits, or otherwise, of cushioning by suppressing the exhaust of a steam-engine as the piston nears the end of its stroke, have been discussed very largely, but one concomitant of the steam cushion I have never heard mentioned. This is the increased friction of all sorts of metallic packing while the piston is advancing against a cushion.

I was led to study the action of a cushion resistance in respect to the packing, by my attempts—and failures—to make a well working metallic packing for pump-pistons, and I suppose that most steam pump makers have made similar attempts, and have failed, like myself.

Let us consider the action of steam on a piston provided with the common three-ring packing, moderately set out by springs. I suppose it will not be affirmed that rings were ever made to fit so accurately between the head and the follower that absolutely no leakage past the edges of the rings would occur, unless the fit were so close as to prevent the necessary outward and inward play of the rings, diametrically. If leakage from slackness of fit be admitted, even to a very small extent, it follows that the rings may be pressed tightly against either the head or the follower, and arrest a great part of the leakage which would occur if the rings fitted with equal slackness at each side. If the slack fit is upon the pressure side of the piston, the leakage into the cavity inside the rings will be large, and out of this cavity, through the close fit, will be small, so that a pressure nearly as great as that acting upon the piston will exist in the cavity and press the rings outward against the walls of the cylinder.

If the piston yields to the pressure upon it, the above predicated state of affairs exists but for an instant, because the movement of the piston transfers the slack-fit from the hind to the fore side of the rings, and the imprisoned steam is released into the exhaust-end of the cylinder through the new slack fit, and the internal pressure (and consequent locking of the rings against the cylinder-walls) is relieved; but the back pressure upon the piston is always exceeded by the pressure inside the rings.

This fact was brought home to me when I started my first compound engine in 1865. I had made the packing of the initial piston as usual then for simple engines, with broad faces, and, moreover, had set out the springs as for a simple engine. The packing made loud complaint, and I was forced to cut a broad groove in each outside ring, with stopper-blocks pinned in the grooves at the cuts, thus reducing the wearing surfaces in contact, and partly counterbalancing the internal pressure; for some leakage occurred over the stopper-blocks, and pressure accumulated in the grooves.

Now, in the case presented—of the piston being driven by the steam, and the slack fit being at the fore side, and the internal pressure nearly absent—no friction between the cylinder and the rings will be developed, except that caused by the resilience (elasticity) of the spring, and the slight internal pressure; so that the steam which acts upon the area of the rings outside the *fit* of the follower, or the head, as the case may be, is sufficient to drive the rings forward independently of the movement of the piston, so that the slack fit is again transferred to the hind side, and pressure again occurs in the cavity; and so on; the rings moving forward by a series of minute chatterings, or if steadily, with an amount of internal pressure which makes the friction balance the steam pressure upon the edges of the rings; in which case the slackness of fit would be about equal at both edges, and the internal pressure say half the steam pressure, plus the back pressure upon the piston. This action caused the complaint of my six-inch wide packing-rings in a cylinder containing direct steam of 60 lbs. pressure per square inch on one side of the piston, and intermediate steam of 30 to 10 lbs. per in. pressure on the other.

When a piston is forced forward against steam, or liquid, both the friction and the pressure upon the edges of the rings co-operate to make the fit at the fore side the slack fit, thus the leakage into the piston cavity is comparatively large, and the leakage out is small; hence, with a driven piston, the pressure inside the rings is as great as the resisting pressure before the piston, and the friction between the rings and the cylinder is that due to the pressure upon the whole inner surface of the rings. In fact the rings are "set out" by the pressure, like the cupped leather (of equal face) in a hydraulic press.

When the exhaust is suppressed, and cushioning begins, the piston rings are subjected to internal pressure, which makes friction, as shown.

Therefore it is not true that cushioned steam restores by its re-expansion nearly all the force required for its compression, because a large part of that energy is rubbed out by the savage setting out of the rings wherever there is compression—how much, who shall say? And who can say how much of the arresting of the motion of reciprocating parts is done by the friction of the cushion?

Apropos of friction from back pressure: Engineers who have had experience with simple engines only, are apt to make a mess when they attempt the adjustment of compound engines; almost invariably setting out the high pressure packing as though there were no back pressure. I once relieved a poor fellow of much trouble by abstracting the springs wholly from his high pressure piston. He was in high feather: "had got the knack of setting out the springs just right," and he stayed in this condition of mind until he took up the junk-ring some months after, and found no springs there.

WHY STEEL BURNS IN AN OPEN FIRE, BUT DOES NOT IN MELTING.

You ask in the last issue, "Why can steel be melted in a crucible without being burned, but cannot approach the same temperature in an open fire without being burned?"

If we will apply our knowledge of combustion to a mere fire, correlate all the facts which we have stowed away in tied-up packages we shall see.

Iron can be melted with a heat producible by art, and carbonated iron (cast iron or steel) is fusible at a lower heat, but if we attempt to melt steel in an oxidizing flame, we not only fail to melt, but first oxidize, or burn out its carbon, and then oxidize (burn) the metal itself. All the carbon is not burned away before the metal begins to burn, but the carbon starts first on the road to destruction, and keeps ahead, so that, as we are obliged to think *seriatim*; we think, and say, that the carbon burns out first.

Now let us consider the matter of an oxidizing flame.

When a blast or draft of air is passed through a mass of carbon fuel the fuel burns, that is, the fuel is oxidized by the oxygen of the air combining with the carbon. This action goes on regularly and spontaneously. The oxidation may take place in one of two ways, or the ways may be mixed. In one way each atom of carbon grips one atom of oxygen, and the two go off locked together as carbon monoxide (CO).

If CO finds a free atom of oxygen (O), which is warm enough to handle, or before itself has cooled down very much, the CO grips the O, and they go off together as carbon dioxide (CO_2). If the carbon (C) finds two atoms of O at once, and all three are warm enough, they jump together at once and go up the chimney as CO_2.

If more than two atoms of O go for one atom of C, the C has no room for the surplus, and the atoms of O, which are in excess of two to one of C, must go through the fire each alone. In going through they get warmed up into a state of great activity, and hunger, so to speak, and if they come into contact with any warm atoms of carbon, even if the C is held fast by metal, as in steel, the ardent O takes the C away and goes on as CO. It is doubtful if an atom of O can take two atoms of C from iron.

To make an oxidizing flame we have only to make a strong blast or draft through a relatively thin layer of fuel. To make a neutral flame we would have to produce a blast, or draft, through a layer of fuel which would exactly supply two atoms of O to one, *and no more*, of C, and to distribute the blast so evenly that no part of the fire would get more than another. I wish somebody would teach me how to do that.

To make a carbonizing flame, one that will not burn iron or steel, we have to so proportion the blast, or draft, that the O will be somewhat deficient, so that a part of the atoms of O will find only one atom each of C, and go off as CO, hungry for another atom of O, and take it from iron-rust, or such like matter, if it has good luck, or from the air after it leaves the fuel-bed. But you can find a place in such a fire where steel may be burned, viz., down near the bottom, where the blast, having been heated, can strike the piece before the O in it has come into contact with the C of the fuel, and satisfied its hunger for C.

Moral: When you heat a piece of steel to make, or dress a tool, make the fire deep over the tuyere, put your piece in five or six inches above the tuyere, turn on a moderate blast, so that a *blue* flame will show over the surface of the fire, and wait. The piece will be heated in time and will not be burned, and inasmuch as the steel will retain all its original carbon (its temper, as steel-makers say), the tool will last, and you will not have the same piece to dress so often, as you would if heated in the hot part of the fire.

Eudoxus, Jr.

TALKS ABOUT THE STEAM-ENGINE.—No. XII.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

If engines had no crank-pins the detail hardest to deal with would be removed.

In every new engine it shares, with the main bearing, the anxious solicitude of the engineer, until it has established by prolonged performance its ability to run without heating to an excessive degree.

The cause of heating is the conversion of work into heat, and therefore, since friction is always present, no crank-pin or bearing can ever be devised that will not heat more or less when running.

It is excessive heating only that the designer can hope to avoid.

Within reasonable limits as to pressure and speed of rubbing surfaces, the longer any bearing, which has a given number of revolutions and a given pressure to sustain, is made, the cooler it will work, and its diameter has no effect upon its heating.

I will prove this statement and endeavor to show what are reasonable limits in what follows:

Perhaps the most satisfactory proof of the correctness of this law is given in the gradual lengthening of car-brasses.

I am informed by a member of the firm of Asa Whitney and Sons that the Philadelphia and Reading Railroad has, since its beginning, gradually lengthened its car-brasses from 4¼ inches up to the present standard size, with a steady improvement, as regards wear and heating. This result would seem to have been attained in a purely experimental way, independent of any mathematical investigation.

There is a limit to the length of bearings, in the impossibility of making smooth running fits throughout the whole length.

Mr. Coleman Sellers has cited to me instances in which bearings, six or more inches long, have been found to bear only for a portion of an inch, at two or more places, the whole of the rest of the bearing being practically inoperative.

This could be seen by examining the worn surfaces of the journal.

The limit, then, as to the length of crank-pin or bearing, is the ability to turn and bore true cylindrical surfaces, and the ability to line these up perfectly, and keep them in line.

The journal and box may be perfectly made and yet get out of line by the movement of the box, or the springing of the shaft or pin, and the longer the bearing is the more injurious the results of being out of line.

Bearings having universal self adjustments are used to mitigate these evils, and do so to a certain extent, but they do not reach all cases.

We see, then, that we must compromise, and get a pin long enough to keep cool, but not so long as to defy the skill of a mechanic to fit it up.

* * * * *

Sometimes journal bearings which run cool in one direction will heat when their motion is reversed. Examine the surface of the journal you will find it "fuzzy," and see that the "hairs" which have all been laid one way are now being laid the other. If the bearing cannot be replaced by another; careful peaning of the whole surface will form a skin which in some cases obviates heating on reversing.

The use of babbitt metal, or of some comparatively soft metal, is for the purpose of having the shaft, or pin, make its own adjustment and bearing.

The pressure per square inch of projected area [The projected area is that rectangular area which would appear if the crank-pin was split longitudinally down the middle, and equals the length of a bearing multiplied by its diameter] which a crank-pin can stand seems to vary enormously.

We have said elsewhere that 125 lbs. per square inch is considered as much as ought to exist between two smooth lubricated surfaces, and yet we have many cases in which this pressure is greatly exceeded on crank-pins, without evil results.

So much depends on the perfect smoothness of the surfaces, and on the continuity of the film of oil or unguent interposed, that, assuming perfect truth of adjustment to be possible, we are still in the dark as to what we should do.

When we oil a bearing we take advantage of the capillarity of a fluid and of the enormous force of capillary action to float the pin or shaft on a film held by its boxes.

With smooth surfaces the pressure required to drive this film out by steady pressure, without rolling motion, far exceeds any except that attained in hydraulic machinery.

With motion, the constant movement of the film facilitates the process of squeezing out the oil.

Any defect of surface also aggravates the liability to heat, especially if the defect exists in the turning body, or if it is so placed in the fixed bearing as to have a tendency to *scrape* the film of oil off.

We are thus awkwardly placed: We know beyond peradventure that the heating of the bearing is due to frictional work, and we cannot reach enough exactitude in the shops to enable us to calculate this work.

If a standard plug and ring gauge are *accurately* fitted together and oiled, the ring can be moved all over the plug. Stop movement for but an instant and the ring seizes the plug so firmly as to require enormous force to remove it. If the diameter of the plug is one thousandth of an inch less than the ring this seizing will not occur.

In this case we must average what has already been accomplished, and use this result until we are assured of more accurate work.

There seems to be an idea prevalent among some writers on the steam engine that wear must be provided for in calculating crank-pins, but as heating always precedes wear, we will leave that to be provided for by the boxes and confine our attention to heating.

From General Morin's experiments we quote the following statements:

> "Unguents are more easily expelled with small than with large journals."

We can take it for granted, I suppose, that the same load was put upon both large and small journals, although he does not say so.

Again:

> "The motion of rotation tends of itself to expel certain unguents and to bring the surfaces to a simply unctuous state. The old mode of greasing, still used in many cases, consisted in simply turning on the oil, or spreading the lard, or tallow, upon the rubbing surfaces. and in renewing the operation several times a day.
>
> "We may thus with care prevent the rapid wear of journals and their boxes; but with an imperfect renewal of the unguent the friction may attain 7, 8 or even 10 per cent of the pressure.
>
> "If, on the other hand, we use contrivances which enew the unguent without cessation, in sufficient quan ities, the rubbing surfaces are maintained in a perfect nd constant state of lubrication, and the friction fall as low as 5 or 3 per cent. of the pressure, and probably still lower.
>
> "The polished surfaces operated in these favorable conditions became more and more perfect, and it is not surprising that the friction should fall far below the limits above indicated."—*Page* 307, *Morin; translation by Bennett.*

The many tests which have been made on special machines and carefully polished journals do determine the relative values of oils as lubricants, but not always with certainty, and should not be used as precedents for ordinary machines.

We can gather from the above that the idea of motion as a factor of the work creating heat, was not in General Morin's mind, although he does refer to motion as expelling the unguents.

No matter how perfectly a bearing may be lubricated, it does seize the journal with some force, and this force, multiplied by the space through which the turning surface moves in a given time, is the power lost in friction and converted into heat.

The heat must be conveyed away by the conductivity of the lubricant, and of the metal of the bearing.

This statement applies with equal force to iron and cast-iron; cast-iron and wrought-iron; cast-iron and brass, or with steel, or wrought-iron in the place of cast-iron.

Brass will conduct heat away from two to four times as rapidly as iron, but the film of lubricant may interfere with its action somewhat.

It is always best to use brass, or Babbitt metal, or some soft metal that can be easily replaced wherever there is any danger of injury by heating, as it would cost more to replace a pin, or shaft, than to replace many boxes.

RULE FOR PROPORTIONING CYLINDERS AND THE POINT OF CUT-OFF FOR COMPOUND ENGINES OF TWO CYLINDERS.

Divide the initial by the terminal pressure and the quotient will be the number of times which the steam has been expanded, say $\frac{120}{7\cdot5} = 16$.. Then get the square root of the number of expansions or volumes, which is the *relative proportion* of the two cylinders, as also the *point of cut-off* in each cylinder. This will give the required degree of expansion and the highest aggregate effective pressure, therefore the best attainable results. It also gives an equal absolute initial pressure on each piston. We will now give an illustration of cylinders and diagrams, based on this proportion, with a calculation to prove the accuracy of it, to make it clear to engineers who understand diagrams.

Fig. 1. Letter *A* shows the steam line or initial pressure, in the high pressure cylinder, which is 120 lbs. *B* is the expansion line, *C* is the terminal and back-pressure line, *D* the atmospheric line, *E* represents the initial pressure in the low-pressure cylinder as a continuation of the terminal pressure in the high pressure cylinder, *F* represents the expansion line, and *G* the line of absolute vacuum.

Fig. 2. The high-pressure cylinder diagram is exactly like Fig. 1, but the low-pressure cylinder diagram is to a scale of 10 lbs. per inch. *H* represents the steam line or initial pressure in low-pressure cylinder, *I* the expansion line, *J* the absolute vacuum line, *K* the atmospheric line, and *L* the back-pressure line, which is 13 lbs. below the atmospheric line.

As the cylinders are in the ratio of 1:4 (see dotted line, Fig. 2), and as the cut-off in the L-press. cyl. is at one-fourth the stroke, it is at this point, of the same capacity as the whole capacity of the H-press. cyl., therefore the larger cylinder will have the same pressure to the point of cut-off, as the terminal pressure in the smaller—omitting loss of pressure by reason of friction, etc., by the passage of the steam from one cylinder to another.

To produce diagrams approaching these in form, will require efficient cut-off valves, and it will be necessary to have a *receiver* between the cylinders, to avoid a variable back-pressure in the H-P. cyl. With a receiver of say 10 times the capacity of the H-P. cyl., the back-pressure there could only vary by a very small amount. In the case of one corresponding to the illustration, where the pressure between the cyls. is 30 lbs., the variation will only be 2¼ lbs., due to compression in the receiver.

A good compound engine will have efficient valves and passages, the cylinders will be steam jacketed and the steam in the receiver superheated, when it is probable that very little or no fall in pressure would occur.

By the proportion given, the same co-efficient of expansion is obtained, as when the same number of expansions is effected in a *single cylinder*, which is the highest attainable.

The following calculations will explain and prove the above rule of proportion:

TWO CYLINDER COMPOUND ENGINE

For 2000 horse-power at a piston speed of 600 ft. per min. for both cyls. The letters indicating the lines in this table do not refer to the diagram.

Lines.	Calculations.	Results.	Description.
A	Pressure in lbs. above atmosphere...	105	Pressure at *H P.* cyl.
B	Atmosphere or perfect vacuum............	15	Perfect vacuum.
C	105 (line *A*) + 15 (line *B*) = ...	120	Absolute initial pressure.
D	Expanding down to...	7·5	Terminal press. in *L P.* cyl.
E	120 (line *C*) ÷ 7·5 (line *D*) = ...	16	Number of expansions in both cyls.
F	√16 (line *E*) = ratio of Exp. = ...	4	Number of expansions in each cyl.
G	As 16 (line *E*) : 4 (line *F*) : : 1 to	·25	Point of cutting off in each cyl.
H	Hyp log. of 4 (line *F*) + 1=	2·386	Or 1·386+1. = 2·386 multiplier of term. press.
I	120 (line *C*) ÷ 4 (line *F*) = ...	30.	Terminal and back-press of *H P.* cyl. and initial of L-P. cylinder.
J	30 (line *I*) × 2·386 (line *H*) = ...	71·58	Average absolute press. in *H-P.* cyl.
K	71·58 (line *J*) — 30 (line *I*) = ...	41·58	Average effective press. in *H-P.* cyl.
L	7·5 (line *D*)×2·386 (line *H*) 2 lbs. deducted for back-pressure...	15·89	Average effective press. in L-P. cyl.
M	Say we have..........	100.	As comparative area of L-P. cyl.
N	Then we have in proportion............	25.	As comparative area of H-P. cyl.
O	25 (line *N*) ×41·58 (line *K*) × 600 feet per min. ÷ 33000 = ...	18·90	As comparative horse-power of H-P. cyl.
P	100 (line *M*) × 15·89 (line *L*) × 600 feet per min. ÷ 33000 =	28·89	As comparative horse-power of L-P. cyl.
Q	Add lines *N* and *M* =.	47·79	As comparative horse-power in both cyls.

R 2000 horse-power ÷ 47·79 (line *Q*) 100 (line) *M* = 4185 area = 73 in. diam. L-P. cyl.
S 2000 horse-power ÷ 47·79 (line *Q*) × 25 (line *N*) = 1046 area = 36½ in. diam. H-P. cyl.
T 4185 (line *R*) × 15·89 (line *L*) × 600 feet per min. ÷ 33000 = 1,209 horse-power for L-P. cyl.
U 1046 (line *S*) × 41·58 (line *K*) × 600 feet per min. ÷ 33000 = 791 horse-power for H-P. cyl.

This table will also be of use in assisting in calculations where the cylinders are of different proportional dimensions. It will be seen, however, that any change in either cylinder from the above proportions will be a loss of efficiency.

There are many foreign writers who have published in substance similar views of the proportion which should govern the sizes of the cylinders of compound engines, but none have so clearly expressed and demonstrated the subject as Mr. Wm. Sutcliffe, an English engineer of ability and reputation, from whose treatise I have copied largely, as best representing my own experience in this field of engineering, and which (when published), I feel sure, will meet a want long felt by practical engineers, among whom your valuable journal largely circulates.

It follows quite properly the articles on the steam-engine indicator and diagrams recently published in THE MECHANICAL ENGINEER.

MIERS CORYELL.

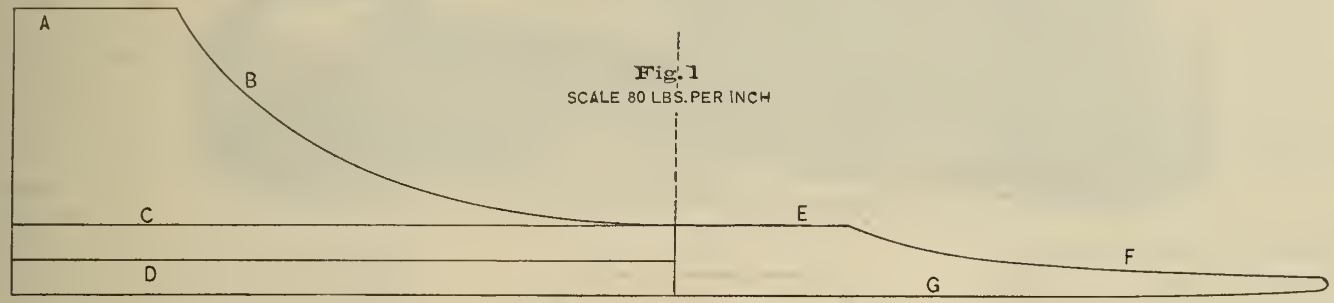


Fig. 1

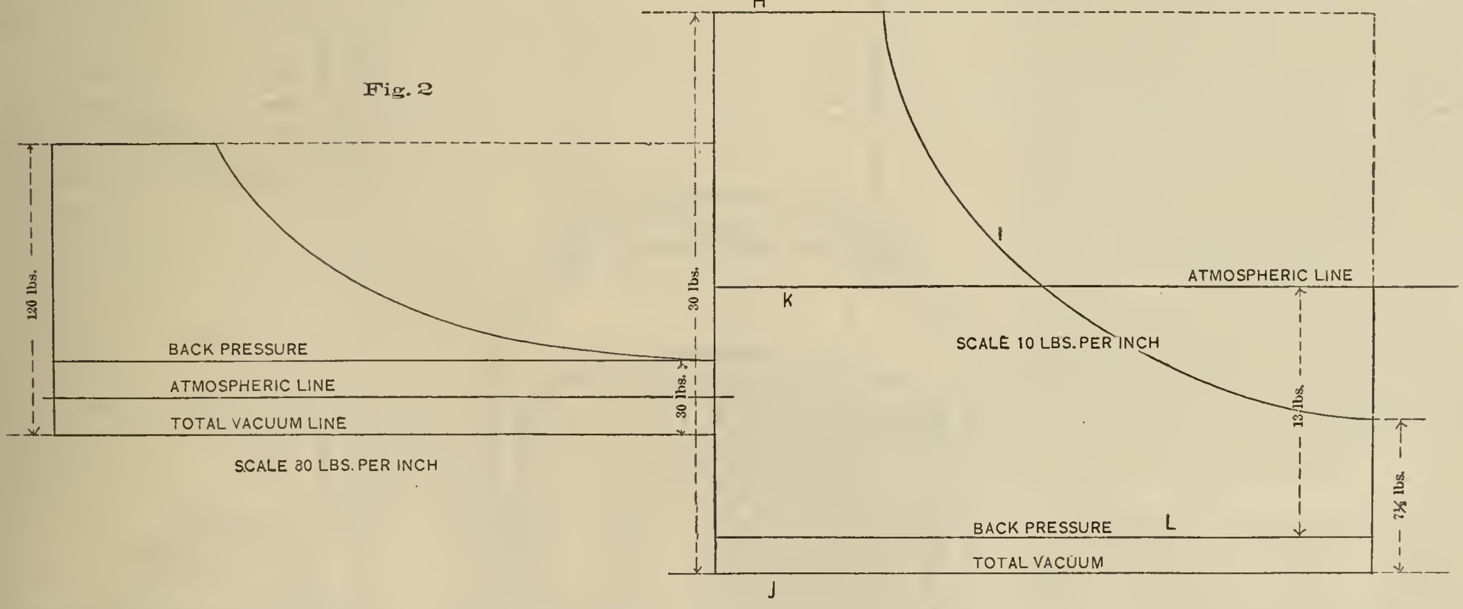


Fig. 2

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LI.

I have not obtruded our shop and its inmates, of late, for the reason that nothing has occurred worthy of note. One shop is pretty much like another, and the same things are happening in them all over the country. When I was at work at the bench, and young at the trade, I used to think I would be better off in some other town and shop. It seemed to me that the present place was a terribly dull and tedious one, and that the present shop was the worst one possible to show what I could do. It seemed to me that some one else was always in the best place, a better place than I had, and that some invisible influence stood between me and the first position in the shop. The more I thought this over the more discontented I got, and it generally ended by my pulling up stakes and going off somewhere, about five hundred miles, as the crow flies. I did not care where the place was, or what kind of work it was, all I wanted was a new place.

That other place it always seemed to me was the one where the highest wages were paid; where the shop-floor was always swept clean, and freshly watered in summer-time; where there were no chips under the lathes or planers; where the vise-benches were square on the edges and had no slivers in them; where the vices themselves stood in one unbroken perspective all down the shop, with never a planer anywhere in the vicinity to bump a man in an unguarded moment, or craze one with its infernal *squiz, squiz,* when the nerves were unsteady.

Somehow when I reached those other places my anticipations where not realized. There was always a leading man ahead of me, who got all the best jobs and was generally looked up to. The wages were a trifle better, but the board was much more than a trifle higher. The shop was not quite so clean as the one I had left, and the prospects for steady work by no means flattering. The town itself became as unlovely as any other, by acquaintance. The same class of shops lined the same sort of streets; the same frame houses stood in them. The people were pretty much the same; barring a local dialect, or habit of expression, there was no difference in them, and then I began to think.

"Moulton," I said to myself, "it strikes me you are an ass. You get discontented and unhappy at your surroundings, and think you are unappreciated and could do better some where else. You fancy conspiracies are incubated and efforts made to keep you down, and the cause of all this is just—Mr. Moulton. You say you are a first-class workman and demand the best jobs. If they are not given you sulk and make yourself generally disagreeable; so much so that it is a wonder that you are not discharged for being 'ugly.' The fact is you are not a first-class workman, though you could be if you would leave off brooding, and give as much attention to your work as you pay to 'jealous' imaginings. You have a correct eye for proportion, are swift in execution and can appreciate mechanical exactness. I never saw the man, yet, who could put his dividers almost on the exact mathematical center of a line, or a circle with you, but you sacrifice all these real values for those which are fictitious. You think it is the place which make the man, instead of the man making his place."

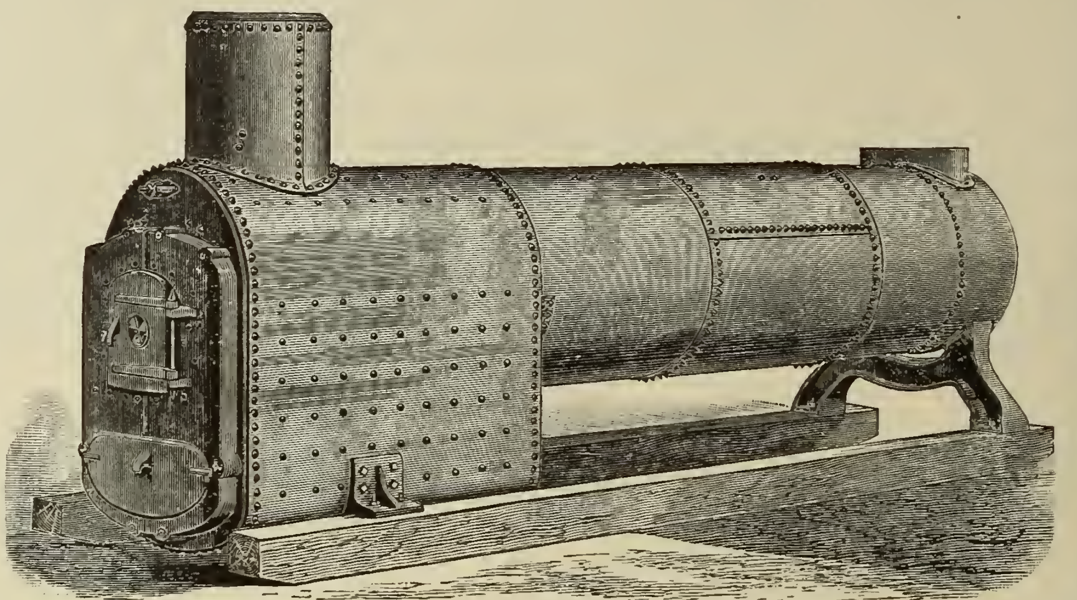
I used myself harshly and unsparingly, because I was out of pocket by my failures to realize the mechanics' Arcadia, and I sincerely wanted to find out the cause. The conclusion I came to has been narrated above. I changed my course entirely. I came to this place, which is an out-of-the-way country town, and tried to do the best I could *for myself.* The result ensuing was that this was also the best for my employer, and I have, as the reader knows who has followed this series, a shop of my own, and am doing as well as a man with my capital could expect.

Now what does all this gossip and prolixity tend to? Is it mere gossip, or is it a chart of a course? Is it not a map of reefs and shoals that lie in the channel of every mechanic's life? I think it is such a map, and I think there are thousands of men to-day whose only enemy is themselves. They have no bad habits, least of all vices; they mean to do right and they want to get on, but somehow they don't. They stick in the same place, and are lucky if they do not fall back; pushed down by some more enterprising than they. They have one fault or another which prevents their ever taking anything but a subordinate position in whatever calling they pursue Sometimes it is a disagreeable personal bearing, sometimes egregious conceit, sometimes unsteadiness, careless workmanship; what may it not be? Who can catalogue the numerous causes which wreck men's lives? If it is not one thing it is another, and lucky is he who can put his hand out and throttle it.

Here is a case in point, ready to hand. Lamb is a young man in our employ of whom I have frequently spoken in times past. He has the making of a first-class machinist, in every respect save one, and that is want of punctuality. This goes through everything that he undertakes to do; no matter what it is. It seems utterly impossible for him to comprehend what time means. He is last in the shop and last out of it. If I give him a job I never know when it will be done. I am certain that it will not be ready when he says it will. This is a very serious defect in one's character, and Lamb is not the only man in the world who is dilatory, but the results are the same to him, he is the only man in his world, and to him this is sufficiently serious. I have tried to point out to him that it is also a great loss to others—his want of punctuality—but he seems constitutionally incapable of comprehension of the subject. I have asked him why such and such jobs were not ready, and he would answer that there was no time to do them in. When I pointed out to him that this was not so, that he had ten hours per day to do his work in, just the same amount exactly as others had who did do what they agreed to, I say when I reminded him of all this he would look at me helplessly, as if I had spoken in a strange tongue.

This dilatoriness is by no means physical laziness. There never was a more indefatigable or faithful man; it is no want of personal effort; it is I think a natural incapacity to portion out his work so that each detail comes in at its proper time. If this is so his case is hopeless. He will always be captain of the rear-guard. A man who cannot plan is always subordinate, because others who can, do much more than he. A man who has not the acquisitive faculty never gets rich, no matter what his opportunities may be; while those who have acquisitiveness wallow in wealth, though they rose from the pig stye, and have no aspirations beyond it.

I look back upon my own wild gropings all over the United States (and part of Canada) in search of something that I had with me in every place that I ever set foot in, yet knew it not, and that is self-help, self-reliance. Oh, what a lever that man has who knows it! Its length is infinite, for by it, with right aims and determination, there is no obstacle he may not overturn. I say I look back and see my own aimless efforts, for I had no one to help me by advice or counsel as to a better walk; now, being through my own efforts in a position to say a word to others, I have done so, being very certain that there are many who will take it seriously to heart and profit thereby.



TYPES OF AMERICAN STEAM BOILERS.

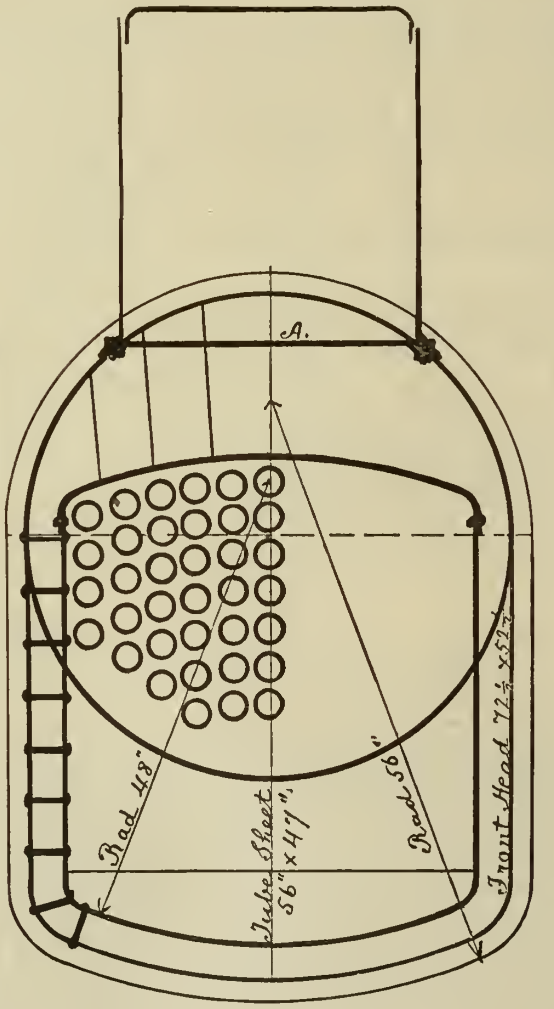
PORTABLE BOILER.

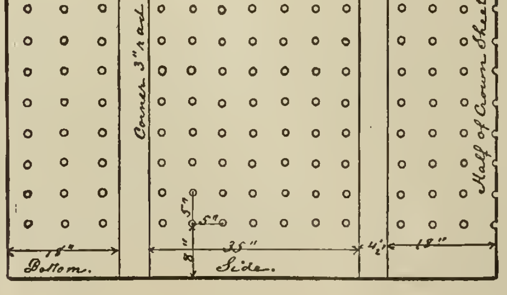
We continue our details of steam boilers, giving in this issue dimensions of a portable boiler, as shown in the engraving and drawings. Our contributor says:

"This boiler is used a great deal for agricultural purposes, the smaller size being set on wheels. The front of this style of boiler is cut out, and flanged outward for the fire-box, and a cast-iron front put on, in place of a water-front, as you will see by the engraving. The sheets are all marked in sizes. The boiler is 48″ diam.; tubes are 7′ long, 65 of them. The fire-box is 64″ long, 42″ wide and 48″ high. The wagon-top sheet is $68'' \times 204'' \times \frac{5}{16}''$. The shell sheets are, 1, $48'' \times 154'' \times \frac{5}{16}''$; 1, $54'' \times 156'' \times \frac{5}{16}''$. The fire-box sheet is $64'' \times 162'' \times \frac{5}{8}''$, best flange; the head is $53'' \times 47'' \times \frac{3}{8}''$, best flange. The front head is $72\frac{1}{2}'' \times 52\frac{1}{2}'' \times \frac{3}{8}''$, and is of *steel*. The connection-sheet is $46'' \times 52\frac{1}{2}'' + \frac{3}{8}''$, best flange. The back-head is $52\frac{1}{2}''$ diam. $+ \frac{3}{8}''$. The dome-sheet is $36\frac{1}{2}'' + 99'' + \frac{5}{16}''$. The dome-head is $34\frac{1}{2}'' + 99'' + \frac{3}{8}''$.

By making the front-head of steel I find it is better, for iron is very liable to crack in the corners in flanging out, for the fire-box; in fact, steel is in all ways better, for flanging of that description. The dome and dome-seat are laid out the same as in the last article.

Our contributor will observe that we have taken a liberty, with his sketch by adding a brace, *A*, across the dome-opening in the shell, as shown in the sectional elevation of the front. This is very essential with such large domes and openings, for the wagon-top sheet is much weakened by cutting out the iron, as stated. The tendency is to open the sides when under steam, and the boiler is strained more than the mere absence of the metal cut out. This occurs through the additional stress brought upon the side seams, braces and dome-seat to resist the outward pressure. We prefer domes with small necks rather than those with full-sized seats. Three such braces as these, shown at *A*, should be put across the dome-opening.





IT CERTAINLY WOULD.

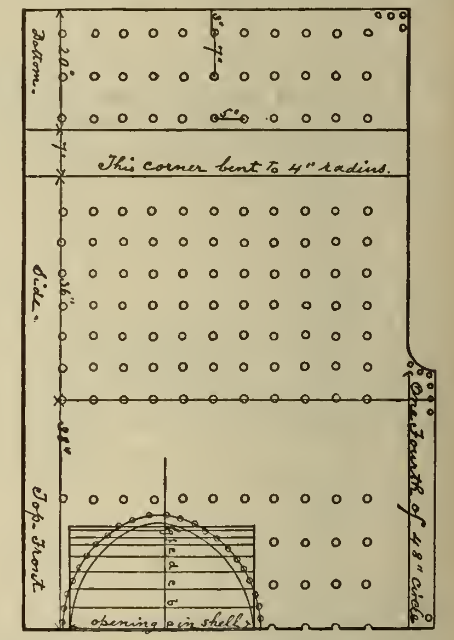
Universal free trade in this country would put an end to the larger part of the mechanical and manufacturing industries of the country, or it would reduce the rate of wages paid to the operatives in those industries by at least 50 per cent. That would be the inevitable consequence of competition. Either the American rate of wages would have to come down, or these industries would have to stop. Neither of these consequences would be a blessing, and either would be a stupendous evil to the country. That country is wise that fosters its own industries and gives to them as great a variety of form as possible; and this is precisely what tariff protection does, and what every country needs to have done, until, like England, it can protect itself by its industrial supremacy, without the help of tariff duties.—*Age of Steel.*

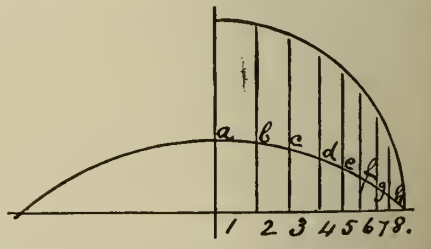
So it seems to us. A strong argument of free traders is, that by reason of it a man procures a watch, a coat, or his tools much cheaper; as if the prosperity and welfare of a community, or of individuals, depended upon the cost of the necessaries, or upon the cheapness of articles that last a lifetime. Free trade in this country means overthrowing the whole social fabric and establishing another, which may, or may not, be better than that we now have. It is at any rate too risky an experiment to be tried.

TEST PIECES.

Testing iron or steel by means of samples cut from plates is by no means an exact process, yet, as will be seen by this quotation from a paper recently read before the English Iron and Steel Institute; we quote from *Engineering:*

"In breaking test-pieces of the same quality of metal by direct tension, very different results were obtained according to the form of the test-piece employed. The sample that one engineer would define as stretching nearly 44 per cent., before fracture, was classed by another using a test-piece of different form, as stretching less than 28 per cent. In fact, to obtain from any bar of metal relatively high percentages of ultimate stretching, all that was needed was to use short or thick test-pieces. Mr. J. Barba had shown, in a paper published in the *Memoires de la Societe des Ingenieurs Civils* in 1880, that test-pieces of the same form, namely in which the ratio of length to diameter was the same, gave the same percentage of ultimate stretching whatever their size might be; but that in those of equal length but differing in diameter, or of equal diameter but of different lengths, the percentages of ultimate stretchings varied very much.





Notwithstanding the extent to which the result obtained in testing a sample of ductile metal was thus affected by the proportions of the test-piece used, no standard dimensions or proportions for such pieces had been generally adopted, and those in common use varied very much. Sir Joseph Whitworth, for instance, advocated the use of a test-piece 0·798 in. in diameter by 2 in. long, or 2·51 diameters long, and the test-piece in use at Woolwich Arsenal was 3·75 diameters in length. From these proportions the ratio of length to diameter was increased in the test-pieces adopted by different engineers, especially on the Continent to 10 or even more. This flexibility in results, from the same materials, would seem to point to some arbitrary sizes as a necessity, if any reliance is to be placed on the tests.

COMPRESSED AIR AS A COMMODITY.

What seems upon the surface of things a wild scheme is that for using compressed air as a motive power in the place of steam. This is now proposed in Birmingham, Eng,, according to *The Mechanical World.*

> "It is intended to establish a central works, at which extensive air compressing machinery will be laid down, and the compressed air will be distributed by means of underground pipes to the districts to be supplied with power. From a practical point of view, certain difficulties will arise that will militate against its success. *i. e.*, in reference to the proposal to apply it to engines at present working by steam. It will probably require greater alteration in the details of such engines than is at first supposed. Certainly, they will save the space on which boilers stand and the money spent in their attention; but against this must be set the price charged for the compressed air, and this will have to be considerable to make the undertaking a commercial success. The cost of laying and keeping in repair the mains carrying air under pressure will be considerably more than is involved in the case of gas, and the superiority of the system to that of gas and gas engines is not very manifest; but as a substitute for steam, air certainly offers some advantages, and the promoters calculate that they will be able to supply power at 20 per cent. less cost than that of steam and its accessories, but they do not claim any great economical advantages for it where powerful engines are in question, although with engines up to, say, 30-horse power, and where intermittent power is required, it would appear as though likely to give good results."

It is difficult to see why. Compressed air is a secondary power; it is produced by the expenditure of another motor. To say that it can be peddled out in small lots cheaper than the first mover is contrary to all experience, and to scientific laws. The alteration in steam engines to work air successfully would be greater, as our contemporary states, than is supposed. Steam is hot; compressed air when expanded is very cold, and exactly opposite conditions of action are introduced, not to mention mechanical difficulties set up by reason of the greater subtlety of air as compared with steam. Selling air, compressed by steam power in competition with steam used direct, seems a very wild scheme.

HERE HE IS AGAIN, in England this time—the crank we mean. He writes to a trade paper as follows:

> "I should be greatly obliged by being informed, through your correspondents' column, of the composition of an elastic cement for covering, inside, a leaky seam in a boiler. The cement was exhibited at the Engineering Exhibition recently held at Agricultural Hall.
> T. M."

We have some queer demands over here at times, but this will match them.

HOW I SERVED MY APPRENTICESHIP.

NUMBER VII.

BY GEORGE SLOCUM.

After working with Brown for about nine months the foreman sent me "tramping" around the shop. One day I would be with the big slotterman; the next, perhaps, helping some man repairing a steam hammer in the smith-shop; then on a little jigger, then sawing off iron for studs, etc., etc. That's why I call call it "tramping."

One day I got a lot of caps, and flanges of different sizes to lay off. I guess they were for Water Stations. Some had five holes in them and some had seven, and some little ones had three. So I put in wood centers and struck circles, and got my dividers and set them and stepped off the holes, and—missed it. I set and re-set, and stepped and re-stepped until I got the proper distance between the holes. Old Jones happened along as I was laying them out, and, said he:

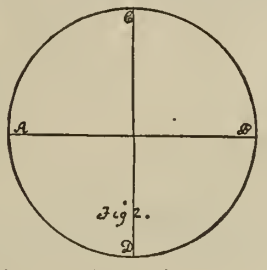
"What's that you are doing?"

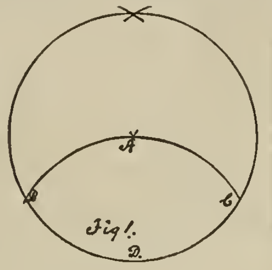
"Laying off holes," said I.

"That's a cut and try way, ain't it?" said he.

"Seems to me more like a 'set-'em, guess-'em way."

"Well, stop a moment. Now, you see, here's where the geometry comes in, that I was telling you about not long since. Hand that small flange over here. Three holes, eh? Circle four inches in diameter? All right! Put centers in an eight-inch, and a ten-inch flange too." Here, you see I strike a circle four inches in diameter, same as you did, and then, without moving the dividers, I set one leg on the circumference anywhere, and describe an arc cutting through the center, and cutting also the circumference in two places. Now I open my dividers the exact distance between those two points and step off three holes, exactly the same distance apart, commencing anywhere I please on the circle. (See Fig. 1.) Where *A* is the center of the circle; *B C*, the two points in the circumference; and *D*, the center of the arc *B C*.





"So, also, if you want to lay off four holes, you describe a circle of any required diameter, and then draw two lines, through its center, at right angles with each other. (See Fig. 2.) Where the line *A B* is drawn through the center of the circle, and at right angles with *C D*.

"Again: if you want to lay off five holes, with *A* as a center (see Fig. 3) describe the required circle. Draw two lines at right angles, as at *B C* and *D E*. Cut the line *A E* at *G*, and with the radius *B G* and *G* as a center, describe the arc *I I*, cutting *A D* at *F*. With your dividers, take the distance *B F*, and it will go around the circle five times exactly.

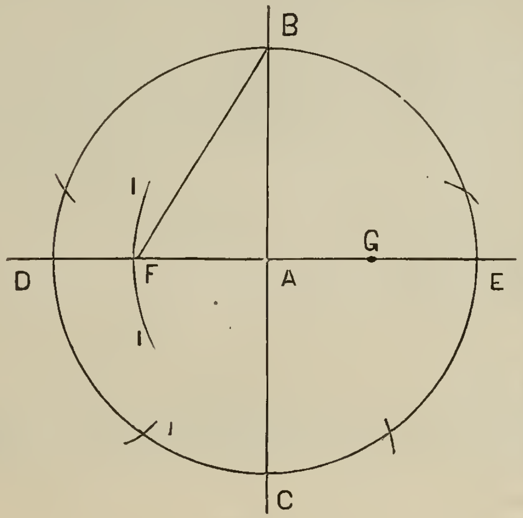


Fig. 3.

"Now, I don't suppose there are half a dozen men in this whole establishment who are not aware that, if you describe a circle of any given diameter, and without moving the dividers, step off six points in the circumference, they will be equally distant from each other, the length of the radius of the circle. See Fig. 4, where *A B* is the radius.

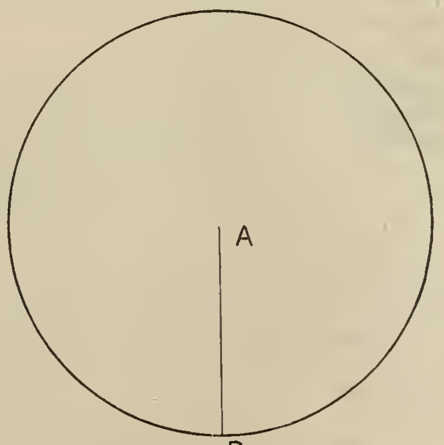


Fig. 4.

"This is quite plain to you, ain't it?" said Jones.

"Oh! yes; I understand how its done. I think I can go through the whole business myself now, without getting stuck. But that aint the thing. What I want to know is, *why* do you draw those lines, and arcs, and bisect, and all that sort of thing. Why? That's the question," said I.

Why do I draw those lines, etc? Well, now, I declare. Perhaps you are not aware that your question comprehends the whole science of geometry, and would require a great deal of time to answer it. And even though I should be able to find time to answer it, you would not profit anything by the answer, as it would be all Sancrit or Greek to you, unacquainted as you are with even the first rudiments of the science. In order that you may get a thorough understanding of those lines, arcs, etc., you must commence at the very beginning and advance slowly, step by step. Geometry was not the invention of one man, nor did it expand into its present proportions in a month or a year. The science as we have it to-day, is the result of the combined studies and researches of all the great mathematicians who have lived, from Euclid and Pythagoras down to the present time. I merely throw in those bits of geometry to give you an inkling of what it is, and to get you interested in its study and gradually draw you into it, and the deeper you get into it the better you will like it. If you have not a genius for it, like some people, you must acquire a talent, by close study, patient reasoning and acute observation. There is no royal road to it; its gifts are for all, without regard to condition in life.

For the present, let it content you to know *how* those lines, arcs, etc., are drawn. After you have studied up, the why will appear very plain.

We had a boy in the shop, a sort of devil-may-care fellow, up to all kinds of tricks, and continually playing pranks on the others, and sometimes on the journeymen. I guess he put in his time in the shop because he had to, because what work he did, didn't amount to much either in quantity or quality. Bill Sykes, for that was his name, got elected captain of a base-ball club, and he was trying to raise some money to buy some toggery, so he offered me Forney's Catechism for $2—said it cost him $3.50. I didn't know anything about the book, so I spoke to Jones about it.

"What's the name of the book?" said Jones. I told him.

"What does he want to sell it for, anything wrong with it?"

"No, I guess not," said I, "only he's been made captain of a base-ball club, and wants some money to buy traps with," said I.

"Oh! that's it, eh? Well, you can't buy a better book to post you up on the locomotive, that's sure. Why don't you jew him down a peg? I always thought Bill was intended for some high position, but I had no idea it would come so soon. Yes, of course, snap it up at $2, if you can't get it for less," said Jones.

A few weeks after this, Bill and another boy were working at the lower end of the shop, where the foreman didn't show up very often. Pretty soon Bill and the other chap were playing ball. The other fellow was sending 'em in red hot to Bill, when presently the M. M. popped in through a small side door. Another boy saw him before I did, and hollered: "Billy, the old man's coming." But it was too late, for the old man got in too quick, and Bill and the other fellow got a two weeks' lay off on the head of it. The foreman said he had a mind to discharge both of them.

"Jones," said I to him one noontime, "let's start in where you left off the other evening."

"Where was that?" said Jones.

"Why laying off holes. Don't you remember?"

"Oh! you're right, that's so. Well, let's resume. I told you there was another way besides making lines and curves and bisecting, etc., and its this: Now, here we'll go back to three holes. You see I've got a little book here, that contains a table of "Natural trignometrical ratios."

"Goodness!" said I, "what a jaw-breaker."

"Yes; just so," said Jones. "Well, these tables are known also as tables of natural sines and tangents. Now I'll describe a circle, say, 5 inches in diameter. We wish to lay this circle off into three equal parts. I set down 180 (degrees) and divide it by 3 and get 60 (degrees) as a quotient. I then look in this table for the sine of an angle of 60 degrees, and I find the decimal ·86603. I multiply this decimal or sine—by 2½, because that's the radius of my circle, and I get 2·16508—then I multiply this by 2, in order to get the chord of an arc of 120 degrees or $\frac{1}{3}$ of the circumference of a circle—and the result is 4·33016 inches. Then I change ·33016 into twelfths of an inch as close as I can, and I get $\frac{4}{12}$ nearly. Now George take those dividers and carefully take off of that scale $4\frac{4}{12}$ inches, and if you don't step that distance off on the circumference of this circle exactly 3 times, why—I am greatly mistaken that's all."

"It does it to a hair," said I; "that is, a horse hair!"

"Oh! you get out," said Jones! "you didn't set your dividers right. That's what's the matter."

"Well, the points *are* rather blunt, and I guess I was in too big a hurry."

"Now, we'll lay off four holes in a 6-inch circle. 180° divided by 4 gives 45°. According to the table the sine of 45° is ·70711, and this multiplied by 3 inches—our radius—gives us 2·12133; and this multiplied by 2—to get the chord of an arc of 90°—gives us 4·24266 inches, or $4\frac{1}{4}$ inches nearly."

"Now, boy," said Jones, "I've got to get some work done to-day; pack up and get out of my way. We'll see each other later."

◆

MR. BUNSBY IN THE ENGINE ROOM.

Listen to Mr. Bunsby in the engine room:

> "It is amusing to find that the criticisms of the English engineering papers, ourselves among the rest, upon the novel and comparatively absurd designs put forward by the Naval Advisory Board of the United States for the new cruisers then proposed to be built have resulted in, first, the abandonment of the employment of beam engines of somewhat similar class to those used on their boats, and the whole question appears likely to be shelved by the refusal of Congress to build the steamers at all. The criticisms upon the designs are not confined to this side the Atlantic only.
>
> * * * * * * *
>
> "The whole blame is to be attributed to the want of experience in that class of construction which the American engineers cannot possibly have acquired. The difference of opinion as to the sea-going fighting qualities of the vessel seem also to be widely spread among the different heads of boards, the constructors, and naval engineers of authority; so that Congress, in the face of all these opposing opinions, does not see a better way out of the difficulty than to refuse to make any further appropriation for new vessels for the present.
>
> "When so much valuable and expensive experience can be obtained from the history of our naval experiments on this side of the Atlantic, we do not doubt that if our American cousins would condescend to profit thereby, they might make a fresh start with credit to themselves and advantage to their country."—*London Marine Engineer.*

What should be done with this party? If we were to deliver an opinion like this on English engines, and the probable motives of English engineers in building them, would we receive a broadside from English papers, or would we not? We think we would. Yet here is an English paper commenting upon a matter it cannot possibly know anything about, and settling the question for and against off-hand. We know how to characterise this proceeding, but we do not like to put the expression into type.

Listen to this, Mr. Bunsby! The *Chicago* is to have beam engines, not the abortions you have seen published in papers in your own country, but engines of the same type. They will make more turns (revolutions) than any engines you have in England, with better distribution of steam, and with less fuel, and the ship will run further, coal for coal, tonnage for tonnage, draft for draft, than any ship you can bring against her. When you talk about experience you are quite beside the question. Experience with vertical direct acting engines does not serve you at all with beam engines; of these latter you know nothing, because you have never built any worth notice.

Go a little slow, Mr. Bunsby, and do not be so pert. It is possible that you are wrong.

We have never been too full of prophecy, but we will make this time the exception, and wish to be put on record as to what we have said above concerning the *Chicago.*

BOOK NOTICES.

Shavings and Sawdust, by "Observer," Comprising a series of articles, some of which have appeared in *The Lumber World* for the past two years, and are now revised, together with others which have not been published, all treating of the designing, construction, care, and operation of wood-working machinery. Illustrated. C. A. Wenborne, Buffalo, N. Y,

A new era has begun in technical books, and those specially addressed to certain classes or trades. This movement has its rise in, and is directly fostered by, trade papers. We have always asserted that mechanics should write for mechanics, and the reasons for this belief are so plain that they scarcely need pointing out. It is not so very long ago that mechanics were looked upon as useful, but very unpleasant people to come in contact with. Even clergymen, and professional people generally, felt called upon to exercise a certain condescension and toleration toward them, as though, being of inferior intelligence, they were not to be encouraged too much lest they become familiar. Absurd as all this sounds, it is fact, and in many parts of the country to-day there are plenty of idiots who look upon themselves as superior to mechanics because their hands are whiter. Now mechanics being so generally of a lower order, it was necessary that works for their instruction should be written by persons of a higher order, to wit, those who knew nothing of the subject treated whatever. As a result we have had in times past, trade publications put forward which concealed the trade ignorance of their writers in sentences that no human being could comprehend, and which were not worth the paper they were written on. All this is being rapidly changed, and to trade-papers the improvement is justly due. They have fostered the communications upon technical subjects, and have shown their readers how to put their mechanical ideas into ringing English. Short, curt, strong, terse sentences, that sink into memory, characterise the style of many modern technical writers, while the subject matter is that derived from their every day experiences. From such publications men derive instruction of great value, indispensable to them, in fact, if they would fill the first places.

The book noticed in our caption is of this class, and to it all that we have previously said applies. We are not expert enough in the management of wood-working machinery to criticise the author's assertions in that line, but from the position he holds in a leading establishment for making wood-working machinery, we feel safe in saying that it is reliable. Where he speaks of machinery pure and simple, we have not detected any errors. The subjects treated give evidence of a wide range of information, and the work is one which should have ready sale. The price is $1.50, and can be had of us, or the publisher direct.

The Magazine of Art. Cassell & Company, limited, 741 Broadway, N. Y. London and Paris.

The April number of this beautiful magazine is at hand; we have never seen it before, but if this one is a fair sample it is certain to find favor among art lovers. The title indicates its specialty, and in this it leads.

In paper and typography it is faultless, while its make-up is attractive and easily followed. The contents of the April number are "*More About Algiers,*" beautifully illustrated; "*Battle and Travel,*" which contains some account of the famous Russian painter, Basil Verestchagin, and also two full page plates of his works; "*Art in the Garden,*" illustrated, instructs the reader how to lay out his possessions to obtain the best effects. "*The Country of Millet,*" illustrated, and a chronicle of art, being a summary of events in that line, close the number. The price is 35c., and money is well laid out in its purchase.

◆

UNINTELLIGENT CRITICISM.

The *Iron Age* says this:

> "The recent circular issued by the secretary of the American Society of Mechanical Engineers, relative to an increase of membership, a larger annual income and a wider influence, has already furnished matter for a good deal of unintelligent newspaper criticism. In speaking of increasing the number of members, the circular distinctly specifies "membership of superior quality," and the opinion apparently prevailing in some quarters that this increase is to be effected at the expense of quality would thus seem to rest on a very slim basis. * * *
>
> "Thus far the Society of Mechanical Engineers has secured but a small proportion of those in every respect qualified for active membership, and it cannot do better than widen the sphere of its influence by increasing its numbers."

The last few lines of this are all that demand notice, and we can tell the writer of it why so many of the leading engineers of this country hold aloof from the Society of Mechanical Engineers, and that is because it includes so many who are not engineers, are of no use to the society, and only appear in their glory when full of new wine, at after dinner speeches. They are simply hangers-on, and have no place in a Society of Engineers. The writer of the paragraph quoted should touch lightly the subject of unintelligent criticism; it would be hard to find a parallel to his paragraph.

◆

EXPERIMENTS ARE BEING MADE IN ENGLAND with what is termed "limed coal," for the production of illuminating gas. The coal is broken up into fine pieces and then mixed with about three per cent., by weight, of slaked lime. This mixture is distilled in retorts in the ordinary way. It is claimed that by the admixture of the lime the production of ammonia is about doubled, and that the sulphur compounds are retained by the lime, so that the gas is more easily purified. A slight increase in the yield of gas is also said to result. The presence of lime in the coke produced is stated not to be detrimental to its use as a fuel, it being claimed that the lime is a beneficial constituent, as it performs the office of an "oxygen carrier," and aids in the perfect combustion of the carbon.

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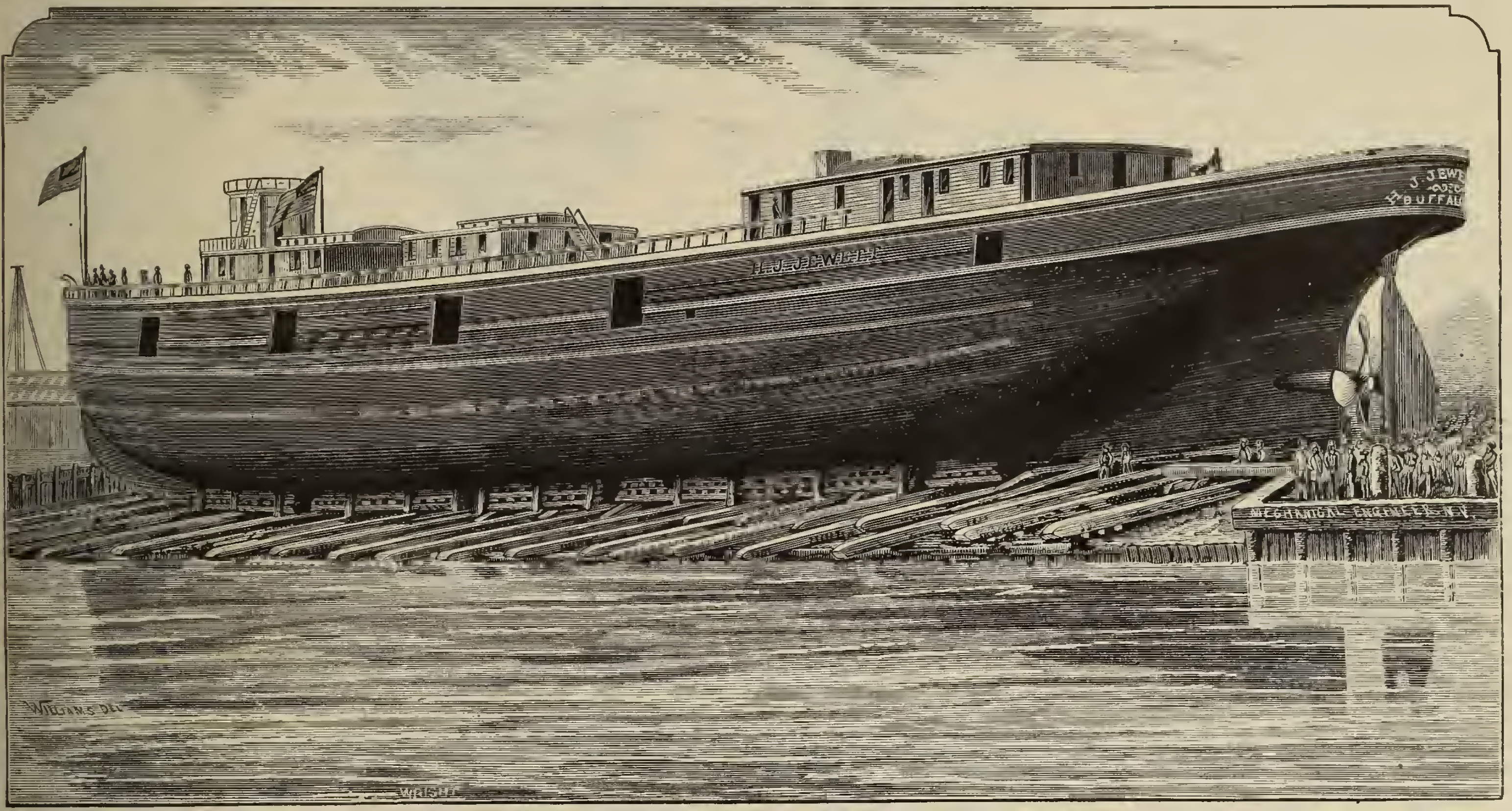
LAUNCHING SHIPS SIDE ON.

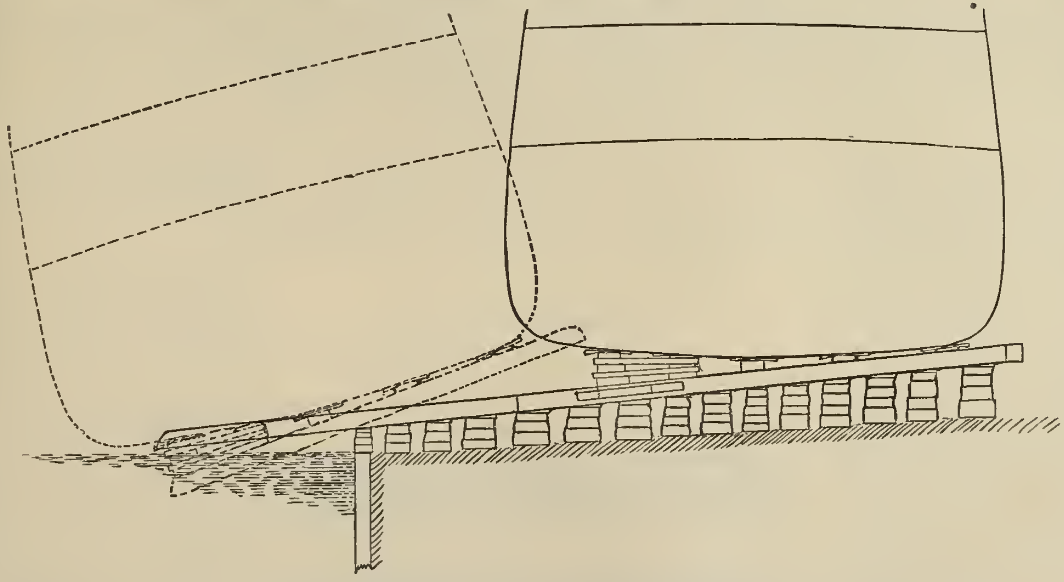
BY NORMAN W. WHEELER.

It is customary to launch vessels side on throughout the lake country. Circumstances compel such launches in many ports, the channels being too narrow and tortuous to permit end on launches; and so accustomed have the builders in those parts become to this, apparently abnormal procedure, that side on launches are made in many instances where end on launches could readily be had.

It is certainly an object to build upon a level keel, for that permits the use of spirit-levels and plumb-lines so long as the ship remains upon the stocks. This saves much time and trouble—especially in building iron vessels, in which the top and deck heights are fixed upon the black-board. If the beams and cross spralls be middled and marked while the frame lies on the black-board, then a surveyor's transit enables one to regulate the sides by simply bringing the middle marks in line upon the hair. The same instrument, used as a level in conjunction with a sheer-staff, enables one to regulate the heights upon both sides accurately, to the intention of the designer, with very little work or fuss. These may be deemed minor considerations by those whose practice has been different, but taken with the more important facts, that, in building on a level keel there is less staging to put up, and less hoisting of material than on an inclined keel: so that construction is cheaper and easier when the ship is on a level than when she is on an inclination.



LAUNCHING SHIPS SIDE ON.—*From a Photograph.*



Launching side on is certainly cheaper in most instances than launching end on. The timbers for the ways are less costly, being mainly made up of common squared timber, without especial preparation, and the packing required for vessels of common shape is of the simplest kind of crib-work without fastenings. Even for vessels with great dead-rise and sharpness, the cradles and poppets required for side-on launching are no more costly than for end-on launching.

This brings us to the question of comparative safety. I hold that—equal care being taken in each case—the side-on launch is safer than the end-on launch; even when there is rise and fall of tide enough to permit the dry-shod laying of ways in such a manner that the ship will be completely water-borne before she reaches the end of the ways. But we are now considering cases in which there is little or no tide to help, and in which we must choose between an attempt to lay ways under water and dumping—so to speak—a ship off a bank. Considering the unreliableness of ways laid under water, I presume there are few who would not risk a good deal of dumping rather than depend upon them.

From these considerations among others, I am inclined to consider side-on launches cheaper and safer than end-on, even where there is a good tide. This favors side-on launches even more than end-on—for if the ship goes in side-on, and is water-borne before she reaches the ends of the ground ways, the strain and risk are almost *nil.* It does not matter if one end leads the other, the only danger coming from ways of too little inclination, which might deliver the ship at too low a velocity to overcome the resistance of the water upon first entrance—and leave the ship sticking on the ways, partly water-borne, but I never knew of such a case.

The preparation for a side-on launch begins of course with laying the ground ways, which are of hewn timber seldom smoothed. The inclination varies from one to two inches per foot. They are spaced from ten to eighteen feet apart. Not much attention is paid to getting them level with each other, but they must be parallel vertically. Each way is, preferably, in two lengths; the inland lengths being something longer than the breadth of the ship, and the outland lengths projecting beyond the blocking out over, or into the water more than half the breadth of the ship. The blocking for the outland ways should terminate in a right line parallel with the keel and upon the edge of the bank, and the inland ends should be secured to the ground, or to the inland ways, in such a manner that all the outland ways may tip upon the blocks as the ship passes over them, and so shoot her into the water before the cradle cribs can be disarranged. The sliding ways are called "butter-boards," and are simply pieces of 4 to 6 inch thick plank, 6 or 8 feet long, laid fore-and-aft-wise, across the ground ways, one line under the keel, and two or three lines on each side. Upon the butter-boards are laid and spiked lines of plank to tie them together. Between the lines of plank and the bottom, over the ways, are fitted pieces of packing to reach and support the bottom. Under the outland bottom the packing takes the form of cribs, because the inclination of the ways leaves a large space between the ways and the bottom. Wedges are driven between the tie-plank and the packing, to shift the weight from the blocks and shores to the ways.

It is the practice of some master-builders to lay the ways "hollow," *i. e.*, lowest along the mid-length of the ship, with the intention of preventing one end going ahead of the other—but I fail to see the use. It seems a better method to lay the ways level and wedge down the outer ends of the butter-boards near each end of the ship, so that they will rest upon the ways as flat inclined planes, when, if the ship swings upon the ways, the boards will raise the leading end, or develop friction enough to retard it until the other end catches up.

For a heavy ship, there are rigged three or four dog-shores at each end, and sometimes one or two at mid-length; all constructed in this wise: The ground way is firmly secured by dart-shores abutting on planks, or timbers buried in the ground. Upon one side of way is bolted a a lug-block to take the end of a lever—of say 12 × 12 in. timber—as long as will swing between the ways. Between the inland side of the lever and the keel is placed an inclined dog-shore, and all finally supported with trip-shores. The lever itself furnishes a purchase of about twenty to one. A four-fold tackle is made fast to the free end of the lever, and to a strap over a post planted inland of the ship, and a block is put under the strap, upon which it is to be cut—to let all go. When all else is ready, the tackle upon each lever is hauled taut with a three or four-fold luff by twenty or thirty men, and made fast. The ship is then wedged up on the butter-boards, the shores having been taken down and the keel blocks split out—beginning amidships. This leaves the ship resting upon the ways and pulling upon the dog-tackles, and it only remains to give the signal for cutting the straps which hold them. As one end of the ship is heavier than the other, and the heavy end will lead down the ways, it is common to have the forward straps cut nearly a second sooner than those aft, in order to bring the ship fair over the line of tipping blocks.

If all goes well the ship slides down the ways upright until the center of gravity passes the outland line of support, when she careens sharply, carrying the outland lengths of the ways with her in her careening motion, so that the cradle-packing remains in place until she falls into the water on her bilge, and then slides clear of the ends of the ways as they fall back into place.

If one end of the ship goes considerably in advance of the other, no great danger or strain is incurred by the ship. In that case she rolls off the ways as though she were in a quartering sea, the end which is late lifting off some of the endmost packing, leaving it a wreck upon the ways. The end-most cradle that holds, guides the ship clear of the ways, and it must be a bad side-on launch in this respect, which will strain a ship as much as the best end-on launch will inevitably do.

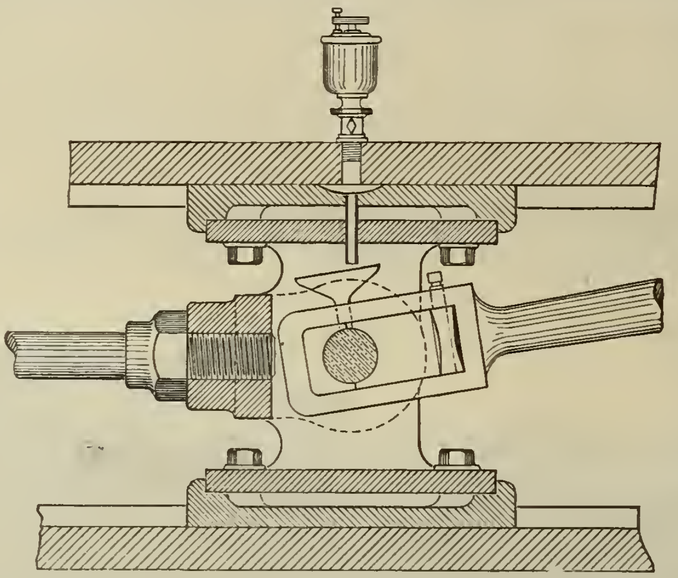
It is true that at the instant the keel passes the last line of support, the whole weight of the ship—or nearly so—is borne upon the keel butter-boards; but it is a poor ship which will not bear safely her light weight upon that line.

Some months since we called attention to the subject of admitting air in the back connection of steam boilers, saying that under certain circumstances it would prove very advantageous. Mr. James Mahoney, the patentee of an improved furnace for steam boilers, informs us that many years ago he did this very thing in the boiler of the *Bay State*, of the Old Colony Line. Mr. Mahoney says that the heat developed was tremendous, and a very great addition to the steaming capacity of the boiler. Mr. Mahoney also informed us that his furnace is meeting with great favor in large cotton mills and other places where he has introduced it, as autograph letters in his possession attest. He is an authority on the subject in question, basing his faith and opinions on the result of forty years experience, as constructing and working engineer of large steam lines.

Not long ago we had occasion to refer to the patenting of old devices under the impression that they were new, and in the *Scientific American* for March 29th we find another example of this, in a bevel-geared ratchet-wrench, designed to give continuous motion to a drill. This identical tool was used by us in 1855 or '56 in the then Detroit Locomotive Works.

CARR'S DEVICE FOR OILING CROSS HEAD-PINS.

Engineers know that the cross head-pin gives a great deal of trouble at times, and that more or less difficulty is experienced in keeping it lubricated without wasting oil. The sketch shows an ingenious device for this purpose, devised by Mr. H. W. Carr, foreman of the Beckett and McDowell Manufacturing Company's machine shop, Arlington, N. J. As may be seen, a recess is formed in the upper gib of the crosshead, which receives a portion of the oil from the sight-feed oiler on the upper guide, from whence it is conveyed by the small tube to the drip-cup on the connecting-rod, which carries it to the upper surface of the pin. This works very satisfactorily. Mr. Carr has it on the shop engine, and he assures us that experience shows that it never fails to do its work. There is no patent, and as Mr. Carr generously donates it to the steam-using public it is only proper that he should have the credit of it.



The question is often asked what amount of power is required for a roller mill; in other words, how much power is required per barrel of daily capacity? This can best be determined by actual facts, and as one tending to answer the question, we give the following: The "Daisy Roller Mill" in Minneapolis is driven by a compound engine, and in testing the same recently it was found to be developing, on an average of numerous indicator cards, 175-horse power. The record of the mill for the same day showed an output of 450 barrels, or an average of over 2½ barrels per horse power. This, we think, may fairly be taken as the result in the best arranged roller mills of large capacity. In mills of 200 barrels per day and smaller, it is probable that the average will not vary much from two barrels per horse power.—*Millwright and Engineer.*

A CHARACTER SKETCH.

Old Fogy writes to the *Railroad Record* as follows:

"I have, at times, been highly amused to see a newly installed M. M. fussing around to find something to tear down that his predecessor had built up, And I have always noticed that the man that knew the least tore down the most. The main valves are about the first things these gentry tackle. They next find fault with the number plates. Then they discover some error in the design of the blow-off-cock. After these grave errors are rectified the boss painter's attention is called to the alleged fact that the figures on the sand-box are too large, or too small, too fancy, or too plain. Then the tallow-pots are not of his standard size, and so on for quality and quantity.

"This is no fancy sketch. This particular brand of M. M. once existed, and may be in existence yet for all we know. He wants to impress all around him with a high sense of his importance. He knows all about a locomotive too; more particularly is he impressed with this fact if he never served his time in a machine shop; never built a locomotive, nor helped to repair one. He is a good talker, dresses well, and has a superabundance of gall. He never learned anything from anybody about an engine, had no need to; his knowledge of a locomotive and he were born together. He looks grave and dignified, and goes about the shop and roundhouse as Atlas of old is supposed to have perambulated, bearing the world on his shoulders. He either addresses a shop-hand as though he were no better than a dog, or, not deigning to reply, signifies his will by an imperial look and a majestic wave of the hand. I could write a volume portraying the tricks and traits of this animated paradox, but would it pay? I guess not."

ADJUSTING COIN-BLANKS FOR WEIGHT.

In New Orleans there are in the adjusting-room of the Mint 30 ladies at work. The salary is $1.75 a day. They go to work at 8 and stop at 4. The work requires the strictest attention, and never becomes purely mechanical. There are three long tables down the room; marble-topped and protected at the edges with leather. The workers sit in high chairs, with good comfortable backs to them. The tools for work are scales for weighing money, tin bowls to put it in, and a file. The round pieces of unstamped coins (blanks) are brought to the ladies in wooden boxes. Each piece has to be weighed three times. A mistake in the weight of one piece, of even almost infinitesimal proportion, may cause the worker to lose her position. It seldom, if ever, happens, however, that one is discharged for incompetency or carelessness. An expert adjuster handles in a day from 3,000 to 3,500 silver dollar coins. The condemned coins are sent back to be melted over; some being only a trifle out of standard weight she can file down. For this she is provided with a leather apron to catch the precious silver dust, the loss in which can be, and must be, measured by the grain. The water in which the ladies wash their hands when they are through filing is carefully preserved and filtered for the silver dust. During nine months of last year the ladies were required to do extra work, which kept them in their seats until 6 o'clock. They were paid by the hour, and received the small sum of 21 cents. The ladies holding positions have accomplished their tasks with unvaried success, and are not often disturbed by rumors regarding their dismissal. The work required of them is easily learned, but is sadly laborious. The eye tires of its fixed gaze at the delicate beam of the scales, but the eye must be as accurate as the scale. There is no time for rest, no excuse for mistake, and after the fashion of women undertaking a work at which they are competent, they bend to the task with a patience that never gives out until the work is finished.—*New Orleans Picayune.*

A wonderfully ingenious and simple printing press has recently been invented and perfected by Mr. L. B. Pease, of the Woonsocket *Reporter*. The circulation of the *Reporter* exceeding the capacities of his press, and feeling indisposed to pay the enormous prices required for a web press, Mr. Pease commenced about two years ago to study up a machine for his own wants. In doing this he has got together a press, occupying the space of an ordinary safe, capable of printing both sides of a seven-column paper, 12,000 per hour, from a roll of paper, folding and counting the edition as delivered. Type forms are used, the impression is carefully adjusted, and the machine is simple, compact and rapid. The model is a success, and a full sized press is being finished.—*Paper World.*

Messrs. Hodge & Co., East Boston, Mass., have just placed on board the steamer *River Queen* of New Bedford, one of the fine boilers for which they are so noted. It is of the following dimensions: 10′ 6″ diameter, 20′ long, steam chimney 10′ high, 7′ diameter, two furnaces 7′ 9″ long, 4′ 8″ wide. Two 18″, four 14″, two 12″, and one 11″ flues with 150 return tubes, 3½″ diameter, 14′ long. The boiler weighs 28 tons.

WRIGHT'S STEAM ENGINE GOVERNOR.

The accompanying illustrations represent the Steam engine governor recently introduced by the Wright Machine Company of Worcester, Mass. Among its other advantages is the arrangement of the valve-stem, whereby a steam tight joint is secured, thus avoiding the use of packing and saving much time and patience over the ordinary arrangement.

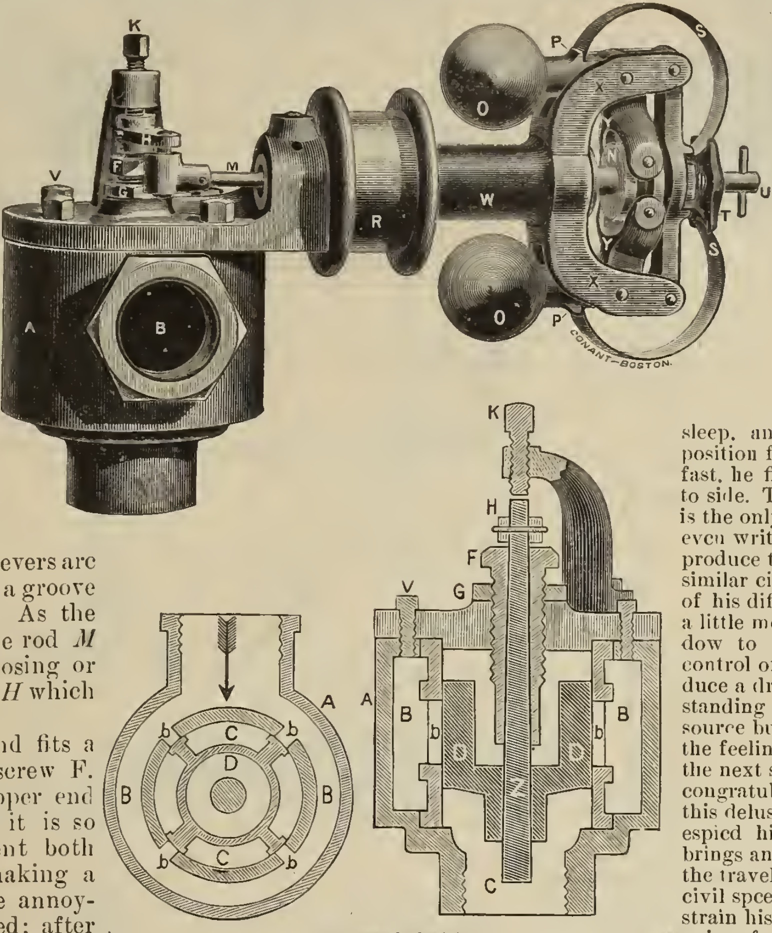
The governor is driven by a pulley *R* attached to the revolving ball standard *W*. This standard has two slotted arms *X X* in which the ball arms are pivoted, and which also support the cross bar; this cross bar is a support for the flat bow springs *S S*, which control the action of the balls by pressing them inward, their tension being regulated by the adjusting screw *U*, which presses the plate *T* upon them, and so varies their pressure upon the arms at the points *P P*, giving a wide range of adjustment without lessening the full volume of steam when the full power of the engine is required. As the weight of the balls is not depended on, as in most governors, light balls are used, running at a high speed, making it very sensitive, and enabling it to run in a horizontal position, avoiding the use of a driving shaft and gears, and and making it very compact and noiseless.

In the forked ends *Y Y* of the ball levers are loosely pivoted blocks which revolve in a groove in the head *N*, fastened to the rod *M*. As the balls are forced outward and inward the rod *M* is moved downward and upward, closing or opening the valve by means of the lever *H* which is attached to the valve stem.

The valve stem is slightly tapered, and fits a correspondingly tapered seat in the screw F. The pressure of the steam causes its upper end to press upon the screw K, by which it is so nicely adjusted to its seat as to prevent both friction and the escape of steam, making a steam-tight joint without packing; the annoyance of frequent packing is thus avoided; after the screw is once properly set, it will need no further attention.

This arrangement of the valve stem, together with the quick speed of the balls, their great freedom of action consequent upon the arrangement of the springs, and their indirect action upon the valve through the lever *H*, make this governor very sensitive to slight variations of speed.

Price lists furnished by addressing the manufacturers as above.



THE GLASGOW MEDICAL JOURNAL mentions an electro-magnet having power to raise upon its point a weight equal to six ounces. It has been used successfully in cases where workmen in iron and steel have been severely wounded by flying chips; the writer says that such instruments must henceforth become an essential part of the apparatus of ophthalmic surgeons.

MR. W. H. TAFT of Salem, Mass., Association, No. 5, National Association Stationary Engineers, writes to say that the organization is in a thriving condition, and that they are increasing their membership as rapidly as could be expected. We are glad to hear of this prosperity, and hope that such associations will increase everywhere.

PERSONS WHO REQUEST MARKED COPIES of papers to be sent them are perhaps not aware that copies so marked cannot be sent at pound rates. The authorities at the New York Post Office are very rigid in their examinations and will send back a whole edition if any numbers are found marked. We have never had any returned.

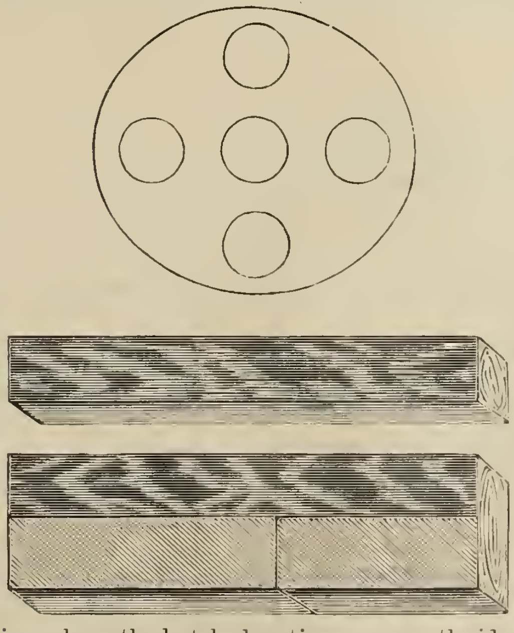
ADDING TIN TO COPPER hardens it, according to the quantity of tin used. Zinc makes copper more malleable when cold, but also makes it short when hot. Lead in alloy with copper makes it tractable, or soft under the tool.

AN EXCHANGE STATES that pieces of wire cable of the Fairmount Suspension Bridge, recently taken down at Philadelphia after being in use some forty years, were found to be fully equal in tenacity, elasticity and ductility to the best wire of that size now in the market.

GRAY CAST IRON is soft and very fluid when melted. Mottled iron is stronger, and better for large castings. White iron is hard and very strong, used chiefly for malleable iron work.

STEAM DOMES.

The injurious effect of a large dome on a steam boiler is not counteracted by making small openings in the shell, for the continuity of the sheet is destroyed, and is no stronger than that portion which remains intact in one unbroken line. It represents in effect a beam sawed into transversely, which is not so strong as a single beam of the area that is left unsawed; this because the sound section is burthened with the load of the cut section, as shown in the illustration, where the hatched section conveys the idea.



Domes are an element of weakness under the best conditions, for the shell has to be cut for their application. Every hole cut in a boiler weakens the sheet that is cut, and all attachments that can be so put up should be made on one chamber, or casting. Domes with small necks are cheaper and in every way more desirable than those which have large openings through the shell.

AN ENGLISH VIEW OF AMERICAN PALACE CARS.

Wonder is sometimes expressed that our American "palace cars," so called, are not adopted abroad particularly in England where they have been tried, notably on the Midland Railway. The reasons why are here given from the *Saturday Review*, an English paper, and for one we think the criticism, as a whole, is by no means out of the way. Black walnut, nickel-plate, and negro porters have no especial relation to comfort, but they appear to be the prominent features of palace cars:

"But in turning to the more showy structures that have come from America one is really puzzled to guess why what is pompously termed a drawing room palace car should ever be used twice by the same passenger. It is decorated in a style which leaves the mind of the beholder blank to all other thoughts, but the question what grudge the designer can have borne to travelers that he wished to consign them to an early lunatic asylum; while it suggests, to the bad sailor, associations which he would prefer absent from his mind. * * * Then the unfortunate passenger finds that, instead of an armchair to sit in, he has only a chair with arms. There is no corner to get his head back into for a quiet sleep, and he cannot settle himself into an easy position for reading. Presently, if the train is going fast, he finds that the car is actually rolling from side to side. True, there is little of the jolting motion which is the only annoyance in the ordinary carriage; he could even write with comfort But this rolling begins to produce the feelings which that of a ship will do under similar circumstances He looks around for a way out of his difficulty, and thinks that perhaps if there were a little more air he might be better. He orders a window to be opened. But, alas! he has no longer the control of the window. The open window would produce a draught at the back of some passenger's neck standing at the other end of the car. He has no resource but to devote his energies to struggling against the feeling of nausea until the express train arrives at the next station—a long time perhaps. Meanwhile he congratulates himself that at least he has not to talk. But this delusion does not last long. An acquaintance has espied him from the other end of the car. And he brings and introduces three more acquaintances. And the traveler, almost overcome by nausea, has to invent civil speeches and to keep up the conversation and to strain his ears to hear the voices of the others above the noise of the rolling wheels and the rattling lamps.

"However well Pullman cars may be adapted for the people for which they were invented, it seems clear that they will not suit our habits or our railways. In America the speed of the trains is slow compared with that of our great expresses, and, owing partly to the enormous length of the lines, and partly to the action of the frost on the road in winter, the permanent way is not maintained with that almost microscopic accuracy to which we have been accustomed. The arrangement of springs under the car is calculated, as far as possible, to neutralize the jolting that would be produced by the roughness of the tracks, but this very arrangement renders the whole structure liable to that rolling motion which produces feelings of sickness in many when the train is running at a high rate of speed. It becomes absolutely necessary also to warm the car artificially when the travelers have to remain in it for a week, during part of which time the thermometer may stand at many degrees below zero. This can easily be done by a stove placed at one end of the car and watched by the attendant. All these things make the Pullman car, if not a perfect, at least a fairly suitable means of conveyance for transatlantic purposes; but they make it an intolerable one here."

THERE SEEMS A PROSPECT that the scandalous patent bills introduced to Congress this session will not pass. Every right-minded man will rejoice at this, for the measures proposed are worse than bad faith on the part of the Government; they amount simply to fraud. The measures give, practically, any one a right to use a patent as soon as it is issued; from which it is easy to see that this branch of revenue would be wholly cut off. It is to be regretted that the principals, or parties who stand behind the visible movers, are not publicly mentioned, so that the people might know them in all their integrity.

PERSONS UNABLE to obtain THE MECHANICAL ENGINEER from newsdealers can have it sent regularly from this office by remitting fifty cents for three months.

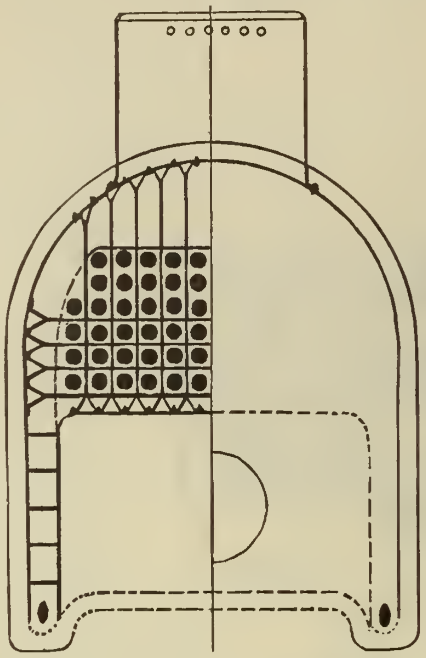
AT A LATE MEETING of the Master Car Builders' Association, a majority of those present were in favor of straight axle seats for wheels as against tapered seats.

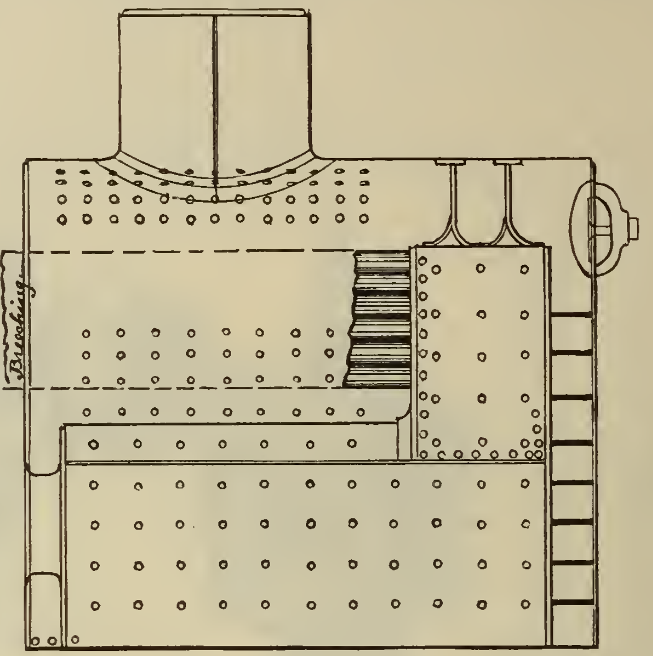
TYPES OF AMERICAN STEAM BOILERS.—No. 7.

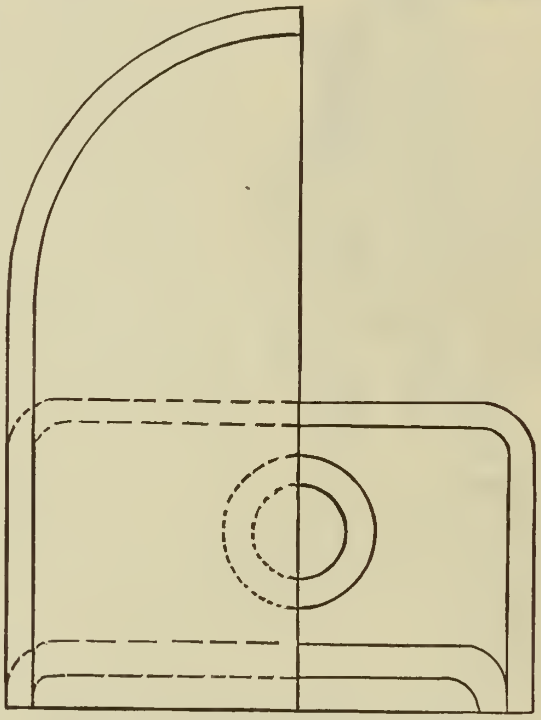
YACHT BOILER.

The dimensions of this boiler are as follows: Diam. of shell, 48″; height 60″; length 72″. There are 68 tubes 2″ × 50″. The fire-box is 40″ wide by 64″ long and 28″ high, with smoke box at rear end of fire-box. The sheets for this boiler are as follows: 1 sheet, wagon-top, 70″ × 146″; 1 front box, 64½″ × 52½″; 1 back head 62½″ × 52½″; 2 side sheets fire-box, 62″ × 24″; 1 crown sheet fire-box, 49″ × 45″; 1 smoke box sheet, 85″ × 17″; 1 front fire-box head, 44½″ × 28½″; 1 back fire-box head, 44½″ × 50½″; 1 back tube sheet, 44½″ × 29″; 1 dome sheet, 78″ × 24″; 1 dome head, 28½″ diam.; 2 leg pieces, 76″ × 10″; 1 leg piece, 52″ × 10″; 1 door piece, 50″ × 10″.

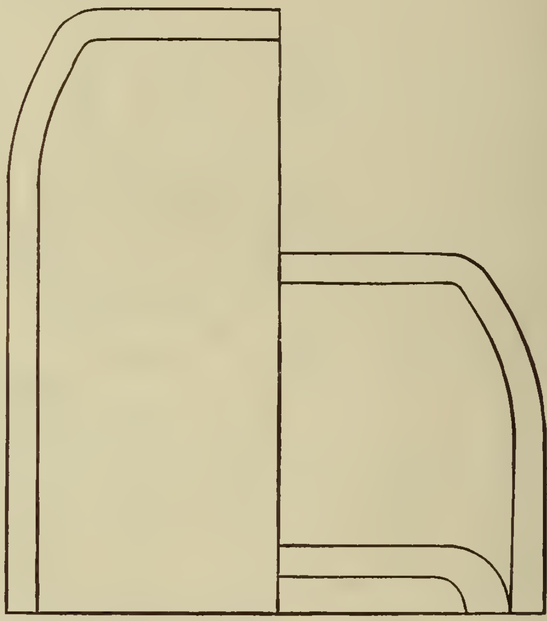
On the crown sheet of fire-box I have shown where the centers of crow feet are marked as also on crown of wagon-top, and for side braces. The holes for the dome have not been shown as they can readily be made by any one. The front head should be cut out and flanged at draft, and, also, the front fire-box head flanged out to lap 3¼″ flange on each, all the rest of the flanges are 2¼″. This style of boiler is built in Buffalo.



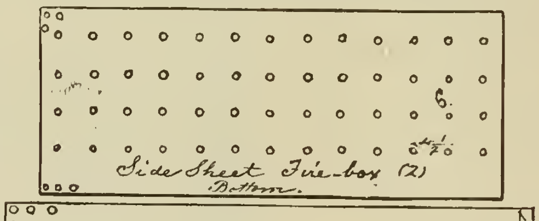


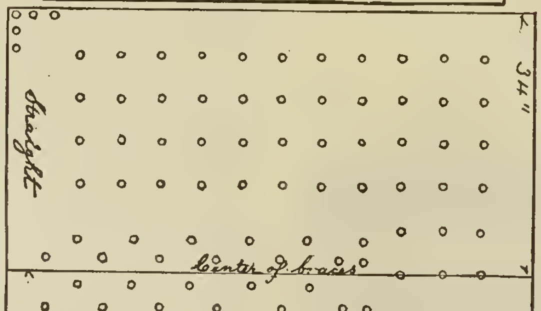


BACK HEAD AND FRONT FIRE-BOX HEAD.

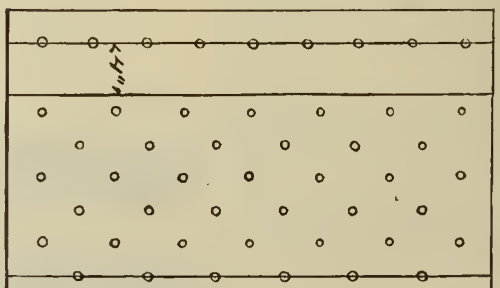


BACK SMOKE-BOX HEAD AND BACK TUBE-SHEET.





HALF OF WAGON-TOP SHEET.



FIRE-BOX CROWN-SHEET.

EXPERIMENTS MADE show that the pressure required to punch iron plates is as follows: ⅛th hole in ⅛th plate, 2¼ tons; ¼″ in ¼″, 6½ tons; ⅜″ths in ⅜″th, 13 tons; ½″ in ½″, 22 tons; ⅝″ths in ⅝″ths, 33½ tons; ¾″ in ¾″, 47¼ tons; ⅞″ths in ⅞″ths, 62¾ tons; 1″ in 1″, 80 tons. Approximately, to find the pressure required to punch any hole, multiply the diameter of the hole by the thickness of the plate, and this by 88 as a constant factor, the product equals pressure in tons.

WE HAVE BEEN favored with an invitation to the fourth annual meeting of the American Water Works Association which occurs on the 15th, 16th and 17th of this month at Melodeon Hall in Cincinnati, and return thanks for the compliment expressed. Various papers of interest will be read, and, thereafter, an excursion and banquet will follow. We hope to be favored with reports of the papers read.

PAPER BOTTLES are now made on a large scale in Germany and Austria.

A NEW KIND OF RAILROAD TICKET is coming to the front. It is best explained by taking the Grand Trunk as an example. That road prints a book of tickets containing 1,000, or 500, or 100, or 50 tickets on a page, each ticket good for one mile. These little tickets are smaller than postage stamps, twenty on a sheet, and perforated. You can buy two, twenty, or a thousand of them at a fixed rate, and the company on its part is bound to accept one of them for every mile you travel. You will not be required to tell the ticket seller where you want to go; you will say, give me 100 miles, or 20 miles, or 1,000 miles, and get on board and give the conductor enough of the little squares to carry you to your destination. There will be no such a thing as lay-over tickets, or trouble of getting tickets exchanged, or loss on through tickets not used—these little tickets will be as good as money, and always current. The road on its part will be only protected from scalpers and the like. The new system has received the indorsement of the better class of passengers, agents and travelers, and has been adopted on several of the western roads.—*Elevated Railway Reporter.*

PUNCTUATION is to many people an insuperable difficulty. Like the civilized ancients they write straight ahead, with no stops at all, or they throw commas about as if out of a pepper-caster. For these persons Mr. Allardyce has published a book. "Punctuation," according to Mr. Allardyce, "has two uses: it enables us more easily, to seize the meaning of a writer." and "it prevents ambiguity." But even in English there have been proud spirits who rebelled against stops. A volume of poems was printed with gaps of different widths, indicating the length of the pauses, where ordinary mortals put colons and commas. Cambridge one time kicked against commas and capital letters. The conservatism of printers soon suppressed the revolt. Probably printers will long remain the autocrats of punctuation, even though people with private views on the subject swear with pen and ink on the margin of their proof sheets. —*London Daily News.*

A NEW METHOD OF process for treating paper so as to render it permanently moist for copying purposes has been devised. It consists chiefly of the use of certain chemicals in the composition of the paper which renders it particularly useful for letter-copying books.

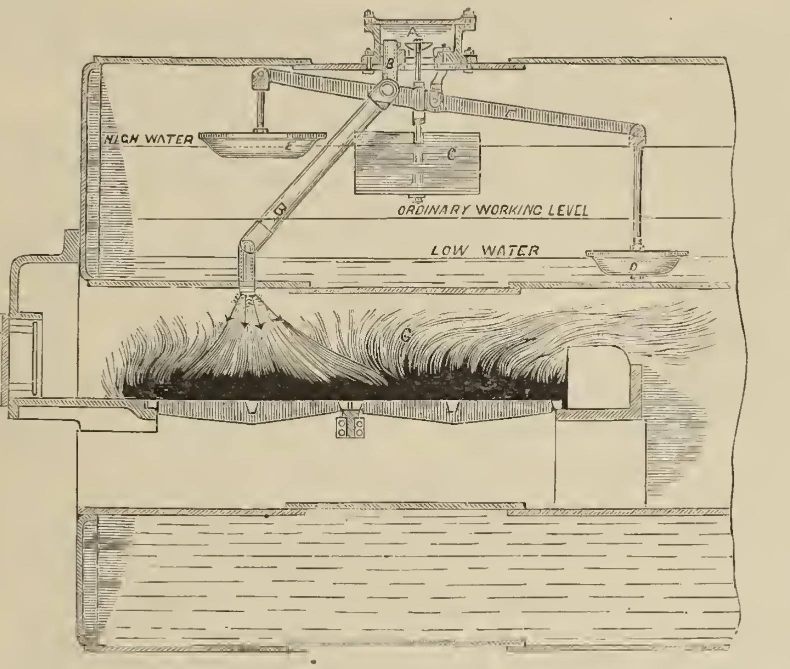
THE CONNECTION so long existing between the Babcock and Wilcox Company, of 30 Courtlandt street, New York, makers of the well known water-tube boilers, and the New York Safety Steam Power Company is, we have it upon good authority, dissolved.

TO PUT OUT THE FIRE.

An apparatus which looks as though it might be attended with some results is here shown. It is an English invention, and is taken from *The Mechanical World.* The object of it is to put out the fire in case of low water, and the action is thus described :

> "The low-water safety valve is not intended to prevent furnace-crowns becoming over-heated, though it may prevent their collapse. In this arrangement the occurrence of low water causes a copious supply of steam to be poured upon the fires, with the effect of quenching them, and thereby prevent over-heating of the furnace-crowns. *D* is the float upon the end of the lever *F*, *E* being the counterbalance and *C* the weight upon the safety valve, which allows, when lifted, steam to pass into the chamber *A*, from which it flows by the pipes *B* into the furnaces. On the occurrence of low water the float *D* falls and raises the valve spindle and weight *C*, and the steam rapidly escapes through the chamber *A*. It is claimed for this valve that, being quite out of reach, it cannot be tampered with. The counter-balance weight *E* acts also as a high water float, serving to open the valve when the boiler is too full, though this is, of course, not so important a function of the apparatus as is the low-water alarm. One advantage claimed is, that when the low water has been remedied by filling up, the valve closes and all is tight again, whereas with a plug time is taken in replacing it and getting to work again."

What would be an improvement on this would be to have no low-water. An efficient engineer, properly paid for his work, does not need any automatic brains, so to speak. The outward rush of gas with this contrivance would be tremendous, though that would probably be no disadvantage to one who would let the water get so low as to bring this apparatus into action.



Steam engines, built for a certain maximum capacity, naturally show at full service their maximum economy. The loss of friction remains practically constant from minimum work to full capacity. This and other causes make a small engine working at its maximum efficiency more economical than an engine of twice its maximum capacity doing the same work. The author gave a diagram showing percentage of loss for two engines whose maximum capacities are as 1 to 2, the engines doing the same work.

The two curves show a difference of about 20 per cent. in favor of the smaller engine. The loss per cent. in working at anything less than maximum capacity as derived from the curves is 20 per cent. for using a machine at $\frac{1}{2}$ capacity; 34 per cent. for using a machine at $\frac{3}{10}$ capacity; 54 per cent. for using a machine at $\frac{3}{20}$ capacity. The example given was derived from several systems of indicator diagrams, and had especial reference to engines used for electric lighting.

The general results are, however, applicable to all prime movers.—*J. L. Hornig.*

◆

For pure, unadulterated effrontery a circular emanating from a milling machinery firm, addressed to publishers as an inquiry for advertising rates—takes the medal. This circular is merely an inquiry, be it remembered, not an order, and contains a list of sixteen questions, put categorically as to the status and general business prospects of the publisher; what he did in 188- and what he proposes to do in 188–. These figures are exactly as printed in the circular. The simplicity of this is only equaled by another paragraph, which admits that this is rather a peculiar request, but says it will be kept "confidential." We would not confide anything to the party, who could originate such a silly scheme as this.

◆

Fictitious alligator leather is largely sold in lieu of the genuine, It is made by taking an impression of the natural leather in plaster, and thus forming a mould from which a die is cast. This is then used on calf-skin in an obvious manner. It is asserted that the imitation cannot be told from the genuine leather, but this is erroneous. The depressions or lines in the imitation are straight up and down caused by forcing the die into them, but in the genuine leather the lines of depression are undercut, forming a scale. This peculiarity cannot be imitated by dies.

◆

Echoes from *The Tech.*—Whistling matches, three times a week, in the third-year mechanical drawing-room. Admission free. The third-year mechanicals find that filing is more tiresome than forging, and lacks its muscular exercise.

[Suppose you try a 16-inch bastard file on wrought iron for a couple of days, and let us know how it feels.—Eds.]

◆

In a description of a new engine we read in the *Scientific American:*

> "The cylinder and its parts are inclosed in a steam tight box in which the steam exhausts. This keeps the cylinder hot, and insures the complete oiling of all the parts."

To engineers this a joke. Exhausting into a a steam-tight box, and the resultant oiling of the parts is quite a nice thing. But there is more to follow, which we came very near missing, to wit:

> "The engine has two cylinders, with steam chest between them, and *two piston heads, one to each cylinder, connected with a small rod.* The pistons are hollow, and as the movement is vertical there is no friction caused by their weight. The lower piston head is connected with the pitman, which is attached direct to the main shaft, no cross-head or slides being used."

"Hollow pistons without weight, pitman attached direct to the main shaft—two pistons, one in each cylinder connected by a small rod." Oh! this is all very surprising.

◆

Engineers have the name among outsiders of being curt in speech and caustic in expression. One of our contemporaries recently said we were caustic. This surprised us, for we try to be very mild and sweet. Perhaps we are curt, but, if so, we are unaware of it. If a thing is a humbug we give our reasons for saying so and say it. We do not use a mile of talk to explain our views. Curt people, and those who are caustic, are not altogether useless, disagreeable though they may be in drawing-rooms or in diplomatic transactions. A mild and genial person has his drawbacks also; he goes driveling on through life never reaching any conclusion. Of the two we prefer the curt man, he has at least the great and saving merit of sincerity and decision.

◆

The astonishing strides adulteration in food staples and luxuries is making in this country calls for prompt repression. A manufacturing confectioner informs us that glucose is one of the most commonly used adulterants in that trade, and forms a very large percentage of the whole material. Even so-called respectable houses use it, being forced thereto by competition. Oleomargarine, as is well known now, is made by the ton and unblushingly sold for genuine butter. Where adulterations will stop seems to be the only question, not how they will sell, for no matter how barefaced the imitation there are plenty to buy. How fine adulteration is carried may be seen from this item: The adulteration of putty is effected by mixing marble dust with whiting. It costs about a quarter of a cent a pound, and whiting costs twice that.

◆

IMPROVEMENT IN PLANIMETERS.

We quote from *Engineering* a recent improvement in planimeters: "In integrating irregular areas by means of the planimeters there is often a difficulty in reading the vernier, from the light not falling directly upon it. Under such circumstances it is customary to use a reflecting surface, such as a white card, to throw the light on to the scale, but for persons of weak sight this is not always sufficient aid, and they are constrained to lift the instrument from the paper and move it into a more favorable position. As the wheel rotates with very slight friction there is a great risk of its being moved and the reading vitiated by this plan; thus after a correct measurement has been made, errors may be introduced by the unskillfulness of the operator. To prevent this, Mr. Druitt Halpin has devised a locking apparatus, very simple in construction, by which, when the pointer has been moved all round the figure under measurement, the index-wheel may be fixed to allow of the instrument being lifted and carried to the window to be read. The locking device consists of a brake spring which is normally held away from the edge of the roller by a sliding wedge situated between the spring and the framing. When this wedge is moved to the left it allows the spring to bear on the roller and exert sufficient pressure upon it to keep it stationary if carefully handled. Amsler's planimeter, when provided with two points to enable it to be set automatically for measuring indicator diagrams, is called a diagram-meter.

A STEAM WHISTLE HEARD TWENTY MILES.

Editors Mechanical Engineer :

I am interested in an article in a recent issue entitled "*A whistle heard fifteen miles,*" and think it can be discounted some. I am the inventor of the single-bell chime whistle, made by Crosby Steam Gauge and Valve Co., of Boston, Mass., and I also inclose a clipping from a local paper in regard to a whistle with a bell ten inches in diameter recently put up on our water works; said whistle is readily heard twenty miles It works under a boiler pressure of 40 pounds only, and the steampipe is 2½″, running 38′ horizontally, and 30′ vertically, having also four elbows and two valves in it.

I just came across a copy of your paper to day for the first time, and I like it so well that, although I take nearly all the scientific papers, I must have it if I have to pay less attention to those of higher price and inferior quality, hence the inclosed two dollars.

Jacksonville, Fla. John Einig.

◆

Can American locomotives run fast? The cyclone express, over the Vandalia Line, on Saturday last, made the run, distance 38 miles, in 44 minutes; 2 miles was run in 1 minute and 57 seconds. The fast mail, which consisted of seven cars, recently beat the above record, running 21 miles in 23 minutes. The train despatcher's record showed that it was 23 minutes from the time the train left Effingham till it was at a standstill at Greenup.—*St. Louis Republican.*

The engine *George R. Minot* of the Boston & Providence road, has been making some remarkably fast time. On March 19th the trip from Providence (44 miles) was accomplished in 65 minutes with seven stops; and on Friday, delays from a misplaced signal and another from a hot box were made up, the train reaching Providence on time, 7 miles of the distance having been covered in 6 minutes 51 seconds, part of it being up grade.—*Boston Advertiser April 2.*

◆

A monkey signal-man manages the railway traffic at Uitenhage, South Africa, according to *The Colonies.* The human signal-man belonging to the post lost both his legs in a recent railway train accident, and so has trained a baboon to discharge his duties. Jacko pushes his master about on a trolly, and under his direction works the lever to set the signals with a most ludicrous imitation of a man.

THE

Mechanical Engineer,

FORTNIGHTLY.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us o judge of the fitness of the matter for our purposes.

HIGH SPEED ON RAILWAYS.

An interesting article is quoted on another page from the *London Engineer*, upon high speed locomotives, and we make no apology for the length of it, as it deals with a subject of importance. Annihilation of space, so far as may be, is a necessity of the time, for, in a sense, it lengthens the span of life. Though this deduction seems far fetched, in reality it is not. It is the legitimate outcome of higher speed on railways. The trifler might say exactly the opposite condition would be truer—that high speed tended to shorten life, but since accident is the only ill that can befall the railway traveler, it matters little at what speed he flies, for injury is as certain at twenty miles as at sixty miles per hour. Leaving this subject behind, we say that higher speed lengthens the span of life, for it leaves more time for the duties of it, consuming less in reaching the scene of them. Whether business or pleasure, be the errand the time spent in reaching the theatre of these events, is time lost. That ancient and honorable person, John Gilpin (if we may be excused the levity of his introduction), understood this great truth, and history has recorded his haste to arrive at his journey's end.

Assuming that the necessity for high speed is admitted, the question is—how to arrive at it? Our contemporary has ably discussed the merits of the case from its standpoint—which is, briefly, improvement in, or rather increased size and weight of the locomotive, including drivers of enormous dimensions, to wit: nine feet in diameter. We have no intention of traversing our contemporary's remarks on this head, but will leave our friends to form their own opinions of the practicability of the scheme it proposes.

To us it has always seemed that the modern locomotive fails to attain higher speed for two reasons chiefly: it is steam-bound, to coin a phrase suited to the subject, and has not force enough. It is steam-bound because the spent steam cannot get out of the way of the flying piston, which backs up against it as against a cushion, and it has not force enough for the reason that the pressure the boiler is capable of cannot be raised higher with the present method of construction. If these two evils could be removed, we believe that the present standard engines in this country, with anything like good roads, would be capable of an average of sixty miles per hour as readily as they now achieve fifty; more readily in fact. Removing the back pressure, shown on indicator cards at high speeds, would add, in many instances, at least ten pounds per square inch to the working pressure.

Assuming that boilers can be built which would stand 175 pounds working pressure, we have then a much greater force at command for the work required of us.

We will so far depart from our announced intention not to criticise our contemporary's remarks as to question the utility of very large drivers for the end in view. No load can be snatched from a state of rest into a high velocity and this fact works directly against large drivers. Whatever weight is upon them, within the possibilities of locomotives, the start would have to be made very slowly, and it would be a long time before the train got up to full speed; the larger the driver the longer the time.

Our idea is, so far as it can be followed out in an editorial room—that more pressure and less piston is needed. There is now too much of the latter; the wheels can be slipped at any time; there is always more force at command than there is adhesion to utilize it, and this latter is greatest at first starting, we do not remember to have seen this point made before but the available tractive force is less under way than when starting from a state of rest, the constant oscillation, tending to reduce the tractive power, Large pistons mean large boilers and we have gone on increasing the dimensions of the one to meet the demands of the other, until we can go no further. The boiler cannot be made any larger—practically—while it is not large enough as it is. The obvious remedy seems to be, carry more pressure in it, reducing the piston until we reach the mean of efficiency. We have not taken refuge in a generality in the last phrase for the sake of closing our remarks with a mouthful of words, but, from the sheer impossibility of stating all the demands of a modern high speed locomotive in one article. There is a limit beyond which we cannot go in speed with locomotives, as roads are now constructed but we have not reached that limit yet; far from it. More piston will not meet the demand, nor yet large drivers, but if we have the latter we must have the former to handle it. This seems to lead us into trouble directly.

Reducing the piston and increasing the pressure increases the efficiency of the boiler, for there is less demand for steam. Cylinders 17″ by 24″ have hauled passenger trains on as good time as cylinders 20″ by 24″. Note that the cubic inches (one cylinder) which have to be filled with steam in the last are 7539+ while in the former there are only 5447+ cubic inches (one cylinder) to be filled, while the loss in area is only as 229+ is to 314+. We can spare the area but we cannot fill the big cylinder.

After all is said and done, spending money to make high speed engines is beginning at the wrong end. Straighten the curves, align the rails exactly, and keep them so, fill up the "hills and hollows," give us reasonably decent surfaces to run over, and high speed, by which is meant 120 miles in two hours, will be brought nearer to possibility.

BROKEN SHAFTS.

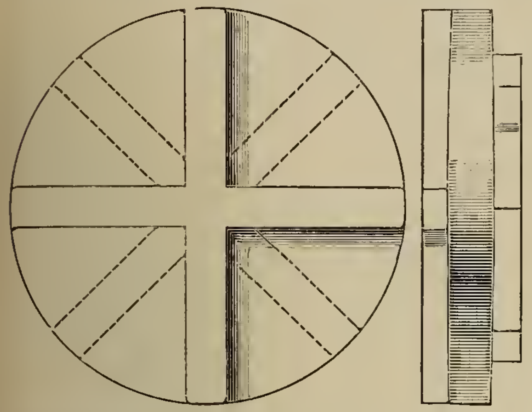
Breaking of shafts on their screw steamers is attracting the serious attention of English engineers. and it would seem about time, for their ships are constantly disabled from this cause. Within the past few months numberless vessels have drifted about the Atlantic with broken shafts. Whatever the reason may be, it is rarely that an American screw-vessel breaks a shaft. We have made this statement before, and were immediately confounded by the retort that there were very few American vessels to break shafts. Admitting this melancholy fact, it is still true that our screw-steamers enjoy almost total immunity from this class of accident. There are hundreds of propellers running up and down the coast, where they encounter as severe weather as occurs anywhere, but broken shafts are rarely heard of. When it comes to side-wheel vessels, however, we cannot say as much, for our large passenger steamers break their shafts, as a rule, much oftener than the screw-boats. Here it cannot be said that the working of the ship (as a basket works under stress) affects the disaster immediately, or directly influences it, for the shafts lie transversely, and the ship cannot work greatly in that direction; from whatever cause it arises, broken shafts in side-wheel boats are by no means uncommon. The engines are not audibly out of line—that is, they do not pound—but the shafts drop off, so to speak, in the most vexatious manner, and when coming down a quiet channel. One vessel has had two shafts in one season, and these were in the vicinity of twenty inches diameter. The question of quality of material does not enter into the matter at all; of course, it is the very best; mostly charcoal boiler-plate scrap. fagotted under very heavy hammers into short blooms, and then piled and welded. He will be a wise man who finds out why a shaft which has a very large factor of safety gives way under ordinary conditions.

Regarding the breakage of screw-shafts, we said (p 52, Vol. I, old series, Feb., 1881):

> "We maintain that no attempt should be made to keep the shaft in line. Provision should be made to allow it to work without friction when not in line, and to this end all rigid bearings and large flat-faced couplings, which act as so many levers to break and heat, should be abolished, and the shafts connected, in one place at least, by an independent driver that will not compel rigid adherence to a straight line. No large flat-faced couplings should be used, but where the shaft-sections join one another the ends should be rounded slightly on the extreme edges, not all over, but at no point for a diameter greater than that of the shaft itself. This might result in the breakage of a few bolts, or perhaps many bolts, but an engineer could afford to lose a great many of these sooner than risk the loss of the shaft or of the vessel."

This seems to us sound practice still, and it would unquestionably "humor" the shaft in its greatest trials. Practically, this method makes a series of hinges throughout the shaft length.

For an independent driver we do not see anything the matter with this device, which we offer as a suggestion. It is merely a cross planed out of a circular disk; the cross on one side "staggered" with its fellow on the other. This can be made of any dimensions, is perfectly noiseless, requires no bolts and has no joints. It cannot work out, and will, in short, if set between the engine and thrust-block, carry any number of horse-power in either direction, backing or going ahead. If it "chaws," to speak euphoniously, it is easily repaired; steel faces would prevent the said "chawing" measurably.



NOTICING NEW INVENTIONS.

Some sage once said that brevity is the soul of wit; it is also the salt of composition, for through it the reader is enabled to grasp the ideas of the writer at once. With this in view we have always endeavored to make our notices of new machines and inventions as terse as possible, feeling that the value of them is enhanced thereby. This is particularly true in considering the business aspect of such announcements, for but few persons care to read a patent specification, or its equivalent, to find out whether the matter presented is worth serious notice. The routine and detail of "a^1" and "b^1", or "*C C D D*," "similar letters refer to like parts," etc., etc., is wearisome beyond description, and so distasteful to the average reader that not one in a thousand cares to follow it. Patentees and manufacturers in general, we are bound to say, do not take this view of the subject, but they should, for their own benefit, for the value of such matter as we have mentioned is inversely as the number of words it contains. A newspaper notice or announcement is not intended as an exhaustive account of the action and operation of machines, it is merely a notice of its salient features, and those who require minute descriptions of construction will be certain to apply for them by reading the notice.

In any event the greatest good to the greatest number of readers demands that such matter be reduced to its lowest terms compatible with comprehension of the ideas involved. So far as our own policy is concerned this course will be followed. Our notice of new inventions and machines is wholly gratuitous; this fact alone should moderate the views of individuals as to space. We neither demand that persons shall advertise, take a certain number, or any number of papers, to secure the insertion of their illustrations, but we do reserve the right to say what space shall be given to this purpose.

COST OF A HORSE POWER.

Estimations upon the subject of the cost of a horse power in steam engines are made, from time to time, and given to the world, but it is hard to see who is the wiser for them; for this reason: The cost of a horse power in a steam engine depends upon variable conditions which again vary with the size of every engine. Suppose it could be asserted with reasonable certainty that the cost of a horse power in a six inch cylinder of John Smith's make, in the city of Philadelphia, was six cents, this would not be of any value in estimating the cost of a horse power of the same engine transported to New York city. The cost of a horse power varies in every street in a city where the conditions vary, and the expression alluded to is as meaningless, in a financial sense, as it would be to speak of the cost of supporting a family. Everything about the factory enters into consideration in calculating the cost of a horse power. The price of the boiler has to do with the question, for interest on this value has to be considered as an important adjunct to producing horse power. Wages have to do with it, the price of engines and of oil have to do with it; in short there are no fixed data from which the cost of a horse power can be told, in round numbers. Approximately we can say it costs so much per horse power for steam engines under average conditions, but a conclusion of this kind rates in value with a mere guess.

THE FREE TRADER'S OPPORTUNITY.

The free trader has an opportunity now to look about him and see faintly what his policy would bring about if carried out. We say faintly because where the slackness in trade is now only temporary it would then be permanent. The free trader would not care, however; if he only got a foreign watch cheaper, or a coat cheaper. If he bought a bundle of iron for less money than he paid his countrymen, everything would be lovely, and we should all prosper. The idea being that the less business we do the better we are off. He always insists—the free trader—that the direct result of cheapening goods in one line, or one branch of domestic economy, necessarily makes everything else cheaper, but he might live to realize the fact that while he was pulling down his neighbor's house, his own, adjoining, was also toppling; that in fact communities have common interests, and what affects one affects all. Better reason with a bear robbed of its whelps than with a free trader.

TALKS ABOUT THE STEAM-ENGINE.—No. XIII.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

Let us assume a given journal to have to bear a pressure of 1,000 pounds, and make 300 turns per minute.

If we assume 125 pounds pressure per square inch proper, we will require 8 square inches of projected area.

Let us first assume a diameter of 2 inches and a length of 4 inches, and that the perfectly lubricated box seizes the journal with a force equal to 2 per cent. of the load, or twenty pounds at the surface.

The work lost in friction in turning the shaft for one minute is:

300×2-12×3·1416=157·08 feet multiplied by 20 pounds or 3141 6 foot pounds.

If, now, we shorten the bearing to 3 inches we must increase the diameter of the journal to $2\frac{2}{3}$ inches, in order to get a pressure of 125 pounds per square inch of projected area:

The work lost in friction is:

300×8-3×1-12×3·1416=209·44 feet, multiplied by 20 lbs; or 4188 8 foot-pounds

We see that an increase in the diameter of the journal (all the other circumstances being the same) means an increased loss by friction.

If we divide by the mechanical equivalent of heat:

```
774)3141·6(4·06          774)4188·8(5·41
    3096                     3870
    ——                       ——
     4560                     3188
                              3096
                              ———
                               920
```

We see therefore that, in the first case, sufficient lubricant must be used to provide for 4 units of heat per minute, and in the second case enough more to provide for $5\frac{4}{10}$ units of heat. In both cases we have the same pressure per square inch of projected area.

It is difficult to fix a limit to speed of rubbing surfaces, but as 8,000 feet per minute is as fast as it is safe to drive a cast-iron pulley (supposing this to be a line-shaft bearing), we will probably never have trouble from high speed, provided we sufficiently reduce the diameter of the journal, the pressure per square inch of area, and increase the lubrication to meet the increased expulsion of oil.

The reason why bearings of small diameter are productive of less loss by friction is this: The force with which a journal is seized is, with practical accuracy, directly proportional to the weight upon it, and is the same under all circumstances, provided we do not get too great a pressure per square inch of projected area, while the distance through which the resistance of the seizing force is overcome depends upon, and increases with the diameter of the journal.

Very refined measurements have shown that the statement that friction is proportional to the pressure is not accurately true. These measurements have also shown that the friction varies with and is affected by the speed of surface, but we have not sufficient knowledge to state these modifications as a law.

Eccentrics are causes of enormous frictional loss, which does not seem to be suspected by many because the very small pressures per square inch of projected area prevent heating. A small pin will save much where it can take the place of an eccentric.

An eccentric is nothing more than a device to avoid cutting shafts in two, and is a very big crank-pin on a very small crank radius.

Bourne places the extreme limit of pressure on bearings at 1,400 pounds per square inch, and recommends 800 pounds per square inch in practice.

The writer knows that any attempt to use even 800 pounds will require an enormous quantity of oil, and extreme vigilance, even in the stoutest engines furnished with lantern brasses for their bearings.

At these high pressures the least break in the film of oil is followed at once by rapid heating.

* * * * * *

Marine engines, probably because of their twisting and working, seem to cause more trouble in their crank-pins than any other type of engine, and their crank-pins are larger for given powers than those of any other type of engine.

Five hundred pounds per square inch is not often exceeded by designers in successful engines.

The work in foot-pounds lost in friction at the crank-pin is equal to a percentage of the total pressure of the steam on the piston-head, multiplied by the distance in feet through which the rubbing surfaces move against this frictional resistance.

If we divide this by the projected area we have the work done per square inch of projected area.

From experiments on the U. S. steamers "*Swatara*," "*Saco*," "*Wampanoag*" and "*Wabash*," the writer has found that the pins ran cool with an average frictional work of 4159 foot-pounds per minute per square inch if we assume 5 per cent. as the co-efficient of friction.

To determine the length of crank-pins for marine engines *as made* we have the following safe rule:

Multiply the total mean effective pressure on the piston-head by the number of revolutions per minute, and divide this product by 317,720. The result will be the length of the crank-pin in inches.

To determine the diameter of crank-pin, divide the total mean effective pressure on the piston-head by 500, and then by the length of the crank-pin

The result will be the diameter of the crank-pin in inches.

For example: Assume the mean effective pressure to be 40 pounds per square inch, the diameter of the steam cylinder 30 inches, the number of revolutions of crank, 90 per minute; then

```
15 square        225
                3·1416
                ——·———
                157080
                62832
               62832
               ———————
               706·8600
                   40
              ————————
              28274·4
                   90
                    ———————
  317720)2544696·0(8·0 inches will be the right length.
         2541760
         ———————
            29360
```

If now we divide the total mean pressure by 500, and then by the length of the pin we have:

```
    5)282·74
     ———————
    8) 56·55
     ———————
          7·07 inches for the diameter of a crank-pin.
```

Which shall not average more than 500 lbs. per square inch.

This rule in fact gives proportions of crank-pins similar to those of the screw-propeller vessels cited.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LIII.

A man looks at a draughtsman making a fine piece of work and says to himself: "I wish I could do that," or another hears a musician execute a difficult air successfully and envies the possessor his talent. Perhaps, descending from the arts to mere dexterity, he sees an individual make a skilfull shot at billiards and thinks he could do the same—if he only knew how. In all of these examples he sees only the immediate result; that appears on the surface, but he does not see the long and wearisome toil and study which has made all these things possible.

Perhaps he essays some of these fine things I have just spoken of, and finds at the outset that seeing a thing done and doing it are different. But if he has the right stuff in him he does not throw the task up as impossible, but goes deliberately to work to find out the causes of his failure and overcome them. That means, in other words, that he is a genius. He has a genius for hard work, a genius for pluck, and a genius to accomplish what he undertakes to. Here is a man of education, for instance; how did he get it? Was it given to him? Was it born in him? Did some one cram it into him as a shot flask is filled? No, sir. He dug that education out of what other men had done before him, and left the record of behind them, for those to pick up who thought it valuable.

Lamb said to me one day, lately: "Mr. Moulton, it's all very well for you to talk about accomplishing things, and keeping on, and never giving up, and sticking to it, never saying die, etc., but how would it be if you were a poor boy again, and left to your own resources, struggling on as best you could against all sorts of discouragement and obstacles, finding after all your labor that you were just where you started? It's easy enough to have pluck when you are beyond want, but when you had tried to the best of your ability and then failed I wonder what you would do?"

"Well, now, Lamb, you make think of the sheep-faced boy who had come of age; his father counseled him to marry. 'Yes,' says this hero; 'it's easy enough for you to talk about getting married; you married mother, but you want me to go and marry a strange girl!' That's about your size, Lamb. I have been exactly where you are, and I have seen the things that you see now. I have had the same misgivings, and doubts, and fears. I have often given myself up as a careless and useless member of society, unable to accomplish anything beyond mere drudgery, and I felt sorry for myself to think that I felt so bad—if you can understand that, Lamb. I wasted a lot of sorrow on an unworthy object, because when I was in that mood I was all that I imagined. I was useless to myself and to everybody else. After this feeling had passed away I began to be a little ashamed of myself, and said 'Here goes once more'—and so I kept on, and won in the end, as you will, and everybody will, by well-directed effort. A man saw a boy thrown off of a horse repeatedly and he went up and asked him why he didn't lead the beast. 'Lead him!' said the boy; 'he's a hired horse, and I'll ride him if I die.' Do you see anything in this fable? I do. I see a good deal. I see the pluck that wins. I see the grit that holds out even to death. I see the grim determination to ride him or die, that has got to fill every young man's breast who hopes to be more than a mere hewer of wood and drawer of water. How splendid such qualities are! The rudest mind can appreciate them at their true value. Pluck is the term for it, but it is really something higher and stronger; it is that subtle thing we call soul, and it is what distinguishes man from brutes.

"Lamb, it is a curious thing that the man or boy who is down on his luck fancies that he is the only man that is, or ever was in such a plight. He thinks that this day and this hour is the only day there is, and that because it is now cloudy, the sun will never shine. He does not feel that because he is now an apprentice he always will be one; he is more consistent than that, but not seeing the President approaching through the shop with an appointment as foreman in his hand he loses heart. One step at a time brings a man to the top of the highest ladder, and no boosting required, but he has got to keep stepping. Just so soon as a boy or a man sits down and bewails his hard luck, from that time on he will have nothing else until he changes his tune."

"Do you think, Mr. Moulton, that every man who tries can be well off, and have all he wants?"

"I do, most certainly, Lamb."

"Well, then, we shall be all bosses; there will be no high privates; who is going to do the work?"

The weakness of human nature will cure that imaginary trouble. There are lots of half-hearted bretheren who won't try, and to them belongs the crown of the high private. Assuredly they will wear it. Don't be anxious about a scarcity there. Nothing can keep a man down who is determined to rise; if he has no advantages, he will seek until he finds them; with that feeling he is certain to achieve his ends.

"It is good for a young man to think, sometimes, not of how deep a hole he is in but how much deeper he might be, and make the best of what he has, trying all the while to rise to the place he wishes.

HOW I SERVED MY APPRENTICESHIP.

NUMBER VIII.

BY GEORGE SLOCUM.

I had now been "tramping it" around the shop for nearly a year, and had got so sick of it that I one day asked the foreman if he couldn't give me a regular machine, or put me on a lathe. He said he would see about it. But it seems to me that his eyesight was bad, for it was three weeks before he gave me an old tumble-down, rattle-trap of a lathe, that the men all shunned as they would the plague. I don't know why he put me on this particular lathe, for there was another one right alongside of it, just as old, and just as shaky. I asked the boss if I should take her apart and clean, and fix her up some. He said no; they were going to throw her in the scrap heap anyhow, and it wasn't worth while.

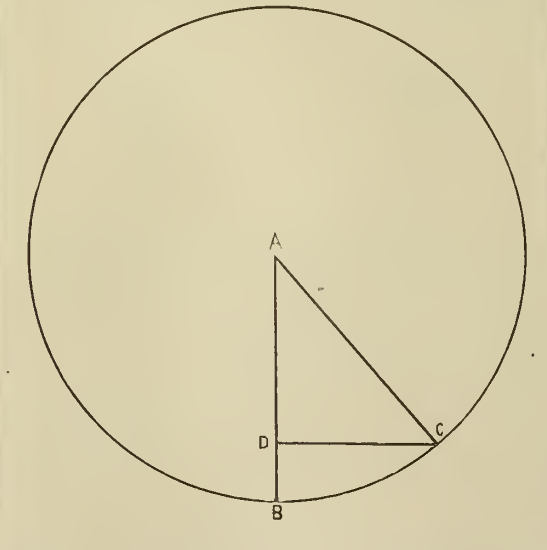
The first job I got was 150 flue-plugs; some of the boys on the other lathes said it was a "bully loafing job." After I had them all centered and the ends faced off, I set my lathe the right taper and started a cut.

"Jones," said I, "I've got on old '76, and she's a daisy."

"She may be a daisy now," said Jones, "but when I ran her five years ago she was a terror. Come over here and we'll wind up that matter of spacing off circles."

"We laid off four holes the last time, didn't we Jones?"

"Yes. And now we'll lay off five. See here; I strike a circle five inches diameter, and I want to lay it off into five equal parts. I first divide 180° by 5, which gives me 36°. I then find in this table that the sine of an angle of 36° is ·5878. I multiply this by 2½, the radius of my circle, and I get 1·4695. I multiply this by 2, and the result is 2·9390 inches, or a little more than $2\frac{15}{16}$th inches. Set these dividers to $2\frac{15}{16}$th inches, and see if it don't go around just 5 times. One more example and I am done. As I said before, the radius of any circle will go around it just 6 times. Now let's see if we can catch these tables in an error. You see I strike here a 6-inch circle. The radius, of course, is 3 inches; without moving the dividers I step off six equally distant points on its circumference. Now by figures I want six points, so I divide off 180° by 6, and I get 30°. The tables say that the sine of 30° is ·5000. I multiply this by 3 the radius, and I get 1·5000. I then multiply by 2, and the result is 3 inches. Of course you know that in decimal fractions ciphers placed on the right hand of a figure don't count for anything, so the answer is 3 inches; just what I got before."



"Jones, that's nice. I'll tell you what I am going to do, just for practice and to pass time," said I.

"Well, let's hear it," said Jones.

"I am going to buy those tables and figure out the sines for radii from 2 up to say 10 inches—increasing by half an inch—and get the chords of from 3 to 20 points in the circle; that will give me range enough to cover all such things as flanges, caps, cylinder-heads, dome-castings, etc., won't it?" said I.

"Better make it from 2 up to 30 inches, and then you can take in smoke-arch fronts and such like," said Jones.

"Yes, that's so. Well, is this all there is to this wrinkle?"

"That's all. If you want to note it down you had better do so before it gets cold."

"Oh! that's all right. But how is that table calculated, anyway?"

"Well, George, it's no use trying to explain it to you, for you couldn't understand it if I did. You don't know anything about trigonometry, so what's the use of wasting time. I don't consider it wasting the Company's time to explain such things as you can understand, for if you get as much theory as practice, and you are painstaking and observant, doing your work as well as you possibly can, you will be just as valuable a hand to the Company as a journeyman during the last six or nine months of your apprenticeship. It will be just so much money in the company's pocket. I know if I was foreman of this shop I would train the boys differently from what they are. I would encourage the boys to learn all they could about the figuring part of the trade, and the good industrious ones I would push right along: The lazy, shiftless, mischief-making chaps I would fire out of the shop, at short notice, you bet."

"I guess, Jones, if you were foreman of this shop, you would do that the first thing," said I.

"No, sir. Not much I wouldn't. I would talk to the boys and give them to understand that this monkeying had got to be stopped. I would talk business to them from the word go. It would be for their own good. I would keep them busy all the time, making tools for themselves if I hadn't anything else for them to do at the moment, and I would furnish them with the stock too. What's the use of trying to make a machinist out of a boy who has no taste or inclination for the trade? It's only wasting his time. In the end he'll be only a monkey-wrench machinist, and won't know as much as a "chunker." They don't treat boys right now-a-days. Most of 'em don't get any show to learn the trade well. They kind of run themselves, instead of being properly directed by the foreman."

"I guess I'll go and start my rattle-trap up," said I.

"And I'll start these frames up too," said Jones.

A few days after this short lecture on apprentices, as I was passing Jones hailed me with:

"Say, George! Come here. I forgot one thing in connection with laying off holes in a circle, as I was showing you, and it is this. Sometimes minutes enter into the question as well as degrees, and I'll show you how to get over them. Suppose now, you want to lay off seven holes in a circle 7 inches in diameter. You go to work and divide 180° by 7, that gives you 25° and $\frac{714}{1000}$ of a degree. Now, you multiply ·714 by 60 (minutes in a degree), and you get 43 minutes nearly.

Now, according to my tables, the nearest you can get to 43 minutes is 40 minutes. So now you want the sine of an angle of 25° 40′, which is ·4331, which multiplied by 3½ inches gives

1·5159, and this multiplied by 2 gives 3·0318 inches, or a little over $3\frac{1}{32}$ inches." (See Fig. 5) where *A B* is the radius of circle, and *C D* the sine of the angle *A B C*. If *A C B* is an angle of 25° 40′, *C D* is the sine of that angle, and twice *C D* the sine of an angle of twice 25° 40′. So also will twice *C D* be the chord of an arc of twice 25° 40′.

GOSSIP ABOUT LOCOMOTIVE DETAILS.

I asked a railroad man, well posted on the locomotive, this question, not long since: "Which do you consider preferable in a side rod, rigidity or elasticity?" He answered promptly, "rigidity."

I asked another man, equally as well posted, the same question. He answered quite as promptly, "elasticity."

Now, here we have two answers to the same question, as diametrically opposed to each other as the poles, and I am placed in a dilemma by reason thereof. I can make my side rods so heavy they will be absolutely rigid, and the risk of breakage while running reduced to zero; but if I do this, I endanger my crank pins and sacrifice my rod brasses.

On the other hand I can make my solid side rods so light and elastic, that they will scarcely affect the brasses, but if I do so, I must be prepared for broken side rods, right along.

I remember, some years ago, there was quite a furore over copper fire-boxes and water tables. I mention copper fire-boxes because, in the case of an Ohio road, the fire-box was born of a water table—so to speak. Well, the Ohio road tried the copper water table $8,000 worth inside of six months, then tore out the whole business and sent it as scrap to brass foundry. This was a clear case of tried and found wanting.

I am informed that one of our oldest trunk lines has adandoned the use of the brick arch in toto. Not long ago I had a conversation with a man, formerly connected with this road, and he told me that company had given the brick arch a thorough trial. They humored it in every possible way; put it in their different classes of engines; tried it with different kinds of fuel; tried it with their best runners; set it up, then down, then in, then out, tried two, four, then six bricks; set it at this angle, then at that; but all to no purpose. Nothing in it, only loss. I do not know how many engines were equipped in this manner, but it is safe to presume that three or four years trial of the thing, in their different classes of engines, must have entailed a pretty heavy expense for labor and material—to say nothing of the injury to side sheets in the way of holes for angle irons.

It does seem very queer to see one road condemning and heaving brick arches out of their fire-boxes, and its neighbor putting them in and lauding them as the *ne plus ultra* of fuel-savers. This proceeding has somewhat of a silly aspect, to say at the least.

Now, these three examples of money wasted by railroads in going it blind, are merely preliminary to a plan whereby all this waste of money can be avoided.

I would, of course, commence with those parts nearest reach, and one of these is the side rod as we find it to-day, on a majority of our engines. A fluted steel side rod, 8 feet 3 inches long, will weigh about $19\frac{1}{4}$ lbs. to the foot; I mean the rod alone without straps, brasses or keys. The uniform cross section area of this rod would be about $4\frac{5}{8}$ sqr. inches, A solid rod, iron or steel, will run from 16 to 25 lbs. to the foot of length, and neither of these can be relied on for safety.

Let us now see what kind of a showing a hollow steel rod would make.

A steel tube $3\frac{1}{2}$ inches o. d., with walls $\frac{1}{2}$ inch thick, can be flattened or tapered and eyes or stub ends welded in solidly.

Taking the tube alone, its estimated elastic stress is from 15 to 16 tons per square inch, its estimated tensile stress, from 28 to 30 tons per square inch, estimated elongation in 10 inches, from 22 to 24 per cent., and its estimated contraction area, from 48 to 52 per cent. Weight per foot, 16 lbs. 3 ounces. The cross section area of metal, in this tube, is 4·71 square inches, slightly greater than the area of the fluted rod, aforementioned, but its weight per foot is 3 lbs. 1 oz. less. If we reduce the thickness of the walls to $\frac{1}{4}$ inch, and make the rod tapering toward both ends, we can reduce the weight to about 9lbs. per foot and have an extremely light, safe, elastic and symmetrical rod, qualities that no side rod extant possesses. These tubes are homogenous, and quite smooth, both inside and out, and could be finished on an emery wheel, at small cost.

What is the matter with the Allen valve? I notice some roads are throwing it away and putting back the common type of plain valve, Now, it appears to me that this is retrogression with a vengeance. We always thought the Allen valve a big thing for getting a good supply of steam behind the piston, just at the very time it needed a good boost.

Can the patrons of the long D claim as much?—*Railroad Record.*

ZYLONITE AND WHAT IT IS.

Our readers have doubtless seen this material spoken of frequently of late and will be interested in knowing more about it. We quote from the *Paper World:*

"Paper, camphor and alcohol, combined and chemically treated, make zylonite, and from zylonite, in turn, are made almost numberless kinds of goods which have heretofore been produced from shell, horn, bone, etc. These goods include collars and cuffs, toilet brushes and combs, hair combs and pins, toilet boxes, eye-glass frames, harness rings, glove stretchers, bottons, and scores of miscellaneous wares, at once useful and ornamental, in both the higher and humbler walks of life.

"As we said, paper, camphor and alcohol are the materials from which zylonite is made, paper being the basis and principal feature of the stock used in this system of manufacture. From one-fourth to one-half a ton of paper a day is now consumed, and this of the finest, cleanest and best tissue paper that can be produced. This must be made from pure rag stock, and be without spot or blemish as the greatest care in the selection of stock and details of the manufacture of the paper can make it. It is made expressly to order, and delivered in rolls. The first process of manufacture into zylonite is cutting the paper into strips, say an inch wide and two feet long, the paper being embossed while passing through the machine to the slitting and cutting knives. The embossing is found necessary to prevent the paper from matting together, as it would be liable to do if in sheets in the process of manufacture. The paper strips are placed in iron vessels, strong acids are applied, and the paper again resolved into pulp. Then by processes peculiar to the company, follow the introduction and combination of camphor and alcohol to the pulp, making the preparation entirely insoluble. At this stage the mass partakes of the nature of cellulose, when coloring matter is introduced, and the combined preparation is passed between heavy and highly polished rollers. It is then moulded into slabs of some four or five feet in length, about two feet in width, and three or four inches in thickness.

"After a certain length of time, and when in proper condition, the slabs are placed on the bed of a machine in which they are shaved to any desired thickness. At this stage of the manufacture the shaved slabs are as clear as crystal, presenting nothing to the eye in looking through them but the shade of color which may have been added at the proper time. These sheets are changed into rolls or rings and made ready for transforming into the various articles of manufacture."

HIGH SPEED LOCOMOTIVES.

Many of the great English railway companies are now building locomotives intended to attain very high speeds with heavy trains; and those who have watched the process of development of the locomotive, know that there is a growing desire—manifested by the direction which this development is taking—for higher speeds. It remains a fact that the average velocity of 60 miles an hour running time—that is exclusive of stops—is not attained on any railway in the world. It may be thought that an addition of five or six miles an hour to the speed of some of our best trains would be a small matter, but it is not. It is the last straw that breaks the camel's back, and engines which can be easily persuaded to run at 50 miles an hour can, by no possible process, be induced to go faster. We propose to consider a few of the problems which present themselves when we attempt to design an engine which shall be capable of running 120 miles in two hours.

* * * * * * * * *

We have said that the maximum gradient shall be 1 in 260, and it may be taken that while only a comparatively small portion of the road shall be as steep as 1 in 260, there will be numerous inclines of less importance. We may deal with a road of this kind in two ways. We may reduce speed in going up hill, and make up for lost time when going down, or we may try to provide sufficient power to maintain a steady pace with little change of velocity the whole way. The latter course will be found quite essential. Let us suppose that our imaginary line rises for 60 miles, and then falls for 60 miles from the middle station at the rate of 1 in 500. Now if a continuous speed of 65 miles an hour is to be maintained, the engine must be sufficiently powerful to take its load at this pace up 1 in 500 for 60 miles. If, however, we please to let the speed down while ascending, and make it up while descending, we shall apparently gain a great deal. Thus we might go up one incline at the rate of 45 miles an hour, and the run to the middle station would then occupy 80 minutes, while the remainder of the run down hill must be done in 40 minutes, or at the rate of 90 miles an hour. A simple calculation, however, will show that no great reduction of speed is possible, save for very limited periods, as when a very short and steep incline has to be surmounted. Let us suppose, for example, that one-half the whole run, or 60 miles, shall be made at 50 miles an hour. Deducting 5 miles for starting and stopping, we have 55 miles at 50 per hour, and 5 miles at half speed=10 miles at full speed, making total for 50 miles per hour=65 miles. Now, 50 per hour=1·2 minutes per mile; therefore 65 miles will be done in 65 × 1·2=78·0 minutes. Out, then, of the 120 minutes 78 have been used for the first half of the journey, or 60 miles, leaving for the sec- 120–78=42 minutes. Of this 60 miles again 55 have to be done at maximum speed, and 5 at an average of half speed; so that the speed on the second 55 miles must be equal to 65 miles in 42 minutes. Now, this will give 0·646 minute per mile, so that 55 miles must be done in 55 × 0·646=33·53 minutes, and the 5 miles at ends in 6·4605 minutes. The maximum speed then is 60÷0·645=93 miles per hour, a velocity far too great for us to contemplate its adoption.

* * * Taking various points which present themselves for consideration, we believe that an engine intended to run steadily and safely at 75 miles an hour must have a single pair of drivers only, and these would be best if made 9 ft. in diameter. To advocate so enormous a wheel requires some courage; but it must not be forgotten that we have to provide for an altogether exceptional velocity. It is extremely doubtful if a speed of 75 miles an hour has ever been attained save for a mile or two by any locomotive; 72 miles an hour is the highest velocity of which we have any personal experience, and this was attained by the *Grosvenor* on the Brighton Railway, the velocity being checked by a Stroudley speed indicator on the foot plate and a Westinghouse recorder in the guard's van. We have travelled at 71 miles an hour, but only for short distances. We are contemplating the case of an engine which may have to run 60 miles or more per day at the rate of 75 miles an hour, and for this speed we believe, as we have said, that a 9 ft. wheel will be found indispensable; at 75 miles an hour this wheel will make 229 revolutions per minute, corresponding, with a piston stroke of 2·25 ft. to 1,030 ft. of piston speed per minute, which is quite fast enough.

A 9 ft. wheel entails outside cylinders as a matter of course, and even with these the center of gravity of a narrow gauge—4 ft. $8\frac{1}{2}$ in.—engine must be raised considerably. We may point out, however, that the London and Northwestern engine *Cornwall* ran with great success for many years with 9 ft. driving wheels.

The barrel of the boiler of our high speed engine must be of large diameter—as large as it can possibly be. The bottom of the shell cannot safely be hung lower than 8 in. above the center of the driving axle, and this will bring the middle line of the boiler about 7 ft. 5 in. above the rails. The center of gravity of the engine will of course be far below this; but comparisons between engines are usually based on the height of the middle lines of the boiler shells, and the figures given above are not excessive. We may go further than this, and ask what are the objections to a high center of gravity in a locomotive? There is not an instance on record of a locomotive upsetting while the permanent way remained able to carry an engine at all; and we may dismiss the notion that any risk can be incurred in this way as a result of a high center of gravity. As regards easy running, on the other hand, it will be found that a high center of gravity promotes it. There is, however, more risk that springs will be broken. * * *

We have fixed the gross load at 175 tons. Our reason for doing this is, that with the narrow gauge it will be found impossible to use a boiler capable of developing much over 1,200 horse power. Indeed, as will be seen further on, it is questionable whether sufficient boiler power can be obtained at all. A train to weigh 100 tons might consist of nine vehicles, namely, seven seven passenger coaches and two brake vans, one at the front, the other at the rear of the train. Each coach would seat forty passengers, weighing about 3 tons. If the train were filled it would carry, say, 21 tons of passengers and 4 tons of luggage, or in all 25 tons. The net weight of the nine vehicles must therefore not exceed 75 tons, or 8 tons 6 cwt. 2 qrs. each. This is very light, but we have no doubt that by the free use of steel specially designed coaches could be produced of this weight. The total number of passengers carried would be 280.

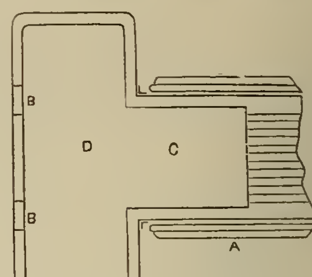
We have said that the resistance would not in our opinion exceed 40 lbs. per ton on a level at 70 miles an hour. But, as we have shown, the speed if the whole line was free from inclines would be but 65 miles an hour. Allowing 40 lbs. to the ton at this speed—which is well within the mark—we should have a gross tractive resistance of 175 × 40=7,000 lbs. Now, 65 miles an hour equals 95·3 ft. per second, or 5,718 ft. per minute, and $\frac{5,720 \times 7,000}{33,000} = 1,213$ indicated horse power. These figures show that if we cannot reckon on getting more than 1,200 indicated horse power out of our boiler the weight of the train must be kept down to about 175 tons, as we have said. But our line is not level. We assume that there will be gradients of as much as 1 in 264 to overcome. It is a noteworthy fact that the higher the speed the less will gradients affect the work to be done by the engine. A gradient of 1 in 264 will represent a resistance of 8·5 lbs. per ton nearly. This would be about the resistance of a train at 25 to 30 miles an hour. Such a gradient would, therefore, double the work to be done by the engine of a slow, heavy train, but will augment the resistance of our fast express by little more than one-fifth; that is to say, an addition of about 225 horse power would suffice to overcome it at 65 miles an hour, and by dropping the speed to 60 miles an hour, it is possible that the incline would be surmounted with 1,200 horse power only. Indeed, curves will be found on the whole more serious impediments to high speeds than reasonable inclines.

The question of adhesion now presents itself. It is of course useless to provide boiler and cylinder power unless we also provide means for utilising it. The tractive effort to be calculated on is, as we have seen, 7000 lb., and it will not be safe to count on a coefficient of adhesion greater than one-sixth. Thus we have 6 × 7000 lb.=42,000 lb.=18·75 tons as the load to be carried by the driving wheels. This may appear a tremendous weight, but it is not too much for an 84 lb. bullhead steel rail. Mr. Pearson's engines on the Bristol and Exeter line carried over 19 tons on their 9-ft. drivers; and we believe that Mr. Stirling's single engines, with 8-ft. drivers, on the Great Northern Railway, carry quite 18·5 tons. We see, therefore, that adhesion can be had; but we also see that the weight of our train will not admit of being augmented. Any addition to its weight would render it necessary either to increase the load on the drivers, which we dare not do, or else to couple two pairs of 9-ft. wheels, which is quite out of the question, if for no other reason than because of the excessive length of coupling rods required.

A very brief calculation will suffice to show that the cylinders of our high-speed engine must be 20 inches in diameter, with a stroke of 28 inches. An average pressure of 1 lb. in a cylinder of this size will give 103 lb. tractive effort, and $\frac{7000}{103} = 68$ lb., in round numbers, as the average effective pressure which must be maintained in the cylinders. This may be taken as standing for a boiler pressure of 150 lb. per square inch, and we may assume an initial cylinder pressure of 140 lb. above the atmosphere, or 165 lb. absolute. Steam of this pressure cut off at one-fifth of the stroke would give an average effective pressure of about 70 lb. in theory, or nearly what is actually wanted in practice, and this represents a fair amount of economy. A properly designed engine running under these conditions ought not to burn more than 3 lb. of coal per horse per hour, or for 1200 indicated horse-power 3600 lb., or for a run of 120 miles 7200 lb., or 60 lbs. per mile. No doubt this will appear at first sight an enormous consumption, but the work to be done is enormous. The advantage gained by running down inclines is as small in proportion as the loss caused by ascending them, and steam must be kept full on from start to finish. In a word, we have the case presented of an engine which has to be run as fast as it can possibly go without any regard for economy or fuel. The cost of the coal burned is here a matter not worth a second thought. Economy in its use is only to be sought because the greater the work that can be got out of it the better is the prospect that the speed demanded will be obtained.

We now come to the most important consideration of all—the design of the boiler. As the driving wheels will rise above the middle of the boiler, its diameter must be kept down sufficiently to admit it between them. The maximum diameter outside cannot exceed 51 in., and to get this the lagging must be suppressed in the wake of the wheels. Without unduly adding to the length of the tubes, it will be impossible to get more than 1000 square feet of tube surface into such a barrel. Under these circumstances we shall have to rely on the fire-box for the production of steam to a much greater extent than usual. We have to burn 7200 lb. of coal in two hours, or 3600 lb. per hour, and even if we burn 100 lb. per square foot per hour, we would need 36 ft. of grate to do this. But the grate cannot be more than 3′ 6″ wide, and $\frac{36}{3·5} = 10·3$ as its length. Such a box could not be properly fired by any stoker, and unless a tremendous draught were maintained by a contracted exhaust, which would entail many evils, 100 lb. could not be burned per square foot of grate per hour. It would not be necessary, we apprehend, to enlarge the fire-box on the Wooton system by spreading it behind the driving wheels over the trailing wheels; but this would entail the construction of a very complicated fire-box, or the placing of the wheels very far forward. As an alternative scheme, Crampton's type of engine might be adopted. The great obstacle standing in the way of this would be the difficulty of distributing the weight, and the only advantage gained would be an addition to the diameter of the boiler barrel. So great, indeed, are the difficulties which stand in the way and bar our progress that we are forced reluctantly to the conclusion that it is impossible to design a narrow-gauge engine which shall develope 1200 indicated horse-power steadily for an hour and yet shall be of anything like the ordinary type. If this be the case, then, it is not easy to see how runs of 60 miles can be accomplished in 60 minutes.

One way out of the difficulty that suggests itself to us is the adoption of a fire box shaped in plan as in the accompanying diagram. Virtually, we would have in the part *C* an ordinary fire-box with about 18 square feet of surface. The remaining portion *D*, a species of addition tacked on, so to speak, might be 7′ × 4′. Thus we should have a total grate surface of about 46 square feet. In order to get in sufficient tube area it would be necessary to use an oval boiler barrel. In this there is nothing novel, as such barrels have been used for years on the Continent. The driving wheels are shown at *A A*, while *B B* are two fire doors. On such a grate the requisite weight of coal could be consumed at the rate of about 78 lbs. per square foot per hour, which is quite feasible.



We have not gone into details of design, nor is it necessary that we should. Our object has been to put the nature of the problem to be solved before our readers rather than attempt its solution ourselves; and, doubtless, many of our readers will take sufficient interest in this most attractive subject to say something to the purpose in our correspondence columns. We have based all that we had to say on the assumption that at exceedingly high speeds such as those we contemplate, the resistance is 40 lbs. per ton. We have also, however, expressed the belief that it is not nearly so much. If it were we do not see how the present rate of speed could be maintained on the Midland, Great Northern, and other narrow gauge lines. In the chance that it is very much less lies the possibility that extremely high velocities may yet be attained on English railways. The discouraging fact is that on no railway in the world is 60 miles run in 60 minutes.

It is a noteworthy fact that this subject has not hitherto met with the full discussion it deserves. In the mind of the general public there appears to be an idea that railway trains could be run much faster than they are if railway companies pleased. The truth is, however, that the quickest trains on our great trunk lines are run as fast as they can possibly go. They are timed so close to their capabilities, indeed, that nothing is left to contingencies, and a small mistake with fire or water will suffice to render them several minutes late. Nothing, indeed, but consummate judgment on the part of driver and stoker can secure that clockwork regularity for which some of our northern lines are famous. It is to be regretted that the magnitude of the difficulty to be contended with is not fully realized.—*London Engineer.*

HOW MARINE-ENGINE CRANK SHAFTS ARE MADE IN ENGLAND.

For extra large crank-shafts the fear of unsoundness arising from the ordinary mode of forging has led engineers to consider the propriety of building the cranks in separate pieces. One advantage of the built crank-shaft is that should there be a flaw it may be confined to one part only, whereas in a solid crank-shaft it may necessitate the condemnation of the entire crank-shaft. My impression is that large shafts will still have to be dealt with in pieces, not because it is a question of being able to make large forgings sound, but the difficulty arising from the fact that no engineer could run the risk of anything going wrong with large shafts, and ships having to wait until another could be finished. This is the difficulty to be encountered in dealing with forgings of excessive size. The built crank-shaft will be 25 per cent. heavier than a solid crank-shaft; moreover, the increased weight necessitated by separate building is viewed as a disadvantage, although it is not attended with much greater cost. Perhaps it would be unwise for me to pass any opinion as to whether a built-up shaft or a solid shaft is the better. The building-up of large shafts with capable tools presents no difficulty whatever. One firm with which I was once connected turned out a ship with a crank-shaft 58 tons weight. It was built up in fifteen independent pieces, every crank web was separate, the crank-pin was another portion, and the two ends were also separate. Three such cranks constituted the crank-shaft of the Arizona. In the mechanical engineering of the future we can rely more on our tools for putting large pieces together much better than formerly, and I should find no difficulty in dealing with crank-shafts up to 100 tons, which I think will have to be made within the next few years. I will now explain the finishing of solid crank-shafts.

First, the crank is marked out to the drawing, to see that the shaft will turn to the required size, then it is put in the slotting machine and cut two grooves at the same time ; the piece between these two grooves is afterwards wedged out to slot out the other end portion. The crank is then rough-turned to a quarter-inch above finished size, and placed in a planing machine, in which are planed the flat and the crown of crank at the same time. The crown is planed by a tool in a rest carried on the upright of a planing machine. The tool-box of this is controlled by a radius bar, and can be set to plane the crown to any desired curve at the same time as the flat is planed. The crank is then turned over and the other flat and crown finished in the same way. There is with this machine a decided economy in time and an extra centering and balancing in the lathe. The crank is then taken to have the pin turned. For this purpose there is a special machine, which finishes the pin, the crank being stationary and the tools revolving. With this machine it is possible to reduce a crank-pin 6 in. in diameter with one cut. Another advantage in this machine over the old plan of turning crank-pins is the saving of time in not having to balance the crank, thus insuring perfect roundness of the crank-pin, a difficulty in the old system of turning the crank-shaft in a lathe.

In the case of a pair of cranks coupled together, the sides of webs and one coupling of each crank are finished, the holes for bolting together are bored, and after this they are bolted together, put in the lathe, and both cranks finished at the same time, which causes them to be perfectly true and ready for the engine.

A built crank consists of five pieces, viz., two webs, one crank-pin, and two pieces for body of shaft. to finish which the two webs are planed to the requisite thickness, then bored, the end for body of shaft being finished to the size, and the other end rough-bored to quarter of an inch of finished size. The webs are then slotted to the required shape and size, and key-ways are cut in the finished holes. The body parts are rough-turned to a quarter of an inch finished size, and the parts that fit into the webs are finished to the size for shrinking them on the body parts. The keyways are now cut to correspond with the keyways of the webs, then the body of shaft is inserted, and the keys are fitted in. The crank is now ready for the horizontal boring machine, by which the crank-pin holes are bored. As you will perceive by the mode of centering I adopt, and the boring of the holes in both crank-webs, with the same setting, and by the same boring bar, I arrive at the strictest accuracy.—*The Mechanical World.*

CARE OF LOCOMOTIVE CONNECTING-RODS.

I propose to take up the subject of locomotive main and side-rods, and have a little to say both on their use and abuse. The rods occupy an important position in locomotives, and tax the mechanical ability of the engineer to a larger extent than almost anything else connected with it, because the functions they are intended to perform are so little understood, except in a casual way.

To give an intelligent idea of how to take care of rods, it will be necessary to convey some idea of the duties they have to perform. I shall confine myself absolutely to main rods in this article.

First, what is a main rod? What duties has it to perform, and what conflicting strains is it subject to? A main rod is, or should be, an unbroken connection from the cross-head to the crank-pin; and its functions are to transform a reciprocating into a circular motion. The conflicting strains are tension, compression, vibration. The secret of a smooth-running and long-lived engine is to keep that connection unbroken as near as possible, by preventing all unnecessary pounding and loose brasses; for the main rod has a tremendous duty to perform which a casual observer cannot conceive of. It has to convey the force exerted by the steam against the piston to the crank-pin, which is tremendous in some cases. In reducing the brasses, both backward and forward, it is necessary, to insure good running after being put up, that they be reduced in a proper manner. There is no reason why a pin should run hot for two or three days after the brasses have been reduced if the pin is in good shape, and the brasses have been properly reduced. If there is, and some one will explain the wherefore, I shall have learned something in mechanical practice. After taking the rod down put the brasses on the pin in the position they are intended to run, and ascertain about how much lost motion there is, for by that means you can tell how much is required to be filed off. Before filing caliper the four corners of each brass; if the four corners are of the same thickness you can go ahead and file the required amount off, Keeping them of the same thickness is absolutely necessary to insure a good fit and good running, for if they are of different thicknesses the low corners will be left open, and if you attempt to key them up, it will twist the brasses and wear them more on the open side than on the closed, heating the pin and destroying both the alignment and wearing surface of rod and brasses.

When filing the brasses you should frequently consult the surface-plate to detect any rocking on the face you have been filing, as the surface where the brasses are put together should present a straight and close joint. After reducing them the required amount, put them in the strap and drive the key in. Don't drive it in as if you intended it to stay there for all time and eternity, for the key acts as a wedge, and exerts a tremendous force when driven in to any great extent. Tap it in lightly till you get brass and brass, then stop driving. If you can just turn the brasses on the pin, and they bear on the four corners, you have them as they should be —a little too tight for running, and will allow a little for keying. Slack the key till you can revolve them free without any shake. Mark the key, as that is the position they are intended to run in. In reducing brasses I notice a pernicious habit among a great many to destroy the bearing surfaces, and file away the brass for about one inch from each side, and often down to the babbitt metal. After the brass has once worn down to a good bearing they should never be touched on the bearing surface unless they are cut or ridged. They should also have a bearing all around the half arch, and not just a little across the bottom, as some would have you believe. It's an established rule with some men after taking the brasses down, and everything is as smooth as need be, to put them in the vise, and with a half-round bastard file, file away for dear life all over the bearing surface, and if there is the least sign of bearing, within an inch, or an inch and a half of the edges, that becomes a special point of attack. If the brasses are cut or grooved for want of oil or lateral motion, it is well to remove the prominent places with a fine half-round file, or scraper, but under no conceivable circumstances touch the bearing proper; for by so doing you only give the engine the work to wear them down again, and yourself unnecessary trouble, besides enhancing the possibilities of throwing the rod out of alignment, which is the cause to a large extent of the brasses hugging on one side of the pin. Is it any wonder the pins run hot for awhile after the brasses have been reduced, under such circumstances? The bearing surface has been reduced so small from filing that the pressure forces out the lubricant, the two metals come in contact, abrasion takes place, which causes excessive friction, and friction produces heat. The only clearance that is needed is the sharp inside edges filed off to prevent cutting the oil. The convex ends should also have a good bearing in the quarter circle fillets of the pin, as that prevents excessive wear on the collars and ends of the brasses. It is a great mistake to leave sharp corners on bearings, and more especially in the case of crank-pins, they should be kept with good large quarter-circle fillets.

In putting up new work or new brasses on old pins, it is necessary that they should have about three sixty-fourths inch lateral motion, to prevent grooving. The bearing cannot be run any length of time and remain true unless it has a little end play to prevent its running all the time in the same channel. Before putting up the rods ascertain the striking points of the piston, if they are not already marked on the guides. It can be ascertained by forcing the piston forward against the cylinder head, and marking on the guide where the forward end of the cross-head stands; the back end is obtained in the same way. Measure the distance between the two marks, and whatever is over and above the throw of the crank-pin, divide it on both ends, giving however a little the most clearance in favor of the forward end; for keying the rod lengthens it, and if the forward end has a little the most clearance on the start, it will be equalized after keying the rod up. After putting the strap on it would be well to see if the rod is in line with the cross-head. That can be proven by keying the brasses up a little snug; then push up the forward end, and if it comes in the center of the wrist-pin, it is correct. If it should not, don't attempt to force it into place; it will give you less trouble, and a great deal more satisfaction, to take it down and ease the brasses out a little so as to bring it into line. If you attempt to force it into place you may expect to have no end of trouble from hot pins and cut guides, as it will twist the brasses, and force the cross-head to bear heavy on the side of the guides.—*J. D. Campbell in Locomotive Engineer's Monthly Journal.*

INTERESTING FACTS ABOUT LARGE CHIMNEYS.

The Pacific Mills, Lawrence, Mass., chimney was built by Mr. Mills in 1873, and consists of an octagonal shell 222 feet high above the ground, with an interior core 8 feet 6 inches in diameter inside, extending one foot above the top of the outer shell and eleven feet below the ground. The chimney is founded 19 feet below the ground, upon coarse sand, the foundation being 35 feet square, inclosed by pine sheet-piling. The base is concrete, one foot thick, then rubble masonry of large pieces of granite in cement, this stone work being 7 feet high. Upon the stone work is placed the brick chimney, the outer shaft being at the base 20 feet wide, and at the top under the projecting cornice 11 feet 6 inches wide. This brick work is 28 inches in thickness at the base; at 12 feet in height it becomes 24 inches, which continues 18 feet ; then 20 inches for 20 feet ; then 16 inches for 40 feet ; then 12 inches for 60 feet ; then 8 inches to the top. The inside core is 2 feet thick to a height of 27 feet and one foot thick for the remaining height of 154 feet. The top of the chimney is of cast iron plates ¾ inch thick. The horizontal flue entering the chimney is 7 feet 6 inches square. The vertical flue of the chimney is a cylinder 8 feet 6 inches in inside diameter, and 234 feet high with walls 20 inches thick for 20 feet, 16 inches thick for 17 feet, 12 inches thick for 52 feet, and 8 inches thick for 145 feet. The foundations were laid in mortar of Rosendale cement and sand ; the outer shell in mortar of Rosendale cement, lime and sand.

During the winter of 1873, the flue being 90 feet above the ground, boilers having 452 square feet of grate surface were connected with the chimney with satisfactory results. The approximate weight of the chimney is 2,250 long tons, the number of bricks being about 550,000. The chimney is opposite the middle of a line of 28 boilers, and 210 feet distant from them. It was designed to serve for boilers having 700 square feet of grate surface, burning about 13 tons of anthracite coal per square foot of grate surface per hour.

The chimney was struck by lightning in June, 1880, after which date a lightning rod was put up, which consists of a seamless copper tube 5-16 inch thick, one inch inside diameter, at the top of which are 7 points radiating from a ball 4 inches in diameter, the top of the central point being 8½ feet above the iron cap. The rod is attached to the chimney by brass castings, and is connected at the bottom to a 4 inch iron pipe extending 60 feet to a canal.

A description was then read of the chimney of the Merrimack Manufacturing Co., at Lowell, Mass., built under the direction of J. T. Baker, C. E., in 1882. This chimney is founded on a ledge of sandstone. The foundation. 30 feet in diameter, is built of granite blocks laid as they come from the quarry. At the surface of the ground there is a dressed granite base 2 feet 6 inches in height. laid in clear Portland cement, the remainder of the foundation being in Rosedale cement and sand. Upon this base is placed the brick work consisting of three cylinders, the outside one 28 feet in diameter, 24 inches thick, the middle one 18 feet in diameter 8 inches thick, the core 12 feet inside diameter and 16 inches thick. The middle cylinder is carried up vertically 75 feet 6 inches; the outside ring has a batter of forty-two hundredths of an inch per foot to a height of 100 feet. At the height of 75½ feet the middle ring connects with the exterior ring, making the masonry at that point 36½ inches thick; it is then 20 inches thick for an additional height of 60 feet; 16 inches thick for 70 feet; and 12 inches thick thence to the enlargement for the chimney head. The core is uniformly 12 feet inside diameter to the top, the first 100 feet being 16 inches thick; then 12 inches thick for 60 feet; then 8 inches thick for 90 feet; and then 4 inches thick for 29½ feet to the top. It is entirely separate from the outside masonry except about the door-ways and openings for the flues. The core was laid in mortar of lime and sand; the outside shell in lime, cement and sand. On one side of the chimney is a ladder of iron extending from the ground to the top, and on the opposite side is a ¾ inch galvanized iron wire rope, both ladder and rope being connected with a copper ring having four spurs, the central point of which extends 8 feet above the top of the chimney. The bottom of both ladder and rope is connected with a 16 inch water pipe. Two wrought iron flues enter the chimney, one 5 feet by 6 feet, the other 5 feet by 11 feet. The chimney is constructed to provide for 15 sets of boilers only 12 now being in use. Each set has 103¼ square feet of grate surface, and is rated at 300 horse power. The weight of the chimney is 3,392 tons, 1,101,000 bricks were used, 6,875 cubic feet of stone masonry. The cap weighs 18,600 pounds. The cost of the chimney was $18,500.

A description was then given by Charles E. Emery of the chimney of the New York Steam Heating Company, it being necessary to place within a very limited area, a very large boiler capacity, viz., 16,000 horse power. This was done by making four stories of boilers; the chimney was therefore necessarily located with reference to these boilers, and the plan of the chimney was determined by the shape of the lot.

The foundation is one foot below high water. The chimney is 27 feet 10 inches in the clear inside, and 8 feet 4 inches wide. The height is 220 feet above high water; 221 feet above the foundation; 217 feet above the basement floor; 201 feet above the grates of the lower tier of boilers, and 141 feet above the grates of the upper tier of boilers. The thickness of the walls on the interior of the building runs from 5 feet to 20 inches, and on the other side from 3 feet to 20 inches. The gases for each chimney are taken from 32 boilers of 250 horse power each. About 1,000 tons of coal will be burned daily.

Mr. F. L. Griswold described a chimney about 160 feet high erected in Mexico for a cotton factory which had been in use for over twelve years, which was built of apparently sun-dried bricks and which seemed to be now in excellent condition. This chimney was built by Indians and seemed to be very symmetrical and well made.

Mr. H. W. Brinckerhoff. described a chimney constructed of old rails, which was in successful use in Pennyslvania. It was generally known as a crinoline chimney.

Mr. Wm. E. Worthern referred to several chimneys built by him, and expressed a doubt as to the necessity of very great height in chimneys.

Mr. J. M. Knap, described chimneys constructed in Pittsburgh, and which though of very moderate height had given excellent results.

MODELS FOR INVENTORS.

Many queer-looking machines dotted a big oblong room on the third floor of an iron building in Elm street, and a lot of workmen were busy at curious-looking machines. A thoughtful looking man walked around and gave occasional directions. Now and then men came in and spoke to the workmen. They examined some particular bit of mechanism, gave the workmen a multitude of instructions, and then went away.

"They are inventors," said the thoughtful looking man. "We make models for them, and queer models enough, at times."

"Are there enough inventors to keep so large an establishment as this going?"

"Yes, indeed, and half a dozen others. You have no idea how many inventors there are in this city alone. We have customers, too, who come from all over the country. That gray-haired man who just went out came from the northern part of the State. He thinks he has invented something that will make millions for him, and says that it won't be long before it is completed. The chances are, however, that he will never complete it. He hasn't told us what it is for, but he has given the workmen some drawings. If he did tell us what he wanted we could help him."

"Why don't he tell you?"

"He is afraid that we will tell somebody. All inventors are more or less suspicious, and it is this very suspicion that makes failures of many good ideas. They ought to know that we would keep faith with them.

"You see, most inventors are not practical men. Our workmen are. If they would just say what they wanted done and gave a rude sketch, the workman would make them a practical model. As it is three out of four of the models made after the inventor's own completed drawings are useless. The models have to be made over and over again as the inventor sees the points where they are impracticable. As a last resort they tell the workman what they are for, and he quickly makes it for them. Their suspicion has cost them by this time several hundred dollars."

"How do they pay for the models?"

"We charge $5 a day for the workman's time and extra for the material used. Sometimes we lump a job, but not unless we know exactly what we have to do."

"Do the inventors ever stand over the workmen and direct them?"

"I should say so. Some of them are so fearful that some one will see what they are at, that they follow the workman all around the shop as he goes from machine to machine. At night they put the incomplete apparatus in a box and carry it home with them, and bring it back next morning. They never let it out of their sight here, and I should not be surprised if they took it to bed with them."

"Are your customers rich or poor men?"

"The most are poor, or in moderate circumstances. Occasionally some rich man gets an idea that he has a valuable invention, and spends $1,000 or so in proving that it is not. As a rule, inventors are reckless with their money, and are willing to make any sacrifice to get their inventions completed."

"Are they good pay?"

"Some are and some are not. If we think a job is going to cost $200 we ask for $100 in advance, and when that amount of labor and material has been used up, we ask for the other $100. We have to do so to protect ourselves.

"We meet lots of curious people. Some really act as though they were insane. An old man comes here who has spent the greater part of his life and a large fortune trying to perfect a type-writing machine. He still thinks that he has a wonderful invention. Not long ago a lady came in and said that servant girls ran great risks in washing windows.

"'Sir,' she said, 'do you not perceive what an appalling loss of life might result from this dangerous practice of washing windows. The servant girls sit on the window sill without anything to catch hold of, sometimes as high as thirty or forty feet above the street.'

"I expressed great concern for the servant girls, and the lady said she had invented a patent adjustable iron window cleaning chair for the protection of servant girls.

"A man had a model made for an apparatus to supersede stilts. It consisted of two skeleton artificial legs to strap to the boy's legs."

"Have you ever made models for inventions that have been great successes?"

"On several occasions, but the fortunes were not reaped by the inventors."—*N. Y. Sun.*

GRATUITOUS ADVICE from the *Scientific American:*

"S. McI. writes: I have a Corliss engine, 3 ft. stroke; how near to the end of stroke should piston be before exhausting? A. The best point can only be determined by applying the indicator; the proper point depends largely upon the size of ports, clearance, and speed of engine; in your case we should judge about 1¼ or 1½ inches. The larger the ports the nearer the point of exhaust can approach the end of the stroke."

This contains some new discoveries in engineering. Suppose our contemporary takes time into consideration, and observes how much there is left for the exhaust to open and shut before the live steam valve opens, while the piston makes 1½″ motion!

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THE MECHANICAL ENGINEER.

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New York, May 3, 1884.

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BOILERS FOR COMPOUND ENGINES.

The extraordinary steam pressures carried at sea in boilers is one of the triumphs of modern engineering, and it is fitting that the trade in general should be familiar with the magazines in which such pressures are generated.

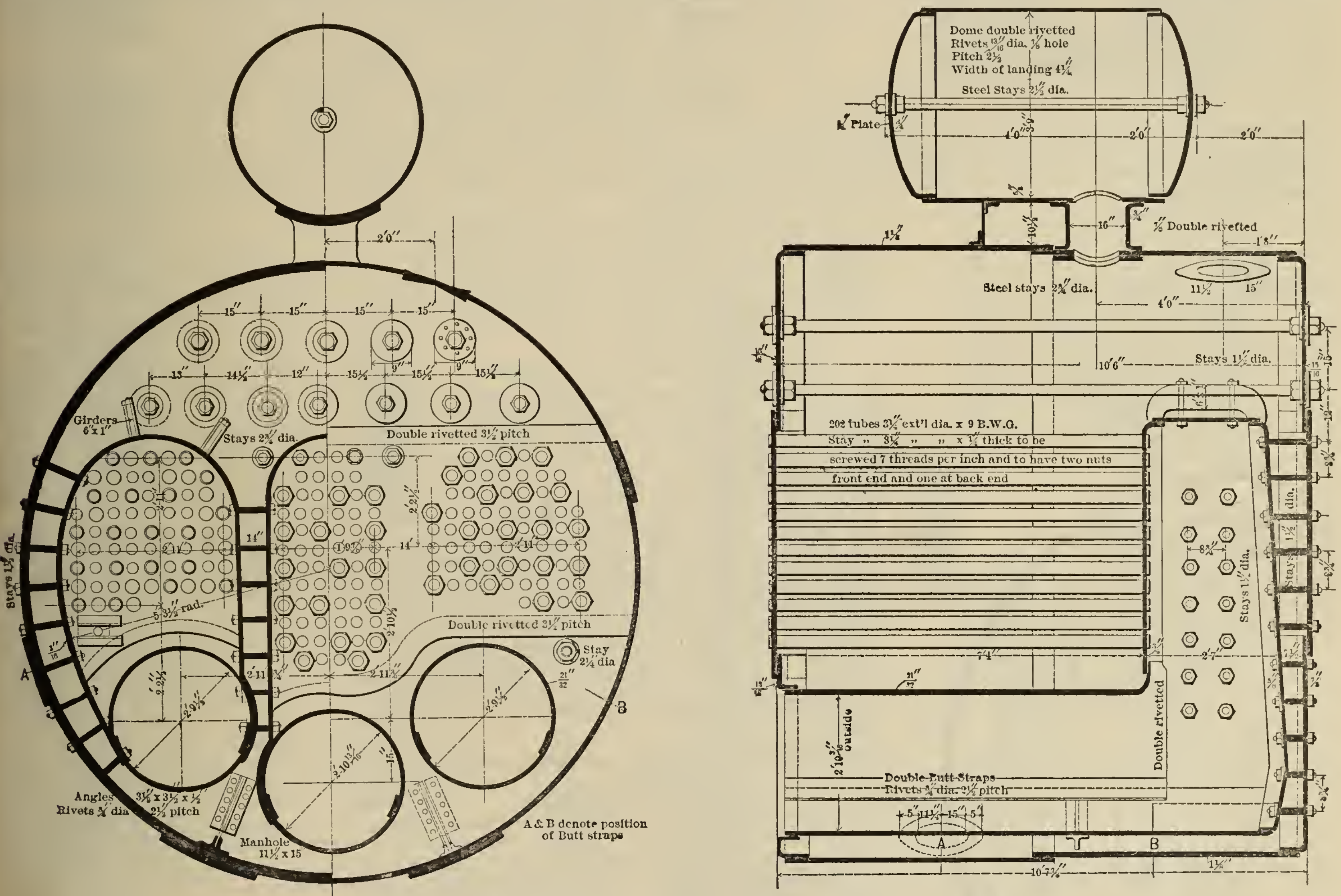
The modern "compound boiler," to use an expression which applies to the situation, but is in itself incorrect, is, we repeat, a great mechanical achievement and we reproduce here one of the latest English marine boilers, made to carry the enormous working pressure of 150 pounds to the square inch. This expression of latent power has become so common that but few realize what it means, or the skillful combinations, experience and good workmanship which it entails; as an example in this direction this boiler is worthy of careful study. One hundred and fifty pounds per square inch is higher pressure than is carried in the average locomotive boiler, whose structure is comparatively straightaway and simple, and whose shell is only some 48″, against this boiler which has heating surfaces disposed at various angles, and a shell of 144″, and has to resist all the changes of form set up by intense heat within the said shell.

This is not the case with the locomotive boiler, the furnace of which is, in a measure, independent, and can come and go by expansion and contraction, without drawing on the shell for restraint or reinforcement.

We have taken this illustration from *Engineering*, and all the details necessary to comprehend it can be found on the drawing itself. A few in addition are appended:

"The shell, furnaces, and combustion chambers and stays are all of steel, and the whole of the details, thicknesses of plates, &c., are so clearly shown in the views just referred to that a special description is unnecessary. The boiler has 42 square feet of grate surface, and 1,650 square feet of heating surface, while the flue area through the tubes is 9·1 square feet, the chief proportions being thus as follows: Ratio of grate area to total heating surface = 1:39·3; ratio of flue area through tubes to grate area = 1:4·6."

This is not the marine boiler of the future by any means. It is that of the present, and its great weight, expense of construction, self-contained furnace, defective circulation and cramped steam room alike demand something simpler and better. In time it will come; as an example of what we have now it is here presented.



AN ENGLISH HIGH PRESSURE MARINE BOILER FOR COMPOUND ENGINES.

THE ENGLISH STEAMER *Oregon* crossed the ocean on her last trip to this port in 6 days, 10 hours, 30 minutes, which is the fastest ever made between land and land. The distance is, by the course taken, 2,861 miles. Appended are the fastest records, in actual time, made by the steamships of the different lines running between Queenstown and the United States:—

Guion line—Oregon, 6d. 10h. 30m.; Alaska, 6h. 21h. 40m.; Arizona, 7d. 8h. 34m.

Cunard line—Servia, 7d. 55m.

Anchor line, all its vessels—Average time, 7d. 4h.

White Star line—Britannic, 7d. 7h. 11m.

Inman line—City of Berlin, 8d.

National line—Spain, 8d. 22d.

A PASSING COMMENT.

In noting our article on English draughtsmen in this country *The Mechanical World* says:

> We would certainly not advise an expert draughtsman to try America He would be disappointed, unless he was so fortunate as to meet with an exceptional opportunity. In the first place, the freedom of social intercourse, of which he has perhaps heard much, would melt away, and we say emphatically that nowhere would he be appreciated as an educated engineer to the same extent as in England."

To which we add that how much he would be appreciated would depend entirely on the man himself. If an English draughtsman, new to the country and its ways, was so devoid of tact and good sense as to be constantly informing his American employers how work was done in the old country, it is quite possible that the "freedom of social intercourse" would melt away speedily.

WELDING COPPER.

The New York *Times* says:

> "Mr. Drummer J. Adams, a mechanic of Kittery, Me., claims to have discovered a process by which he welds copper as perfectly and securely as iron."

Welding copper is not a difficult achievement. We welded it eighteen years ago, and so can any one who will follow these directions:

Get a can of concentrated lye—Pennsylvania Salt Company—and put the contents in an iron kettle over the fire. Melt the lye (without water) and when it boils up take it off. Scarf the copper to be welded as you would an iron rod; take a good heat on it and use the lye as a flux, dipping the scarfed ends in it just before bringing to a welding heat. We have welded copper rods ⅝ths-inch diameter with this so that no one could tell where the junction was.

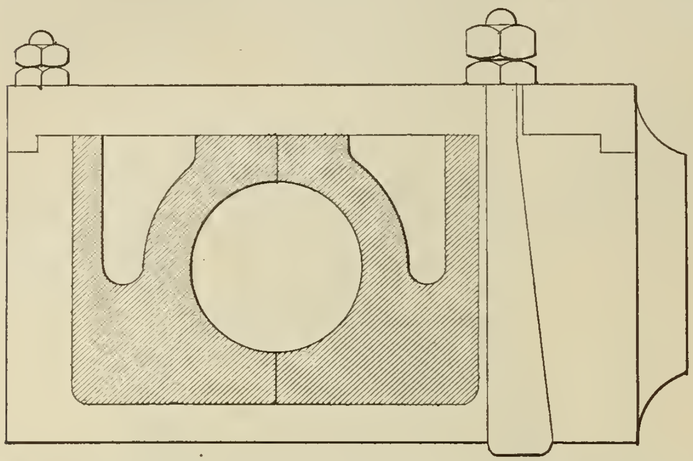
NOTE ON "DIRT" BURNING.

If our observation is correct the dirt burning engines, so called, on the Philadelphia and Reading R. R. do not burn dirt. The nearest approach to it is pea coal. This, also, is only on the draught engines, while the passenger locomotives burn stove and egg coal. Nothing is said about this latter in the reports.

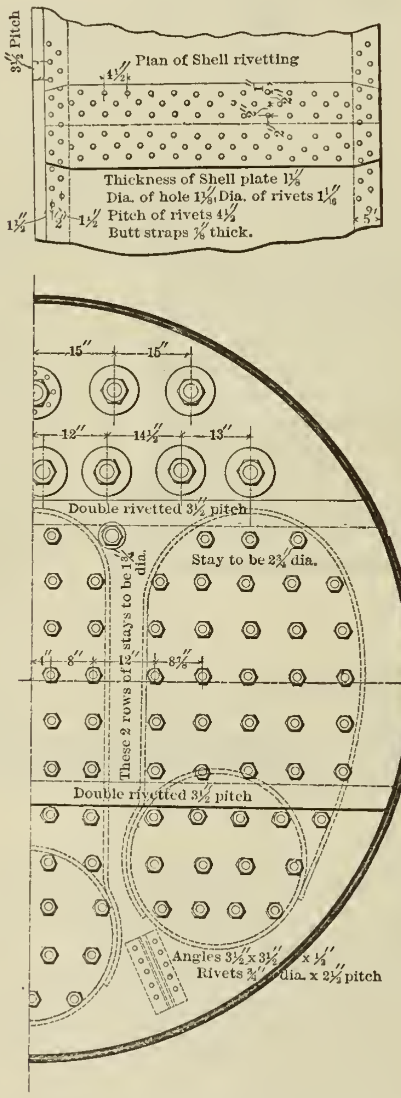
ONE OF THE NOTICEABLE THINGS seen in a recent visit by a representative of the *Railway Age* to the works of the Hartford Hammer Company, at Hartford, Conn., was a large lot of hammers which were being packed for shipment to Sheffield, Eng., where they sell at about double the rates of those of English manufacture. English workmen are willing to pay good prices for hammers forged from bars of crucible steel, and which will stand the hardest usage.

BUTLER'S DEVICE FOR OILING CRANK-PINS.

Mr. W. H. Butler, of Rhinebeck, N. Y., well known as an engineer of many years experience, sends us the sketch herewith published, representing his method of constructing boxes on the crank-pin end of the connecting rod. This is used on high speed saw mill engines, which run at 500 and 600 revolutions per minute.



Mr. Butler states that it has always given entire satisfaction. The construction explains itself to all engineers so well that it seems unnecessary to particularize.


3½″ Pitch
Plan of Shell rivetting
4½″
Thickness of Shell plate 1⅛
Dia. of hole 1⅛″, Dia. of rivets 1 1/16″
Pitch of rivets 4½″
Butt straps ⅞″ thick.
1½″
2
1½″
9′
5
15″
15″
12″
14⅛″
13″
Double rivetted 3½″ pitch
Stay to be 2¾ dia.
These 2 rows of stays to be 1¾ dia.
4″
8″
12″
8⅞″
Double rivetted 3½″ pitch
Angles 3½″ x 3½″ x ½″
Rivets ¾″ dia. x 2½″ pitch

AN ENGLISH HIGH PRESSURE MARINE FOR COMPOUND ENGINES.

A CYLINDER MACHINE is thus described by the Railroad *Gazette:* Each cylinder is bored and faced in eight hours on one of Sellers' machines for that purpose, both ends of the cylinder being faced at once. The valve-faces and ports are then planed on a special shaping machine, also of Sellers' make. The cylinder is centered by conical chucks between two vertical face-plates secured to a horizontal circular table. A shaping-machine arm, with a very long bearing in proportion to its stroke, works at a suitable distance above the table, so as conveniently to reach and plane the valve faces. The table is accurately quartered, and when the valve-seat has been planed longitudinally the table is turned a quarter round and the cross planing proceeded with. The machine completes its work on a cylinder in about nine hours, the rest of the planing being done on a large planing-machine of the ordinary type, two cylinders being secured on the bed by special chucks and angle plates.

THE "WEEKLY" AGAIN.

THE MECHANICAL ENGINEER as a weekly is still mooted by some correspondents, but, on the other hand, there is a large class in favor of it as it is.

The opinion of a man of large experience and thorough education, in this city, connected with one of the heaviest manufacturing concerns, is worth quoting: "Keep it as it is," said he, on this question; "there are too many valuable articles in every issue of THE MECHANICAL ENGINEER to be lightly slurred over, and it takes me all the time between issues to master them. I can read other technical papers—all I want of them—in an hour, but it is not so with THE MECHANICAL ENGINEER. A man who can read it at a sitting does not want it. I hope it won't be made a weekly."

We quote this gentleman, who is not a myth, or a creation for the sake of a paragraph and think he has sensible views upon the subject. Making a weekly paper of THE MECHANICAL ENGINEER would involve an entire change in its tone, a thing we should be loth to do.

WIRE SHAFTS FOR STEAM VESSELS.

Mr. Samuel B. Jerome, of this city, proposes what may be called a composite shaft of steel wires for steam vessels, in order to obviate frequent breakages. The invention is patented and is described as a central core, or body, of steel wires sufficient in number to obtain the desired size, and firmly bound together by exterior coils wound spirally in opposite directions, in much the same manner as suspension-bridge cables. At intervals the body of the shaft has collars, or sleeves, shrunk on for bearings, and the same plan is proposed for the crank-bearing or seat. The collars, or sleeves, on the body of the shaft are serrated on the ends, and interlock, so that the torsional strain is transmitted equally throughout the whole length.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.

BY JOSEPH P. MULLIN.

THE SCREW-PROPELLER—HOW TO MAKE IT.

In order to lay out a screw-propeller we must first ascertain the following dimensions: The kind of screw required. The extreme diameter. The number of blades. The thickness of the same. The width of the blade measured along a tangent at the extreme diameter, and the size and form of the hub.

In this article I will illustrate a good method of drawing, pattern-making and moulding, a true screw. In other words—a screw in which every equal portion of a revolution of the generatrix corresponds to an equal advance along the axis. This method (with slight variations) may be adopted for the construction of the different kinds of screw-propellers in general use.

DRAWING.

A method of laying out a screw-propeller is shown at Figs. 1, 2 and 3. Fig. 1 is an end view, and Fig. 2 is a side view; Fig. 3 shows the mode of determining the development of the thread or angle of the blade. The angle of the blade is as the pitch of the screw to the circumference of the same.

Example:—Circumference of screw 54'. Pitch of same screw 24'. Angle of blade 24' to 54'; which being reduced to a lower term is equal to an angle of 12" to 27", as shown at Fig. 3.

To determine the pitch of the screw developed on a tangent plane, draw a vertical line through the points, *A B*, Fig. 3, and set off on it (to a convenient scale) the length of the circumference of a circle, the radius of which is equal to half the diameter of the screw-propeller required. At this point draw the line, *B* 9, equal to the pitch of the screw. If we now draw a line through the points, *A* 9, it will represent the development of the thread, or angle of the blade on a tangent plane.

We now take *C*, Fig. 1, as a center, and describe the circle representing the end view of the propeller required. On this circle lay off the points, *D E*, which we will assume represent an end view of the blade before the corners have been rounded off. Between the points, *D E*, lay off the aliquot parts 0, 2, 4, 5, 6, 7, 9, and if necessary 1, 3, 8, and draw radii from these points.

Now take 6 for a center in the side view, Fig. 2, and lay off on each side of it the aliquot parts 7, 8, 9—5, 4, 3, 2, 1, 0 points to the pitch corresponding to the same parts of the circle in Fig. 1. If from the points of the circle 0, 1, 2, 3, 4, 5. 6, 7, 8, 9, in the end view, we draw the dotted lines joining the corresponding points in Fig. 2, the points so joined will of course represent the generating points, or outline of the blade in the side view.

Now, if the lines drawn from the points 0, 1, 2, 9, etc., in the end view and joining the corresponding numbers in Fig. 2 give the various points for the outline of the blade in the side view, it of course follows that by nearly the same method of procedure we can develop a sectional, or end view of any given point of the blade, as *F*, *G*, *H*, *J* or *K*.

PATTERN-MAKING.

When a screw-propeller is to be cast in loam, as in the present case, it is sometimes well to make a complete pattern of the hub, but for large sizes it is generally built up in loam, and when such is the case it will be necessary to make a sweep-board, or templet, to guide the moulder in his operations. Such a templet is too simple to require any description or illustration. When a complete pattern of the hub is made, it must have a hole through the center just large enough to be an easy fit on the spindle which the moulder uses when working on the job in the foundry.

The principal work of the pattern-maker, however, consists in making the sweep-boards and curved guide-boards which are necessary to the moulders in producing the correct form of the blade.

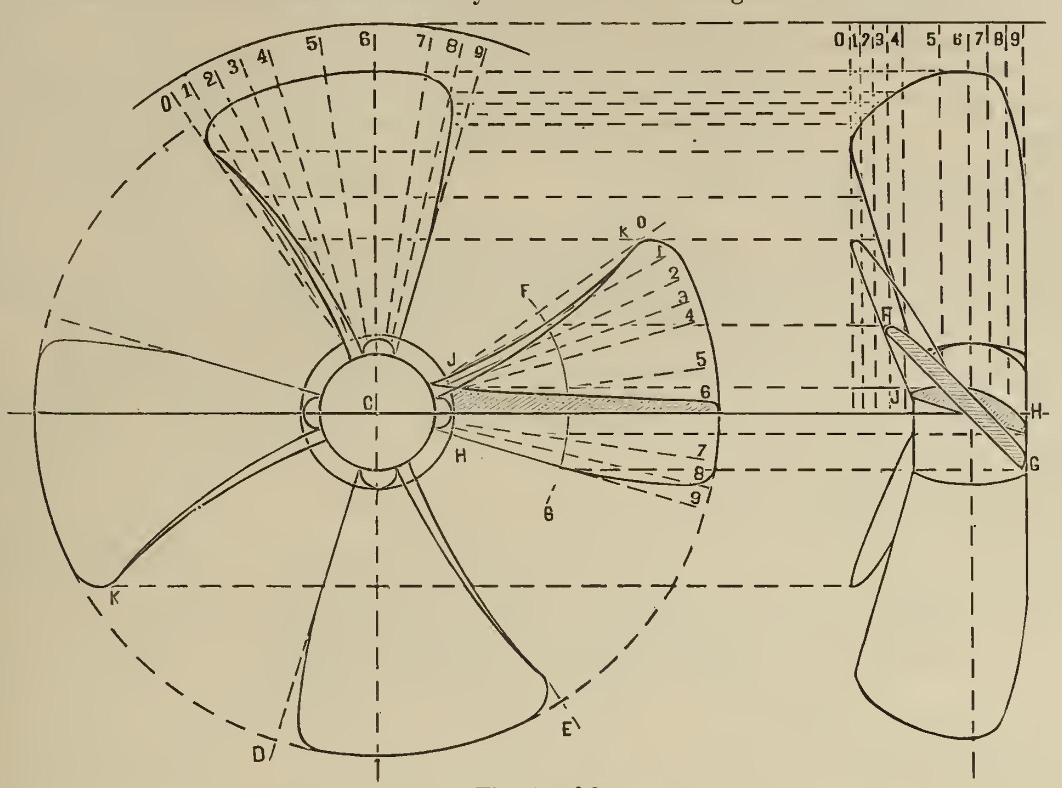
Since the acting surface of the blade is made up of straight line elements, or as stated in the commencement of this article, "every equal portion of a revolution of the generatrix corresponds to an equal advance along the axis," it is evident that the same surface can be produced in loam by moving a straight edged sweep-board along a guide-board having an acting surface which corresponds to the extreme helix of the blade. Such a straight edged sweep-board is shown at *L*, Fig. 7, and needs no further explanation; Fig. 5 represents the curved sweep-board for forming the back of the blade.

The curved guide-board for the outer helix of the blade is shown at Fig. 6. The method of projecting the curved, or working surface of this board, is shown at Fig. 4, and is as follows:

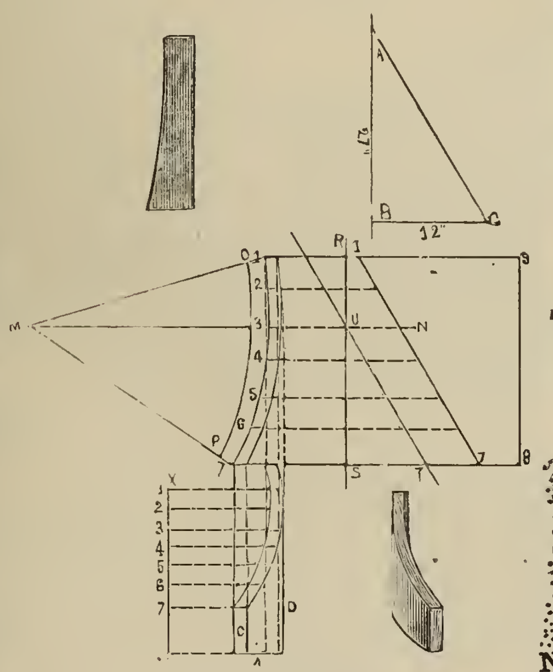
Draw the horizontal line *M N*. Let *M* represent the center of the hub, or the element *C*, Fig. 1, and with a radius equal to half the extreme diameter of the propeller, describe the arc, *O P*. This will represent the element, *D E*, Fig. 1, or, in other words, the actual limit of the blade. As the moulder will have to build a good margin of brick-work outside of the blade, we must take a radius of about 8" or 10" additional length, and draw the arc 1, 7. This will represent the inside corner of the acting surface of the guide-curve. We can now add the desired thickness of the guide-curve to the radius, and strike the arc representing the outside corner of the same. Set off on the arc representing the inside corner of the curve a number of aliquot parts, as 1, 2, 3, 4, 5, 6, 7. Let *M*, 3, 1, 7, represent the elements. *C*, 6, 0, 9, Fig. 1. Now draw the vertical line, *R S*, and at *S* draw the horizontal line, *S T*, equal to the pitch (or the corresponding part of it), and from *T* draw the line cutting through the point, *U;* this represents the developed helix. If we now draw the line 1, 7, parallel to *T U*, and the horizontal lines 7, 8 and 1, 9 join 8 and 9, as shown in the figure, we produce a complete side view of the guide-curve.

The point to which we now direct our attention is to project the end view. For this purpose we draw the vertical line, *X Y*, equal to 1, 9, and from *Y*, at a distance equal to 7, 8, make the point 7, and on the remainder set off a number of aliquot parts corresponding in number to 1, 2, 3, 4, 5, 6, 7. From the points draw the dotted horizontal lines, and from the corresponding points of the arc, 1, 7, drop perpendiculars. Through the various points of intersection, draw the curved lines representing the top edge of the guide-curve.

If we now draw the horizontal line, *a*, and the vertical lines, *b c d*, we have a complete drawing of the guide-curve required.



Figs. 1 and 2.



Figs. 3, 4, 5 and 6.

It only remains for us to build up—either with staves or segments—a block of wood large enough for the purpose. Work it out to the proper shape, and we are ready for

MOULDING.

The method of moulding is shown at Figs. 7, 8 and 9, and is as follows:

In starting the moulder first sets the step and spindle, *N T*, Fig. 7, and then adjusts the spindle-arm, *O*, to which he then bolts a straight strickle-board, and with this sweeps off a good level bed for the mould. He then removes the straight strickle-board from the arm, *O*, and in its place adjusts the one marked *L* and shown in the figure.

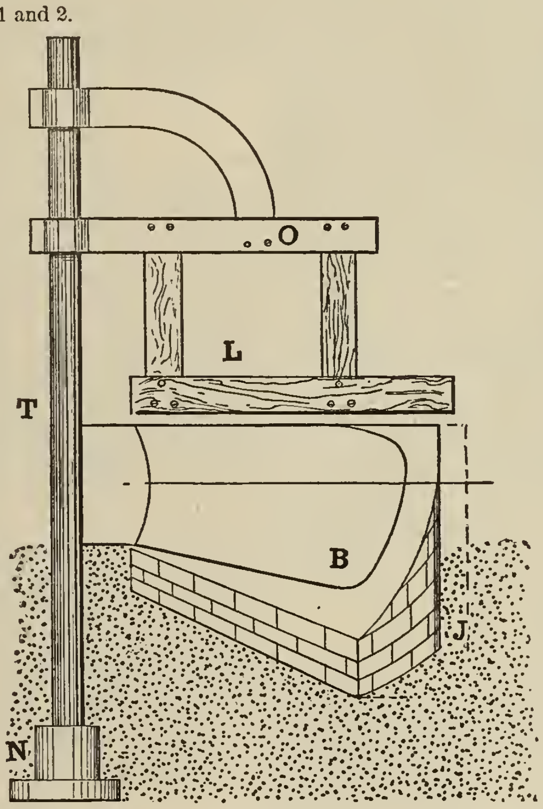


Fig. 7.

The curved sweep-board for the back of the blade, shown at Fig. 5, is then screwed to *L*, letting it project below the bottom edge, just the thickness of the required metal in the blade.

We will now take the curved guide-board, shown at Fig. 6, and set it in the position indicated by the dotted lines, and proceed to mould up the back of the blade by building up the form of brick. This should be well bound together with iron rods, bolts, cement and sand, as shown at *J*, Fig. 7.

We can now spread the loam over this rough form of brick and work it to the required shape by rotating the curved sweep-board (which has been adjusted for this purpose) around the spindle, *T*. We now take off the curved sweep-board, and swing the arm, *O*, and sweep-board, L, around out of the way. Round off the corners, as shown at B, and, in fact, finish the mould by hand, and then let it dry.

After drying, the form of the blade is filled up with sand and then swept off true with the straight sweep-board, *L*, thus producing the acting surface of the blade.

We are now ready to remove the curved guide-board, make parting, and then cover the whole surface with loam, and upon this loam build the cope, as shown at *H*, Fig. 8. While building the cope great care should be taken to have it well vented, and a riser or flow-off set, as shown at *R*, Fig. 9.

We may now lift the cope off, and remove the sand from the form of the blade.

The blades are thus moulded separately, and when each section has been thoroughly dried and finished we are ready to close the mould, set the hub core, *E*, Fig. 8, make the joints tight and secure, and be tolerably sure of turning out a good casting.

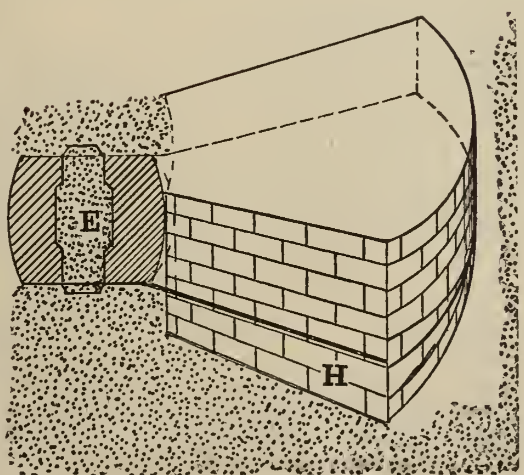


Fig. 8.

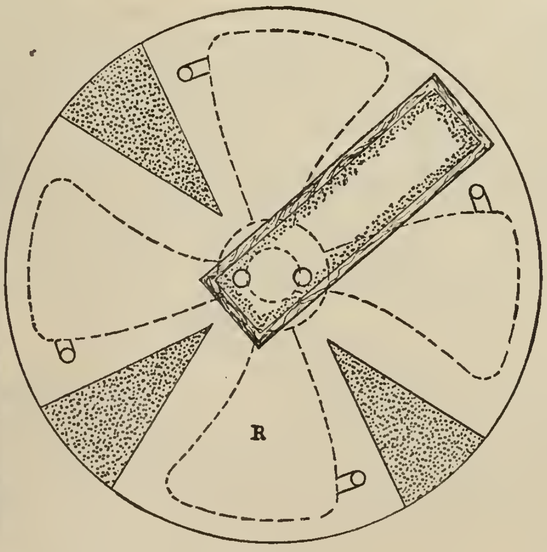


Fig. 9.

A NEW INDUSTRY, that of making white elephants, has been introduced. According to the New York *Sun*, a number of persons examined a bleached elephant at the Madison Square Garden recently. The elephant looked as if it was whitewashed, and not a black spot could be seen on it. The hair had turned red. The bleaching liquid had removed the accumulation of dirt which gathers on the skins of elephants, and left the skin comparatively soft and pliable. Mr. De Spottes, the chemist in charge, rinsed his mouth with the bleaching liquid, and bleached one of his fingers to show that the liquid was harmless. The dwarf elephant, Tom Thumb, was used as a blackboard, and a large white spot was made on his back with the liquid.

The bleached elephant, Tip, is much whiter than the sacred elephant, but he has no flesh-colored spots.

THE *London Engineer* says:

"In the construction of agricultural implements in the United States, they are gradually acquiring knowledge by the slow process of finding out by experiment for themselves what they might get from many an ancient book or catalogue in a few minutes. But that is not their way. One man has just patented a bad form of the old and well-known Norwegian harrow. What a lot of things some of this class could invent immediately after they returned to the States if they visited one of the Royal Agricultural Society's shows?"

This seems a trifle uncomplimentary to the R. A. Society's show; does our contemporary wish us to understand that it is an asylum for decrepit ideas.

SO FAR AS HEARD from the hottest place on the habitable globe is Bourke, in Australia. According to a correspondent of the New York *Times* the temperature in January, 1884 varied from 108 degrees to 122 degrees, the average being 110. This was taken from government registration.

Letters to the Editor.

Correspondents are welcome to express their views in this department in their own way. No changes will be made in the tenor of their favors, and none except those necessary to render them clear to all readers.

It is specially requested that all figures be made very plain and all proper names clearly written.

ONE OF THE OTHER KIND.

Editors Mechanical Engineer:

I sometimes see in your paper notices of how well people like your paper, and I wonder, as well, whether you don't sometimes get letters of another kind, that is that they don't like it very well, because it seems curious to me that you should not get such letters. I see a good many things in your paper I do not like. I take it every issue and will tell you some of them. I do not like so much about boilers. There is very little to be learned about boilers, for engineers. I never see anything about tools and machines, such as I read in other papers, and as for the writings of Mr. Moulton, called "*The Professor in the Machine Shop*," it seems to me to be the worst kind of silliness. If any young man can learn anything from them he can do more than I can, for I can't. Why don't you give some practical directions how to run engines, so that engineers can learn something about their business, and not a lot of things that nobody cares anything about. I don't care much about England and what English engineers are doing; this country is good enough for me.

I don't suppose you will print this letter; editors never do. I have written to other papers in the same way but they never printed them, but I thought I would let you know the other side of this question besides flattering letters. ———

New York.

[Well, now, here is a young man who seems to have an offset in him somewhere; not because he does not like our paper but simply for the reason that, not liking it, he keeps on taking it. He cannot learn anything from it, but he buys it every issue. He should not waste his time and money in that way. But, to answer him specifically, we will say that we print the opinions of our friends who take the trouble to write to us simply for the reason that they are a part of their communications; perhaps not always relative to the body of the letter, but still a part. To us, and a good many others, this expression of good will is a very pleasant part, for it indicates that those who support us are satisfied with our efforts to do what we agreed to. Of letters expressing disfavor, or dislike to the tone of the paper but two have been received since it was first published.

We are sorry to be obliged to prove our correspondent in error, but he will see, by ocular evidence, that we have printed his letter without erasure, except the name. Perhaps if we received more of the same character we should change the tone of our paper, for the editors do not publish for their own taste, but to suit what they conceive to be that of their readers. Of course, if they misinterpret this their occupation is gone; they have no excuse for being. Will our correspondent permit us to say that he is wrong in judging one paper by another, that because others suppress—if they do—letters criticising their work adversely, it is no reason why we should. We have nothing to fear from criticism but, on the contrary, can always learn by it. —Eds.]

STEAM ON TOP OF GLOBE VALVES.

Editors Mechanical Engineer:

In your paper for March [illegible]th I noticed a communication in regard to the proper manner to connect globe-valves to steam-pipes whether steam should be on top or on the bottom. You advised placing the valve so that pressure would come on top instead of the bottom, as is the usual custom here. I wish to give an illustration that recently came under my observation, which reminded me of what I had read in your paper concerning the subject.

A factory in a suburban town had its engine recently overhauled, and everything went well until a week ago, when they sent to the shop for the "best man." The engine did not seem to get steam enough, as the exhaust plainly showed. The machinist examined the valves and found them all right. He next disconnected the stop-valve on the steam pipe near the boiler, and found the valve connected up with the pressure on top. Upon close inspection it was found that the thread on the stem was worn so that it slipped through the nut, almost closing the aperture.

Now, this little circumstance caused no end of detention and annoyance, and I will add expense. I think it goes to prove that this is one reason why a globe-valve should be connected with steam on top.

East Boston, Mass. J. T. A.

[We are always glad to receive letters like the above, giving the other side of any question or position taken by us, and we suppose our correspondent will not object to our asking a question or two. Suppose this same valve had been connected up with steam on the bottom; suppose, further, that the main belt had run off, or the lacings had whipped out. Suppose again, that some poor fellow had suddenly been carried round the shafting, how could the engine have been stopped? It could not have been, and any system which precludes the possibility of this, at all times, is in our opinion a bad one. If the stop-valve had been examined and repaired when the engine was overhauled, the trouble mentioned would not have occurred, and it seems to us that it is a good argument for thorough inspection of all details when repairs are made.—Eds.]

CONCERNING SCREW-CUTTING GEAR.

Editors Mechanical Engineer:

I have been studying the article in your paper "*Concerning screw cutting gear*," and am stuck on the third proposition, the first and second being self-evident. The worst of it is that I can't make the third one work, as I understand it from the description. I know something about screw-cutting and am anxious to learn it all if possible. Will "*Grumbler*" please go more into detail, and if not too much trouble give the reasons for its correctness if it is really correct? Screw-cutting is important, and perhaps other readers would like to know more about it.

Boston, Mass. Machinist.

REPLY TO THE ABOVE.

Thanks to "Machinist" for nailing the blunder so promptly. Instead of running "the *lathe* backward to the place of starting in," &c., it is necessary to run the *carriage* back by hand (the lathe, meanwhile, standing still), and find the place nearest the starting point at which the nut and tool will fall into their proper relations. At the place thus found, arrange the mark or stop. This place may be found by measurement or by trial. The same principle is involved in this as in the second case mentioned on p. 81, your issue of April 5th.

The distance moved back by hand must always be a common multiple of the pitch to be cut, and the pitch of the lead-screw.

If a pitch of $\frac{5}{8}''$ is to be cut with a 3 per in. lead-screw, the distance moved back must be 5″ or a multiple of 5″, because 5 is the least common multiple of $\frac{5}{8}$ and $\frac{1}{3}$. The closing places on the same lead-screw in cutting a pitch of $1\frac{1}{8}''$ would occur at intervals of 9″, because 9 is the least common multiple of $1\frac{1}{8}$ and $\frac{1}{3}$. Of course it is necessary to close the nut at the place nearest the starting point, and then run the lathe back, or forward, enough to bring the tool to the position required.

Such awkward combinations as those above will very seldom occur. In any case, the length of the work, the arrangement of lathe and counter, and numerous other circumstances, must decide what particular method of running back will be most economical.

Philadelphia, Pa. Grumbler.

A WORD OF WARNING.

Editors Mechanical Engineer:

I have been in nearly all the principal countries on this planet, and, so far as my observation goes, the two most deadly enemies of the race are ignorance and extreme poverty. We have here the slave labor of the Chinese competing with honest free-labor, and existing under conditions that the Society for the Prevention of Cruelty to Animals would not permit in their province. The result is that our prisons are crowded and our children are retrograding, for the reason that but a small portion of them can get an opportunity to earn their bread against the competition of the Chinese. For the sake of temporary gain and an apparent profit, there are too many who are willing to employ them, but the social results I have mentioned will be apparent long after the tariff destroyers and patent stealers have ceased to exist.

I visited Great Britain a few years ago and spent a year among the mechanics in engineering establishments there, and, after seeing the advantages of this country, it was apparent to me that their case was hopeless; there was nothing for them but toil to the end, or the poor-house as an alternative. This is precisely the station American workmen will arrive at if they allow the patent-laws to be trampled upon, or the tariff-laws to be tinkered to suit the notions of those who never earned a dollar in their lives by hard work. Let American workmen be warned in time and look to their own interests or they and theirs will suffer for it.

San Francisco, Cal. John Mailer.

FROM A BUSY MAN.

Editors Mechanical Engineer:

I have been down in Arkansas all winter running a locomotive on a logging railroad, and at the same time keeping the saw-mill engine in repair, which will explain why I did not renew my subscription before; the object of this letter is to say that when I used to read in The Mechanical Engineer that some of the correspondents had no time to read a semi-monthly paper, much less a weekly, I used to think there was something wrong somewhere, but I found while I was in Arkansas that I did not have time to read even a monthly paper. When a man has all he can do from the time he gets up in the morning until eight or nine at night I am willing to concede that he don't want to read much.

Ryerson, Mich. S. R. K.

MR. SLOCUM CRITICISED.

Editors Mechanical Engineer:

I am greatly interested in Geo. Slocum's writings in your paper, and have got every one from the beginning. I am glad that he thinks there are still some boys in the world who wish to learn the trade. At the same time I want him to understand that I can lay out five holes in a flange while he is looking up his angles and sines in the table, and get them partly drilled, if the machine is not too far off. Mr. Editor, I hope you won't think I am condemning anything Mr. Slocum writes because I have said this, but I take the liberty to do so, feeling that it will not be out of the way.

New York. J. McC.

GRATUITOUS CIRCULATIONS.

Respecting papers that have no subscribers, but are simply published to catch advertisers, the *London Printer and Stationer* says:

"There is a fallacy in this. What is a journal? It is a publication having regular and intermittent readers who are subscribers or occasional purchasers. The editor addresses these people. They form his constituency. He or his paper holds its own by the suffrages of the readers. If they were not interested in it, they would not buy it.

It may be said: But there are many papers supported by their advertisers. Exactly so; but why do people advertise in them? Simply because they have readers. So it all comes to the same thing.

A paper that is simply "given away"—thrown at people—pitched down by the postman on the desks of how many people—is not a journal at all. Unless there is a body of people who voluntarily read, and an editor responsible for providing them with reading matter, there are none of the elements of journalism.

Political parties have sometimes tried to further a cause by starting a "paper" to be given away. The expedient has always been a failure. It has been invariably found that people are not influenced by what is thus presented to them.

If none accept a particular journal as to some extent their "guide" or their "philosopher," or their "friend," then the journal has no existence—it is virtually defunct. This is a fact that should never be lost sight of. It is not the number of papers printed, it is the number read; the number that find their mark, that are to be taken into account.

OF INTEREST TO BOILER-MAKERS.

The Pratt & Whitney Company of Hartford, Conn., have, after years of experiment, succeeded in making taps for stay-bolt holes in boilers very perfect in pitch, and straight in length, an achievement which is worthy of note. From the nature of the work done it is easy to see that unless such taps are straight and correct in pitch, inch for inch, the holes will not be threaded alike in both sheets. When it is added that these taps can be furnished of any length from 12″ to 54″ and of any desired diameter, form, and pitch of thread, it will be seen that boiler-makers can also boast of using tools of precision.

A foreign correspondent of the *Industrial World* says: "There is no end to the improvements that are made in fuel-economizers. A new method of forced blast for economizing fuel and consuming smoke is called the duplex perfect combustion, fuel economizer, and has been tried on the boilers of the steamer *British Prince* for several voyages, and has proved satisfactory. The invention consists of a double forced blast of heated air, produced by means of a very small jet. The blast is spread with great force under the fire-bars and at the back of the bridge. The patentees are Messrs. Whitehead and Chadwick, Cardiff.

This seems to be essentially the same, in principle at least, as the well known Jarvis Furnace.

So long as men exist there will doubtless be one, occasionally, who will obligingly figure out for us the amount of nutriment contained in certain kinds of food. This is a harmless amusement, and as useless as harmless. What does it matter how much nutriment is contained in this or that edible? Very little, for it is that which one's system is able to assimilate, or take up, which strengthens, not the quantity which passes into or through it. Savors assist deglutition quite as much as more nutritious food. There is no danger that mankind will not get enough nourishment; the trouble is in the opposite direction usually.

To copy in black lines on white ground *The Tech* says that some of the paper is to be coated with a solution consisting of three parts acid chloride of iron and one part of cream of tartar in thirty parts of water. The exposure is made as in the common "blue process," and the print developed with dilute gallic acid, giving dark lines on a white ground.

A NEW WEAPON OF WAR.

Experiments are now going forward, under the auspices of government officers, with a new weapon intended to throw dynamite cartridges, or bombs loaded with dynamite. This weapon uses compressed air as the impelling force, and from late experiments would seem to be fairly successful.

Air at 500 pounds per square inch is used, and with this force a dummy-shot, or cartridge weighing 17 pounds was fired across the Narrows in this harbor, or from Fort Townsend to Fort Hamilton. As reported in the New York *Sun* the details are as follows:

The same gun, at a previous test, sent a 24-pound shot across the Narrows, with 500 pounds air pressure, striking about fifteen yards short of the target, at 20° elevation. Another shot, with the same pressure, at 25° elevation, went five yards to the right of the target. These figures, however, have no significance as to possible accuracy, for the gun has not been fired often enough to give the requisite data for accurate aim. The projectile is new, the propelling force is new, and the gun is new, so that many details are to be learned by experience; but the fact that a 24-pound shot can be sent across the Narrows with compressed air opens a wide field of possibilities, when the use of increased air pressure and improved projectiles is taken into consideration.

The advantages claimed and partly demonstrated are stupendous. The ammunition is much cheaper than powder, and on board ship the steam power to compress air is easily available. For field work the compressed air can be transported in flasks. The gun is not made dirty, and need not be cleaned. There is no smoke to reveal the location of the gun to the enemy, so that masked batteries may be planted with immunity. There is no more noise than is made by one puff of a starting locomotive. The propelling force can be measured accurately and does not vary with the dampness of the weather.

The gun costs only about one-twentieth as much as other guns of its range, and can be built in almost any machine shop. In an emergency the entire coast could be studded with such guns in a few weeks. The propelling force used was only about one-fiftieth of the explosive force of gunpowder. But the gun can be adapted to an air pressure of 2,000 pounds to the square inch. The projectile is a torpedo in the air, much more dangerous than a torpedo in the water, because it can be sent more accurately and more swiftly.

The next dynamite air gun to be tried will be of 6-inch bore, and will throw a dynamite shot weighing 112 pounds. Such a shell, it is calculated, would destroy any ship afloat and dismantle any fort. The experiments thus far have been made with a smooth bore, but later on a rifle bore may be used. Already some attempt has been made to rifle the feather of the projectile so as to secure accuracy of aim. It is not so necessary for the projectile to penetrate the object as with an ordinary shot, because it is the explosion of the dynamite, and not the concussion of the projectile, that does the execution.

"HALF A MINUTE SLOW."

As illustrating a popular weakness, the following paragraph is worthy of comment:

> "A lawyer whose office is in the Leffingwell building, New Haven, stepped up to his telephone one morning, watch in hand. He did not ring or talk into the transmitter, but listened intently for several seconds with the tube at his ear, and his eyes fastened upon the face of his watch. 'Just ten minutes past 11 o'clock,' he remarked, as he returned the watch to his pocket and hung up the tube. 'I am precisely half a minute slow.'"

What would he do with that half minute, or for the want of it? The popular idea is that watches must split the second mark at a given time daily, if they do not the owners feel that, in some mysterious way, they are defrauded. Meanwhile they loaf away solid hours; they dawdle in bed, or they sit around, finding nothing to do. If their watches cheat them out of two minutes in a day they make a hue and cry, but throughout the day they cheat themselves out of fifty times two minutes. This is consistency. As a matter of fact a watch that does not average over a minute a day *variation*, is near enough for all the affairs of life, save railway operations. No man times himself to a minute, and he need not fret if his watch is "precisely half a minute slow."

DISRESPECTFUL BEARING TOWARD MATHEMATICS.

In looking over a recent work by a learned mathematician, and finding a note on a class of transformations which surfaces may undergo in space of more than three dimensions, we cannot help but think how readily the formula might be turned into use to solve questions of a purely ethical complexion, or, indeed, to interpret the most ordinary affairs of life.

The learned professor says: "If the material bodies which surround us were placed in a space of more than three dimensions, their kinetic susceptibilities would be increased in a manner which, at first sight, would seem very extraordinary. Each body would, in fact, be susceptible of n independent motions, and $\frac{n\,(n-l)}{2}$ separate rotations, n being the number of dimensions of the space."

He says his present purpose is not, however, to discuss the general theory of the subject, but to point out a special case of it, as seen in a remarkable transformation to which closed surfaces may be subjected in space of four dimensions. The proposition in question may, he says, be expressed as follows:

"If a fourth dimension were added to space, a closed material surface (or shell) could be turned inside out by simple flexure, without either stretching or tearing. For simplicity, we may suppose the surface to be spherical. Let

$$x, y, z, u,$$

be the general rectangular co-ordinates in the supposed space of four dimensions. An infinite plane space of three dimensions may then be represented by the equation:

$$ax+by+cz+du=A,$$

a, b, etc., being any constants whatever. For simplicity, we may suppose a, b and c all equal to zero, and the axes of x, y and z, therefore, to lie in the space of three dimensions under consideration. A Euclidian or natural space may then be represented by the single equation, $u=A$, A being an arbitrary constant. The four-dimensional space may be divided into an infinity of Euclidian spaces by giving all possible values to A." And so on.

That's as good as a fairy tale! Of course, no one who reads it will doubt that the Euclidian marries A, and they begin house-keeping down among the secluded shades of that charming region watered by the Gowanus canal. The other fellow, as will be seen by the equation, evidently had "kinematic susceptibility," and was sent to the asylum; but the mystery remains, *what became of the old man?*—*Electrical Review.*

THE NEW MOVEMENT AMONG MANUFACTURERS.

(*Communicated.*)

There is a tendency in all industrial channels to a combination of like interests, for the purpose of placing competition under proper control, in the interest of moderate profits and steady trade. This tendency is the legitimate outgrowth of threatened over-production, and is the logical result of the dangers which surround industrial capital. The evidences of this tendency to combination are numerous. For example: The Western Nail Association met, April 9th and 10th, at Pittsburgh, Pa., and completed the organization of a pool of Western nail manufacturers. The country west of the Allegheny Mountains was divided into four districts: 1st, the mills at Pittsburgh and vicinity; 2nd, mills of Wheeling and vicinity; 3rd, the mills along the Ohio Valley; 4th, the mills in Indiana, Wisconsin, and in St. Louis, Mo. A board of control, consisting of two members from each district, with the president of the association, was formed, and empowered to regulate prices and production, and also to appoint as many agents as may be deemed proper. These agents will sell the products of factories, and the manufacturers will not fill any orders, large or small. The pool has been the outgrowth of the too great increase in the number of nail machines. The operations of this new pool will be watched with interest. If artificial combination can hold these interests together in the face of the extraordinary increase in the producing capacity, it will be a remarkable fact.

Another combination attracting attention in manufacturing circles is that of the coke-pool, which has started out under excellent auspices. Prices have been advanced, production has been restricted, and orders are coming along quite freely. Manufacturers see no way but to pay the price, and are making this fact the excuse, or justification, for an advance in prices of product into which coke enters largely as a fuel. The ten thousand coke ovens are virtually under one hand, and the undeveloped region contiguous to the present producing territory is practically under the same control. Freight rates have been reduced, but consumers are worse off. It is said in coke circles that $1.25 will be the prevailing price; some of the more sanguine members of the pool say they will not stop until prices have reached $1.50, but it can be safely relied upon that a good many outsiders will begin building ovens in other fields, and not stop until they seriously interfere with the prospects of the coke pool.

A third combination, possessing some interest to those who are watching the course of industrial affairs, is that of the barbed-wire manufacturers. The opening up of the great West and Southwest by the railway system has created an enormous demand for barbed wire. The industry is comparatively new, and for several years there has been a go-as-you-please race among the manufacturers, an enormous increase in capacity, and a consequent cutting of prices, which led to the present combination. Over thirty of the leading barbed-wire manufacturers of the country, met at Chicago, April 3rd, and agreed to maintain an advance of ten per cent. Another meeting will be held May 1st, when another advance will probably take place, partly on account of the increased cost of wire rods, and wire of all kinds. Seven manufacturers have issued a circular from St. Louis against the combination, promising protection to their own purchasers. The demand for barbed wire is very great, and, but for the conflict upon the question of royalty, no difficulty would be experienced in maintaining the combination.

The meaning of these centralizing influences in manufactures is not difficult to discern. Manufacturing interests are seeking the only protection within their reach. They are arranging to act in conformity to the laws of trade, and the legitimate requirements of the market. Such combinations as these are desirable and advantageous as far as they prevent undue cutting and arrest excessive competition. But they are disadvantageous where they allow, or enable, an advance to be made above what fair competition would fix. Experience has repeatedly demonstrated that combinations which attempt to create artificial values are of short duration. The general course of trade is to steadier values, to an equalization of production; to low, but steady profits, and to a firmer industrial foundation. Failures have been weeding out the weak, and giving the rest a fair chance.

◆

THE LATEST MADNESS is the "ammoniaphone." "Italians," says an exchange, "are remarkable for their good voices, and various theories have been given for this, the latest being that of Dr. ———, who has found that the air and dew of Italy are more largely impregnated with free ammonia, and peroxide of hydrogen than is the case elsewhere; and he has constructed an apparatus, called an "ammoniaphone," containing absorbent material saturated with peroxide of hydrogen and condensed ammonia, which is used as a respirator in order to imitate the Italian atmosphere. On several occasions, as we are informed, the value of the inhaler for improving the range and quality of the voice has been publicly demonstrated by singers."

This exceeds the statement of a friend of ours, who always insists that the mercurial temperament of the Irish is due to the large amount of mercury in the vegetables of that country. Nothing like having a reason handy for use.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors,

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

ARE THIN FIRE-SHEETS USEFUL AND NECESSARY?

It is a curious fact that in the construction of steam boilers the thickness of metal interposed between the fire and water seems to have but slight influence upon the evaporation. Boilers have been made with flues of all practicable degrees of thickness and thinness, to use an awkward expression, but the effect, so far as observable from daily performance, seems to be unnoticeable. It is safe to say that the average quantity of water evaporated in boilers in daily use will not exceed seven pounds per pound of coal, and this is, perhaps. a little too high. In new and clean boilers, specially fired, and carefully watched to get the last drop of water into steam, this amount is exceeded, but such tests as these cannot be considered commercial usage.

In view of these facts it is not improper to inquire whether we have not reached the limit of efficiency with the means at our disposal. Our question is whether we can transfer any more heat through boiler plates to the water against them than we are now doing?

It will be urged by some in refutation, possibly, of what we have said, that though there is no perceptible difference in the evaporation per pound of coal in boilers that have fire-sheets (surfaces) widely varying in thickness, there is a vast difference in the water evaporated per square foot of grate, and square foot of heating surface, in different boilers. This statement which we have put into the mouth of the opposition is correct, but of what value is it? It concerns not the economy of performance, but simply that of construction, or of space; two negative values which give the proprietor and steam-user no dividend. In better disposition of the fire-surfaces. better methods of construction, greater durability of the boiler itself, lie the advantages of one boiler over another, but the fuel expenditure for a given evaporation is almost on a dead level throughout the country.

The measure of economy is the quantity of water evaporated for the fuel expended, and not the quantity evaporated for the size of the boiler.

Unless we have misstated the case there is no value in thin tubes and furnaces, for the compound boiler, so called, with its flues $\frac{5}{8}$ths of an inch thick, evaporates 8 lbs. of water to the pound of coal, which is quite as much as the average return-tube boiler can do with much thinner walls.

We have said nothing about that other aspect of this question, durability of fire-sheets of various thicknesses, for it is one which can be properly judged only by the light of data we have not at command. As much can be said on one side as the other, we fancy. Thick sheets have the unquestionable advantage of holding threads for stay-bolts or screw-braces much better than thin ones, and they are less liable to "quilt" or cushion, as it is sometimes called, between stays when high pressures are used. They come and go less, they are less liable to buckling and strains from springing; they stay where they are put. On the other hand, thick sheets are enormously heavy for a given heating surface, are cumbrous to handle and work, and, possibly, less likely to be sound than thin sheets. That thick sheets will waste away on the fire side any faster than thin sheets is very doubtful. What engineer of any experience is there who has not noted that singular thinning of ordinary furnace sheets just above the grate line? This is sometimes attributed to wet ashes, external corrosions, and the like, but it seems to us that it is much more likely to arise from actual loss of substance, due to work done; that is, waste of iron from standing the continued heat of the fuel, than from any other cause.

Thin sheets also have their advantages, which are so palpable that we need not especially point them out. Not to be prolix, we put the question flatly: Does it make any difference whether the heating surfaces of steam-boilers are thick or thin?

THE PROPER COURSE.

With his usual vigorous action, Mr. A. F. Upton, of the Jarvis Engineering Co., Boston, has addressed the following circular to every United States Senator, on the subject of patent stealing by the Government:

> "DEAR SIR: We wish, most respectfully, to protest against the House bill No 3,617, in regard to reducing the life of a patent from seventeen years to five years. We are doing business under patents issued to Mr. Kingsbury M. Jarvis in the year 1876, and it took us over five years to get them introduced and put on a paying basis; this was only accomplished after sinking a large amount of money and doing the hardest kind of work
>
> "We wish, also, to protest against the Senate bill No. 1,588, as we feel that, if it passes, inventors and owners of patents will have no protection We have spent thousands of dollars in defence of our patents, and, under this law, all our labor and expense will have been thrown away."

If every manufacturer and individual whose interests are imperiled by these scandalous bills would do the same, we fancy there could be but one result, and that the speedy quashing of the proceedings.

It is, in point of fact, very difficult to believe that these bills are introduced in sober earnest, or that any one fit to be in Washington could be found to bring them forward.

UNIFORM BRASS CASTINGS.

Every machinist who has had much to do with brass work knows full well that no metal which he deals with has so much irregularity in its nature. We do not allude to different lots poured from different mixtures, but to castings from the same batch of metal. Perhaps this peculiarity does not exist to the same extent everywhere, but varies in degree with the kind of metal made, and the skill of the founder; it is, however, unquestionably a fault common to brass castings. It is by no means unusual to come across tin, lead, or spelter in isolated pieces—chunks—we were going to say. This want of uniformity has been frequently noticed by mechanics and constructing engineers, and it is a serious fault. The cause of it is an unskilful combination of the various metals forming the alloy. To be homogeneous, these should unite in definite proportions—atomic weights, so to speak—and when this occurs the union is a chemical one; in any other event the mixture is merely mechanical. The tin, lead, antimony, or other metal added to copper is held in suspension (in a greater or less degree) and the castings are not uniform. Copper, it appears, will unite chemically (take up) with tin in certain proportions only, and if the composition so made is too hard it must be rendered softer by a baser metal, lead for example, also in certain proportions. Castings made from scrap-brass are more uniform than those compounded from the original metals for the reason already set forth. Plainly, the crudity or harshness of the union of the components is lessened by previously fusing them.

The only thing that now remains for us to render this information immediately serviceable as regards producing uniform castings in brass is to define, or mention specifically, the weights in which copper combines chemically with tin, lead, antimony and zinc, but this we confess we are unable to do. If the information exists we do not know where to find it, but it is some satisfaction to have been able to point out the cause of want of uniformity in brass castings.

INDEPENDENCE, NOT IMPUDENCE.

A member of a large machine-firm in San Francisco writes:

> "I am glad you are making an independent mechanical paper; such a one ought to be supported in this country, to the exclusion of those which only publish puffs of machines patented from the office where the paper is issued."

Our friend shows his sincerity by ordering THE MECHANICAL ENGINEER from the first number issued, and we are glad that he appreciates a strictly independent mechanical paper; that is, one which does not wear the badge of any manufacturer, clique, or society.

Between independence and impudence, however, there is a vast gulf and many who endeavor to be independent, end in being simply scurrilous, and abusive of every one and, everything, that does not run in their little groove. THE MECHANICAL ENGINEER aims to represent the views of the trades it is supported by to the best of its ability. If it is wrong in its interpretations the said trades are very much to blame for continuing to uphold it.

RESPECTING THE PROPORTIONS OF COMPOUND ENGINES.

In THE MECHANICAL ENGINEER for April 5th I notice an article on the *Proportions of Compound Engines of Two Cylinders* from the pen of Miers Coryell. As it is intended for the benefit of practical engineers, I trust you will give me the space to indicate a method of designing a two-cylinder compound engine of given power in accord with the best practice and in harmony with correct theories. The exceptions taken in the article above mentioned are :

1st. Too great a range of expansion is taken for the given steam pressure.

2d. The function of the receiver, and its size, are not properly given.

3d. The power is not as should be the case, equally divided between the two cylinders.

In regard to these points we may give the following explanations :

1st. The best authorities state, and the most careful and extensive experiments have shown (see Recent Practice in Marine Engineering by W. H. Maw, pp. 41–59) that the range of expansion depends, practically, entirely on the initial pressure, rising as it rises, but not nearly in so great a degree as would be found by taking it as the initial divided by the terminal pressure assumed in this case. The rule, based on experiment, is that the ratio of expansion should be *one-tenth of the boiler pressure* or *one-twelfth of the absolute pressure* at admission. The experiments show that when the ratio of expansion exceeds this it causes a reduction of economy. This rule assumes, of course, a condensing engine. If the low-pressure cylinder exhausts into the atmosphere, the ratio of expansion is less than that given above.

2d. The function of the receiver is not to maintain a constant back-pressure against the high-pressure piston, but simply to provide, in engines with cranks at other angles than 0° or 180°, a place for the steam to exhaust from high pressure before the opening of low-pressure valve. In the continuous expansion, or tandem engine, the low pressure opens to steam at almost the same moment as high pressure to exhaust, and hence no receiver is necessary, but in order to have the cranks at 90°, as is commonly the case in two-cylinder engines, a receiver must be provided.

The size of the receiver should be sufficient to provide space for the steam as it exhausts from the high pressure before the opening of low pressure valve, without any compression. Experience has shown that a space equal to from one to one and a-half the volume of high-pressure cylinder is ample, and that the space in exhaust-passage pipes leading to low pressure, and low-pressure steam chest, are all that is needed. A larger receiver-space simply causes loss by free expansion, and greater surface for radiation.

3d. The object of putting the cranks at right angles is to insure a more uniform turning effort, and to increase the handiness of the engine. To secure the former it is necessary that the power developed in each cylinder should be the same. The best authorities are agreed as to this point.

In addition the best practice is to so proportion the volumes of the cylinders that, when working at full power, the cut-off in high-pressure cylinder will be at from four-tenths to six-tenths of the stroke. The object of this is that, when reduced power is desired, it can be secured by an earlier cut-off in high pressure cylinder with, of course, an increase of total expansion. Though, as already indicated, this ratio of expansion is not so economical as the one determined for full power, it is a more economical way of working than to follow further with reduced initial pressure due to throttling.

Is may be of interest to show how an engine is designed in accordance with these principles.

Take, as in the case given in your issue of April 5th :

Initial pressure	120 lbs. absolute
Indicated horse-power	2000
Piston speed	600 ft. per min.

Assuming a condenser pressure of 2 lbs. absolute, the back pressure in low pressure may be put at 4 lbs. absolute. (The increase is due to friction in passages, etc.)

The ratio of expansion (total) will be from foregoing principles : $120 \div 12 = 10$.

The ratio of cylinders are as (assuming same shute for each) in this case, should be about 4·5. This will give point of cut-off in high-pressure cylinder 0·45, or ratio of expansion in that cylinder 2·22.

In order that the power may be the same in each cylinder, we must so choose the receiver pressure that such will be the case. By trying a few pressures we find that 25 lbs. absolute will do this very nearly.

Now in order that this pressure may be maintained in receiver, we must so adjust the point of cut-off in low-pressure cylinder that pressure × volume of steam given to receiver by high-pressure cylinder will be just equal to that (pressure × volume) taken from it by low-pressure cylinder. This is readily determined as follows (calling volume of high-pressure cylinder unity and that of low-pressure cylinder 4·5) :

$$120 \times 0{\cdot}45 = 25 \times 4{\cdot}5 \times X$$

$$X = \frac{120 \times 0{\cdot}45}{25 \times 4{\cdot}5} = \frac{12}{25} = 0{\cdot}48$$

or the cut-off in low-pressure cylinder is at 0·48 of stroke.

Mean forward pressure in high-pressure cylinder:

$$= 120 \times {\cdot}812 = 97{\cdot}44 \text{ lbs.}$$

Mean effective pressure in high-pressure cylinder:

$$= 97{\cdot}44 - 25 = 72{\cdot}44 \text{ lbs.}$$

Mean forward pressure in low-pressure cylinder:

$$= 25 \times {\cdot}83 = 20{\cdot}75 \text{ lbs.}$$

Mean effective pressure in low-pressure cylinder:

$$= 20{\cdot}75 - 4 = 16{\cdot}75 \text{ lbs.}$$

Reducing mean effective pressure in high-pressure cylinder to its equivalent on low-pressure piston, we get:

$$\frac{72{\cdot}44}{4{\cdot}5} = 16{\cdot}10 \text{ lbs.}$$

The total mean effective pressure of the two cylinders is 32·85 lbs.

Now, as is well known, the size of low-pressure cylinder must be the same as that of a simple engine which would do the same work as the compound engine with the same total mean effective pressure and total range of expansion.

Hence area of low-pressure cylinder:

$$= \frac{2000 \times 33000}{32{\cdot}85 \times 600} = 3348{\cdot}6 \text{ sq. in.}$$

Area of high-pressure cylinder:

$$= \frac{3348{\cdot}6}{4\ 5} = 744{\cdot}24 \text{ sq. in.}$$

Diameter high-pressure cylinder, 30·8 inches.
" low " " 65·3 "

Horse-power of high-pressure cylinder:

$$= \frac{16{\cdot}10 \times 744{\cdot}24 \times 600}{33000} = 980{\cdot}1$$

Horse-power of low-pressure cylinder:

$$= \frac{16{\cdot}75 \times 3348{\cdot}6 \times 600}{33000} = 1019{\cdot}8$$

Horse-power of both cylinders, 1999·9.

This calculation omits the effect of clearance, cushion and volume of piston rods, but the changes due to them can be readily made.

Since it seems in order to recommend good works on the steam engine, I would say that two of the best of which I know are "*A Manual of Marine Engineering*" by A. E. Seaton, and "*The Marine Steam Engine,*" by R. Sennett. The former is a text-book at Cornell University and Stevens Institute. Both are written by practicing engineers of large experience and are worthy of the most careful study.

The method of designing a compound engine here given is substantially that of Seaton's book.

"COMPOUND ENGINE."

BLAST FURNACE SLAG has been cut and polished like precious stones, and, it is said, makes very handsome jewelry when mounted.

PERSONS WHO CANNOT obtain THE MECANICAL ENGINEER from newsdealers, can subscribe three months for fifty cents.

TALKS ABOUT THE STEAM-ENGINE.—No. XIV

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

It will be found on applying this rule (see previous issue) to stationary engines, that success has been attained with a length of crank-pin varying from $\frac{1}{4}$th to $\frac{2}{3}$ds of the length apparently demanded by marine engines.

Locomotive engines do not seem to demand more than one-tenth the length of marine engine crank-pins.

It is evident that the friction on marine engine crank-pins must sometimes be enormous, and that the cooling effects of the variations of speed and rush of wind in locomotives must count for something.

Locomotive crank-pins have usually the same length and diameter.

Mr. J. M. Whitham, Eng. U. S. Navy, has published in the Journal of the Franklin Inst. for 1883 a very complete table of crank-pins showing average results of marine engines, from a very large number of marine engines, to be about ten per cent. less than what I have given.

I am so firmly convinced that there is something radically wrong in the enormous sizes given to marine engine crank-pins that I trust endeavor will be made to assure greater stiffness in the framing than has as yet been reached.

It is the custom of some marine engine builders, in some cases, to make the double crank-pin of the same size as the shaft for no other purpose than to meet unforseen strains due to getting out of line, to loosening of the caps on hot bearings, and to the working of the vessel.

It will be found, also, that our constructors have either been in the habit of making crank-pins much longer than was required, for slow engines with low pressures, or that manufacturers of high-speed engines are making crank-pins too short. Time will tell.

Unless the crank-pin projects considerably from the crank, before reaching the boxes, limiting the pressure to 500 lbs. per square inch will insure sufficient rigidity.

The length and diameter of a steel crank-pin should be the same as for wrought-iron.

Steel, because of its homogeneous structure, will permit a smoother surface and have greater strength, but it is more liable to snap when wrenched by any of the numerous strains in marine engines, and for that very reason I have known steel crank-pins to be taken out of marine engines and wrought-iron pins substituted for them.

This, of course, does not apply to properly constructed stationary engines, or with so much force to locomotives.

* * * * *

I have already referred to the balancing of an engine on the dead-points in my first paper, and would like to repeat what I there said, that is: that an engine balanced for the dead-points is very much out of balance when the crank is at right angles to the center line of the cylinder.

Balancing an engine does not relieve the crank-pin in the least, nor does it add to the stress on the crank-pin. It only steadies the shaft.

The stress on the crank-pin in the direction of the stroke can be rendered tolerably uniform if we can predetermine and keep a constant steam pressure, a constant point of cut-off, and a constant number of turns per minute, but as this is rather an intricate discussion I will speak of it at some other time.

The only engine that can be balanced all round has an oscillating cylinder and will in all probability be the high-speed engine of the future.

This can be done by opposing the inertia of the oscillating cylinder against the centrifugal force of the counter weight.

The objection is immediately offered that this cannot practically be realized, to which I agree, unless one has sufficient knowledge of elementary mechanics to properly arrange the weights of reciprocating parts of the cylinder, and of the counter weight; in which case it is perfectly practicable.

The details of this form of engine have been very thoroughly worked out by Dr. Albau of Germany and by the Messrs. Penn of England, but evidently it has not occurred to them that the engine can be balanced all round.

The Shaw locomotive with four cylinders and as many sets of reciprocating parts could have been much more easily balanced by the use of an oscillating cylinder and the pressure on the rail due to the centrifugal force of the counter weight ("hammer blow" (?)) avoided.

If the cylinders of any locomotive were placed vertically, the "hammer blow" (?) [squeeze would be the better word] on the rail could be avoided, but the forward motion of the locomotive would have a series of pulsations in it, which would be disagreeably similar to the pitching of a vessel at sea.

HOW I SERVED MY APPRENTICESHIP.

NUMBER IX.

BY GEORGE SLOCUM.

One day the foreman sent me over to help Rube Sly. His partner was laying off, sick. I thought this was a good chance to get some pointers on air-brakes, so I asked Rube what was the difference between the automatic and the old style brake.

"I dunno," said Rube; "hand me that gasket will you?"

"Well there is some difference ain't there?"

"Can't prove it by me," said Rube; "gimme that head."

"I hear 'em say something about the triple valve making it automatic, is it so?" said I.

"You've got me up a stump now," said Rube, "gimme that monkey-wrench."

I saw it was no use trying to pump Rube, so I let go the handle. I told Jones about it afterwards, and he said that Rube knew enough about air brakes to draw big pay, and knew enough to keep what he did know to himself. "He puts me in mind of when I was a boy," said Jones. "In those days we didn't have so many books and papers to explain all about steam, and engines, and such like, as we have to-day, and if a fellow knew a little something about figuring, and you wanted to know it too, you had to pay him for it. Its different now; any machinist who wants to post up, and reads books and papers and builder's pamphlets, knows more in a week than them fellars did in a year. I know it. I've seem them fellars strut around like turkey-cocks, and hold their heads up, and bluff off poor devils that didn't know as much as they did about figures. But that's all changed now. You needn't care for Rube Sly; you just write to the air brake company for a pamphlet, and I guess we'll try and wade through it some way. It will only cost you a nickel anyhow, and if you don't learn anything out of it, you won't be out of pocket much."

About this time we got a lot of new tools from the east, among them some Putnam lathes, and I was just tickled all over one day when the foreman gave me one of them to run. They fired my old rattle-go-bang out into the scrap pile, and I was happy once more.

*   *   *   *   *

"Say Jones, do they use any other kind of a contrivance for pressing on driving wheels besides a hydrostatic press?" said I to him one day.

"No, I guess not. That's the most convenient and effective machine for the purpose. Why do you ask?"

"Because I heard 'Windy Jim' tell the boys to-day noon what a high old time he used to have pressing on wheels with a screw. I guess he was blowing as usual."

"Well, no," said Jones, "I guess not this time, for a wonder. I had forgotten about the screw-press, when you asked me. I just happen to think now of a one-horse road I was on once down in Indiana, where they had an old rattle-trap of that kind."

"I should think it would require a mighty good screw, and a stout, long lever to press on drivers at 70 tons."

"I don't think the screw we used was much to brag on, but the lever was lovely. It used to take all hands and the M. M. to get the darned thing back into place every time we came down on it."

"Must have been a heavy one, wasn't it?"

"Heavy's no name for it. Makes my heart ache when I think of how we used to tug at it," said Jones.

"I suppose there is room for figuring around a screw press too, ain't there?"

"Well, there is. There ain't a machine in this or any other shop, but what will give you a job of figuring, if you are inclined that way."

"Well, go ahead. Give us a little on the screw-press, just to keep your hand in." said I.

"All right," said Jones. "Now I forget the particulars of that Indiana screw, but it makes no difference. In the first place, the general appearance of the machine is about like that press over there, the main difference being, that a stout screw is used in place of the ram. Of course you understand that there is no pump used or any gauge. Well, we'll say that our screw has a thread of $\frac{1}{2}$ inch pitch, that is, I mean 2 threads inside the space of 1 inch. And we'll say our screw is 30 inches long, and that our lever is 10 feet long. Now—"

"You haven't given the diameter of the screw."

"It does not matter about the diameter. Let it be thick enough to resist twisting off, that's all we care about now. A lever 10 feet long having one end stuck in the head of the screw and turned completely around, would describe a circle 20 feet in diameter—that is the outer end of it would—you understand?" said Jones.

"Yes sir."

"Very well. Now while that lever is making one complete revolution, the screw must make a revolution also, musn't it?"

"Yes sir."

"Well, the screw in making one revolution advances $\frac{1}{2}$ an inch. In making 2 revolutions it will advance just one inch. And while the screw is making 2 revolutions and advancing 1 inch, the lever is making 2 revolutions—or would if it were turned completely around."

"That's plain enough. I know what you are driving at now," said I.

"Well, hold on and stop your noise till I get through. Now, if we multiply 20 by 3·1416 we will get the circumference of the circle generated by the end of lever in turning around once, which is equal to 62·8320 feet, and for 2 revolutions it would be 62·8320 multiplied by 2, or 125·6640 feet; this reduced to inches gives us 1507·9680 inches. This is the distance passed through by the lever while the screw passes through a distance of 1 inch. The ratio is as 1 to 1508—dropping the decimal. Now 1 pound at the lever's end—making no allowances for friction—will balance 1508 pounds at the point of the screw. And if a number of men grab hold of the lever and pull down with a force of 100 pounds, they will exert or cause a pressure at the point of the screw of 100 times 1508 pounds, or 150,800 pounds. This is not pounds per square inch, but the full force or pressure, or load moved. Now lets figure on a screw, say of 8 threads to the inch and see if we can't use a shorter and lighter lever; I guess we can, but at the same time it will take us longer to do the same imaginary job we just did with the other screw."

"You say, Jones, that it makes no difference about the diameter of the screw in this calculation, I don't understand that, when I imagine one screw head 6 inches in diameter, and another 12 inches in diameter."

"Well, it don't sure as you live; and I think I can explain it so that you can understand it."

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LIII.

In 1857, or thereabouts, I was working in a machine-shop in Detroit. I ran a small 26″-inch lathe, doing whatever was brought to me as well as I knew how. Sometimes it was first-class work that I turned out, at other times it might have been a good deal better. I remember one such case which I will relate, for it seems to me it was a useful experience at that time, and may still serve some others.

I had a job to make about a dozen small jack-screws $1\frac{1}{4}$ inches diameter; to bore and cut threads in the castings, and cut the screws themselves. The thread in the casting was about six inches long and was, I think, four to the inch pitch. It was nothing but fun to cut the screws, but when I came to the castings I began to have misgivings. The hole was so long, and so small in diameter, that I really didn't see how I was going to make a decent job of it. The man who wanted the screws probably foresaw what might happen. So he warned the boss that if the first thread didn't fit as tight as the last one he would not accept the job. But, unfortunately, I only learned of this after the jacks were lying on the floor completed.

I had to bore the casting with a boring-bar, then take off the feed and put on the gears for screw-cutting, and cut the thread without shifting the casting. The hole I bored was $\frac{7}{8}$ths and $\frac{1}{16}$th, leaving $\frac{5}{16}$ths for the thread. Now a boring-bar seven-eighths of an inch diameter, and two feet long, will do about as much execution with this job as a good penholder would, but nevertheless this was all the tool I had to work with, and the job had to be done.

I had the bar made and cutter all filed up and in its place, and at it I went. The reader sees that this was not a funny piece of work in any event—to cut this thread in this way—for the cutter had not only to fit tightly enough to resist the strain of cutting the thread, but it had to be slack enough to drive out endwise, so as to take another cut. Moreover, as the cutter was in the middle of the bar, or thereabouts, on the start, the spring was the greatest at that point, and I had to go very gingerly to work to do anything at all. The first two or three turns through went all right, and I began to congratulate myself that I wasn't going to have any trouble after all, when the cutter began to get dull. This was nice—to take it out and grind it and start it in all right, but nevertheless it had to be done. I cut the thread to the size of the screw that was to go into it, and, running the carriage back (taking out the boring-bar), I tried it in. The first two threads entered properly, and then the screw would not go any further. I thought to myself that I had not let the bar run through often enough to take up the spring of it in the thread, and full of this belief tried again. The next time the screw ran down about half its length, and wouldn't go any further. Then I began to think; the conclusion I came to was that the spring of the bar was so great on the outside of the thread that in spite of all I could do it would be taper anyhow, so I just put the bar in again and took another cut, until the screw would go the whole length; the result being that it was a first-class fit when the screw was down in the casting, but when it was run up with a load on it, it was, as one might say, "wobbly." I went ahead with the job, and in course of time had half a dozen lying on the floor, carefully screwed home. The foreman came along, ran one of the screws out about three inches, shook it to feel of the fit, and said: "That's a good job, Moulton," and went on about his business.

Thinks I to myself you don't know much about it, anyway, or you would have seen that the screw must necessarily fit down there, if it fitted at all, but I wasn't going to say anything that might tend to criminate myself, and I finished the job without more ado. All of them worked first rate, except on the first two or three inches; there they didn't. Next day came the man who ordered the job. He ran every screw out full length, and when he saw how they shook in the upper ends of the thread he was wroth. He said the screws were of no use to him, and he rejected the lot. The foreman came over and looked at them and said they didn't shake when he tried them, and he couldn't make out what was wrong. He evidently thought that viewing the matter in the light of a mystery removed any blame that might attach to him for not finding it out.

After the angry man went away he came to me and wanted to know how it all came about. Then I took him to the lathe and showed him. I said I wasn't given to quarreling with tools and did the best I could with what I had, but, said I, if you want me to tell you, that's no way to do the job, anyhow. You can't cut a thread of that pitch parallel from end to end in a hole $\frac{7}{8}$ths and $\frac{1}{16}$th diameter, and 6 inches long, and it is useless to try. What you ought to have is a tap for this business, and after the job is sized on the outer end pitch it out of the lathe, run the tap through it, and there you are, in one quarter of the time I have been fooling over it, taking scraping cuts and trying to accomplish the impossible"

"Why didn't you say so," says the foreman, "and I would have had one made."

"For this reason," I answered: "Where I came from it was the boss who ran the shop and the men who did the work. I was taught when I was a boy to mind my own business, and do as I was told, without question, and it has stuck to me ever since. If you told me to take a forty pound sledge and smash the crossheads off of every planer in this shop I would go at it and do it out of hand. You are the one who is to blame for this job, and not me, because I have done the best I could with what I had to do with. If you give me a lathe that has got a lead-screw on it that is worn out with feeding, that takes five minutes to move the carriage after the lathe is started, am I to blame if the threads I cut are like the lead-screw? I guess not. You are supposed to know what every tool in this shop will do, and you can't blame a man for doing the best that the tool will do."

The foreman was a good fellow at bottom, and he said: "that's so, Moulton, you are right; we will make a tap and size the castings out, make a new lot of screws, and know more another time. A man is a fool, anyhow, who wants a jack-screw like that."

I thought that this was a curious conclusion to come to, but I was glad enough to get shut of the thing in any way.

Now, I put it to my friends whether I was right or wrong? After a lapse of twenty-seven years I still think that I was right. I hold to the view that if a man is foreman it is he who is responsible for putting work on tools that they are not fit for, and that if it does not come out in as good shape as it should, the man who does the work should not be blamed. The old saw says a bad workman quarrels with his tools, but I think it is just as apposite to say a good workman quarrels with bad tools. In every shop in the land, that I ever saw, there are some tools that are fitter for the scrap-heap than floor-room; yet there they stick, and are occasionally used to waste time and do poor jobs on. I am—we are—not an exception; there is one in our shop that has been there from time immemorial, but in some sense we are excusable, for we never use it. Have good tools and put good men at them; then you will have good work.

SENSIBLE TALKS ABOUT BOILERS AND THEIR FIXTURES.

I have among my acquaintances and friends, a gentleman of wide experience in steam engineering.

As I happen to be interested in steam and steam boilers at this time, I took occasion to ask him a good many questions on some points. Said he:

"No man who wants a first-class boiler now-a-days will not do less than get a boiler with a steel shell, which, by the way, isn't steel at all, but highly-refined iron. I think that the time of flue-boilers is nearly past. There used to be objections to flue-boilers which are now overcome, and while I am aware that in St. Louis tubular boilers are very little used, I know it to be the outgrowth of the old river prejudice in favor of the flue-boiler. The nearest that I can come to getting a tubular boiler in St. Louis is the 6-inch tubes riveted into the heads. But the 4-inch tubes, with plenty of water space between and a circulating space down through the center, a man-hole under the tubes in front, and above the tubes in the rear, is on general principles the boiler which I am inclined to recommend. I think that the present run on short tubular boilers is inconsistent with the desire for economy. Eighteen feet is none too long. The 14 and 16 foot boilers waste the difference in heat. One does not have to think about it very long to see that there will be more heat utilized in the passage under and through a long boiler than a short one. If from necessity I were compelled to use a flue-boiler I should certainly have it 24 or 26 feet long.

"What diameter of boiler do you use mostly?"

"Sixty inch wherever I can work it in."

"What thickness metal?"

"Five-sixteenths inch for the shell and 7-16ths for the heads, flanged to a radius of not less than three inches. It makes no difference if the shell be of steel, the head should be of the best flange iron. I will say here that there is no object for a boiler-maker to use anything else than the best flange iron for boiler heads. He is sure to waste a good deal of material and labor if he uses anything else. It is not unusual practice now to have the fire sheet double the length of the other sheets in the boiler, so as not to have seams or rivets directly over the fire."

"How about riveting?"

"The longitudinal seams, of course, should be double riveted."

"Should the rivets be in vertical rows or staggered?"

"Oh! that does not make much difference. There is a good deal of talk for and against both methods. If any difference, I believe I would prefer the chain or staggered riveting. For the shell the rivets should be ⅝ths of an inch in diameter and 1½ inches long, and of a quality so that they can be hammered down cold without fracture. But they should always be put in hot. Separations from center in single riveting should be 1⅞ inches, and in double riveting about 2 inches. But a very important thing is the rivet holes. We have heard a good deal about drilling holes, but there are not many people who want to pay for that. The ordinary method of punching is barbarous; shear punching is a great deal better, and double-shear punching is the next thing to drilling. This is done by first shear-punching a small hole, and then shear-punching it to the proper size. This leaves the iron around the hole in good condition. No matter whether the hole is drilled or how it is made, if the drift-pin is used, for any reason, I do not wish to have anything to do with such sheets. It is a very good plan to bevel-shear the edge of the plates to a true line."

"I have noticed that there are different kinds of calking," said I.

"Yes, and there is more nonsense about it than anything connected with boiler making. A boiler which requires much calking is not worth much. Of course, next to the corners and angles of sheets where they meet, forming and calking are necessary. It is the riveting which makes the boiler tight. Calking a joint on the outside is a good deal like cementing a cellar-wall on the inside to keep water from leaking through. If the wall leaks, the inside cementing does little good. It is the same with calking, which merely covers up bad work in riveting, and for which reason it will be used. It should be done with a tool which does not bruise or mar the sheet, and a round-nosed tool is the best for that purpose."

* * * * *

In giving the conversation with my engineering friend, I was giving the opinion and experience of one man. It is well known that we can hardly converse with one another on any subject without meeting differences of opinion, and there is no reason why a conversation expressed in writing should not meet the same differences in the minds of those who read. This steaming talk was of long duration. There was considerable branching off to other topics of general and special interest, but it was boiler information which I was after.

Said I: "I hear different methods of bracing mentioned; what have you to say about that?"

"I have to say that I do not want diagonal bracing in any boilers built for me."

"What do you mean by diagonal bracing?"

"I mean bracing from the head back to the sheets or shell. It is not the shell which you want to brace, and if you did you don't want to try to do it from the head. If this was necessary, it could be done from one part of the shell to another. The form of the shell, cylindrical as it is, is the best possible form which could be given the boiler, and the bracing from the head to the sheet is a constant strain on the shell, because of expansion and contraction.

"The bracing which I would advise using is not bracing at all. You don't want to keep the heads from coming in, but from going out, which is the direction of the strain, so all you have to do is to tie the heads together by iron rods passing from head to head. The tubes or flues do the tying or bracing, as it is called, for their part of the boiler, and they do it well—the very best kind. Now all you have to do is to continue the same thing above the flue line, and it may be well done with 1¼ inch iron bars attached to pieces of T iron riveted to the head."

To diverge a little from this conversation, I recall a talk which I had with a boiler inspector on the same subject. It was after the talk with my friend. It is my habit to seek information from all directions. I asked him what he thought of tie-rods instead of diagonal braces?

"Well, you don't want any tie-rods."

"Why not?"

"Well, because you don't."

"What are your objections?"

"The braces are the best."

"Why are they the best?"

"Because they brace better."

"But I cannot see why. You understand all about this thing. I wish you would explain to me the reason."

"I'll explain it to you now so you can see it," said he. "You take and fasten one set of braces back against the first sheet and another set just below it back against the second sheet. You see there the strain is divided between the two and she is well braced and all right."

This was his reasoning in favor of the diagonal bracing. It was not as convincing to me as that favoring the other method.

Said my engineer friend: "Lugs are not generally regarded as being very important, but when a boiler is not properly set on the walls and provision made for expansion, it makes a good deal of difference in the life of that boiler. There should be three heavy cast iron lugs on the side, having a planed bearing surface of 9 × 12 inches. Under each lug there should be an iron plate 12 × 12 inches, and ¾ inch thick and planed on the upper side. Between the lug and the plate should be placed three steel rollers, one inch in diameter. Pieces of steel shafting are about the thing. Then everything can come and go according to the temperature, without strain. The practice of building the lugs solid in the wall, with no provision for movement, is barbaric."

"What steam gauge is the best?"

"There are quite a number which are good enough and a vast number which are worthless. Those which are usually put out by boiler makers as a part of the standard fixtures are next to worthless. A cheap gauge is like a cheap anything else. Its only merit is its cheapness. While we are on the subject I want to say something about water-gauges. I want to tell you never to use any of those combination water columns which have a glass-gauge and gauge-cocks all attached to the same castings and which are set out from the boiler by connecting pipes. I want Mississippi gauge cocks, and I want them tapped right into the boiler, without any intervention of pipes or fixtures. Glass water-gauges are very pretty, but I don't care whether I have them or not. There are so many things which may cause them to indicate falsely that I am afraid of them. There are very few firemen or engineers who will pay any attention to a gauge-cock as long as there is a glass water-gauge in the house."

"What have you to say about safety valves?"

"A safety valve as ordinarily constructed is a lie. In the first place there is no safety about it, and in the second place it is not a valve. It is a misnomer. The true safety valve is the nickel-seat "pop safety." There is no corrosion; they can be accurately adjusted, are extremely sensitive, and always ready for business."

We then got around to the question of fronts.

"I would always advise square fronts," said he. "That is, fronts where the ordinary breeching which projects beyond and over the fire doors is not required. In this way the smoke chamber is formed by allowing the boiler shell to extend out beyond the head. This projecting sheet is fitted to a cast iron square front which has soot-doors in circular form, or rather a circle with the top cut off, the top of the door being about on a line with the water line. The opening for the smoke is made by cutting out a part of the projecting sheet before mentioned. It makes a better looking engine room and is somewhat more economical as to fuel, carrying the smoke back over the top of the boilers, rather than by the ordinary method, into the uptakes. The conduit over the boiler is formed by turning a brick arch from the side wall over against the brick arch which covers the boiler. This is in case one boiler is used. Where two are used, one flue may be formed between the two boilers—that is on top. They should connect with the stack at the rear. This makes a clean, nice looking boiler house. The area of these flues should be about one-fourth to one-third greater than the boiler flues. Theoretically this would not be necessary, as the difference in the temperature of the air in the boiler flues and in the outside flues would more than make up for all the allowances to be made on account of friction in the latter. Practically the flue would be from one-fourth to one-third full of ashes, and for that reason should have the extra size.—*North Western Miller.*

VERY SUGGESTIVE STATISTICS.

Those who are interested in the use and maintenance of steam-power will find in a report of an English boiler insurance company, which we summarize herewith from *Engineering,* some very suggestive facts. They go to sustain the growing belief that boiler explosions are wholly inexcusable from any aspect, a position we have maintained and upheld for years. *Engineering* says:—the italics are ours.

> "Like our contemporaries, we publish from time to time returns of killed or wounded, the list of lives lost or damaged by the *greed, carelessness or incompetence of of the makers, owners and attendants of steam boilers.* The information we now give we take from the annual report of Mr. E. B. Martin, the chief engineer to the Midland Steam Boiler Inspection and Assurance Company, whose admirable yearly summary just issued bears evidence that the long-continued efforts of the scientific press and the boiler companies are bearing fruit, though somewhat tardily. The number of lives lost in Great Britan during the year 1883 from the explosions of steam boilers was only 21, a great improvement upon the past."

The causes of explosion are arranged under the following heads:

Faults of construction or material which may be detected before starting or after repair.—weak tubes, weak ends, seam rips, bad joints, bad punching, bad stays.

Faults to be detected by periodical inspection.—Internal corrosion, external corrosion.

Faults which could be detected by attendants.—Shortness of water, deposit, over-pressure from valves out of order.

The exploded boilers were of the following kinds, the causes of explosion being stated:

Cornish or Lancashire.—Weak tubes, rigid ends, seam rips, internal corrosion, external corrosion, shortness of water, deposit.

Plain Cylinders.—Bad repair, internal corrosion, external corrosion.

Locomotive Multitubular.—Bad stays, internal corrosion or furrow, over-pressure.

Vertical or Crane.—Bad joints, bad punching, bad stays, internal corrosion, external corrosion.

Marine, Ship, tug or boat.—Internal corrosion, external corrosion, shortness of water, over-pressure.

Here are some of the details:

Railway locomotive, 15 years old, 8 ft. 4 in. long, 3 ft. 4 in. diameter in the barrel, $\frac{7}{16}$ in. plates, 110 lb. pressure. A longitudinal seam gave way from corrosion in one line, called a "furrow," caused by bending backwards and forwards of metal not of very good quality.

Cornish, 20 years old, 14 ft. long, 4 ft. 6 in. diameter, tube 2 ft. 3 in. diameter, $\frac{3}{8}$ in. plates, 25 lb. pressure. Being much corroded internally, it was too weak to bear the ordinary working pressure, and the back end of the tube collapsed upwards for half its length.

Marine, second hand 16 years ago, 15 ft. long, 7 ft. 6 in. to 6 ft. 6 in. diameter, made of $\frac{5}{16}$ in. plates, 12 lb. pressure. The shell was reduced by external corrosion to $\frac{1}{32}$ in., and too weak to bear even the small working pressure.

Plain cylinder, said to be 46 years old, 30 ft. 6 in. long, 6 ft. 6 in. diameter, $\frac{3}{8}$ in. plates arranged lengthways, 26 lb. pressure. The plates at the ruptured edges were so reduced by corrosion and internal pitting as to be quite unfit to bear any pressure.

Vertical, 18 years old, 5 ft. 10 in, high, 3 ft. 6 in. diameter, $\frac{1}{4}$ in. plates, 50 lb. pressure. The fire-box collapsed, having been reduced by internal corrosion until unable to bear the usual working pressure.

Lancashire, 36 ft. long, 7 ft. diameter, $\frac{7}{16}$ in. plates, tubes 3 ft. diameter, 44 lb. pressure. The right-hand tube collapsed, the plates being weakened by shortness of water.

Lancashire, 12 years old, 28 ft. long, 6 ft. 6 in. diameter, $\frac{1}{2}$ in. plates. Tubes 2 ft. 7 in. diameter, $\frac{7}{16}$ in. thick, 80 lb. pressure. The right-hand furnace collapsed and ruptured, the left also being somewhat collapsed. Overheating was said to be due to a soapy deposit of soda and grease.

Vertical, second-hand 5 or 6 years ago, 8 ft. 2 in. high, 4 ft. 6 in. diameter, $\frac{3}{8}$ in. plates. Fire box 3 ft. 8 in. high, 3 ft 9 in. diameter, $\frac{5}{16}$ in. plates. Two cross tubes, 65 lb. pressure. The fire-box collapsed, the plates being pitted and honeycombed $\frac{1}{8}$ in. deep over large patches, particularly near the feed inlet.

Fifteen years old, 24 ft. long, 7 ft. diameter, $\frac{3}{8}$ in. plates, 50 lb. pressure. The left-hand furnace tube collapsed and ruptured, through softening of the plates from shortness of water.

Vertical, 6 ft. 4 in. high, 2 ft. 6 in. diameter, $\frac{5}{16}$ in. plates. Two cross tubes $6\frac{1}{4}$ in. diameter, 70 lb. pressure. It gave way in the lower cross tube, where it was corroded nearly through by wet dropping from the chimney during the long intervals of working. The contents rushed into the fire-box and out at the fire-door, and scalded the owner's son, who was near.

Plain cylinder, 35 ft. long, 5 ft. 6 in. diameter, $\frac{3}{8}$ in. plates, 40 lb. pressure, It gave way at back end, which was torn into several pieces, while the front was thrown forward. The plates were nearly eaten through by internal corrosion.

Marine, 11 ft. 9 in. high, 5 ft. 6 in. diameter, $\frac{3}{8}$ in. plates. There had been four cross tubes, but all but the upper one had been removed. It gave way in the uptake, where it was very thin, indeed, and temporarily repaired with a patch held on by two iron straps. The contents rushed through the fire-box, and out of the fire-door, and scalded the engineman.

Portable, while in charge of the owner, who left it for a short time, the end blew out, but no further particulars have been obtained. Most likely undue pressure.

Steam digger, upright multitubular, of peculiar construction, 7 ft. 6 in. in high, 3 ft. 4 in. diameter, made of $\frac{3}{8}$ in platef, 70 lb. to 125 lb. pressure. It was in two compartments, attached by one bolt, 2 in. diameter. The head of this bolt was badly welded, and came off, allowing the two compartments to come apart.

COMMON FLOUR BEST AFTER ALL.

Those intelligent persons who are now habitually rasping their digestive tracts by eating branny foods, on account of the gluten supposed to be found only in the fourth layer of the grain, may be interested to learn of the investigations of Dr. N. A. Randolph of Philadelphia, which offer food for reflection. The manufacturers of specially prepared foods have always maintained, on good scientific authority, that the gluten of wheat resided only in the cortical cells of the grain, the body of the grain being composed almost wholly of starch. Up to now, microscopical examination has upheld this dogma, although Prof. Richardson of Philadelphia and Prof. Leeds of Hoboken have pointed out that such was not the case.

Dr. Randolph now demonstrates that the wheat grain itself possesses a large amount of gluten, which forms a sort of network around the starch. It appears that the gluten of this central portion was always masked by the large number of starch grains, and thus Dr. Randolph declares, it escaped observation. By dissolving out the starch grains a network of gluten was found by Dr. Randolph which may be demonstrated in more than one way. In fact, the starch grains may be said to lie in a bed of gluten. It is therefore satisfactory to know that those who desire this highly important nitrogenous element of food will find it in considerable quantities in the ordinary prepared flour.

But this is not all. Dr. Randolph has made experiments to discover whether the gluten which undoubtedly exists in the external covering of the grain was capable of serving as food to man. The result showed that even after careful cooking, the hard, dense cellulose walls which enclosed the gluten were unaffected by the digestive juices, exhibiting no change, after prolonged maceration at the temperature of the human digestive tract. These cells were also found to be unaffected by maceration for thirty days in liquor potasse. Even immersion in strong nitric acid for several days practically had no effect upon them.

Such being the case, the use of branny foods for the purpose of obtaining gluten appears to be a fallacy and worse than a blunder; for, in rejecting fine wheaten flour, which really contains gluten in a form easily digested, a refuse product is accepted which yields up no part of its gluten, but rasps the digestive tract, clogs the stomach with indigestible trash, and lays a foundation for a future of dyspepsia.—*John Michels in N. Y. Sun.*

PRESSURE IN A DIVING BELL.

A diving-bell allows us to perceive a sudden increase of pressure, but not by the ordinary sense of touch. The hand does not perceive the difference between 15 pounds per square inch, pressing it all around, and 17 pounds or 18 pounds, or 20 pounds, or even 30 pounds per square inch, as is experienced when you go down in a diving-bell. If you go down five and a half fathoms in a diving-bell, your hand is pressed all round with a force of 30 pounds to the square inch; but yet you do not perceive any difference in the sense of force, any perception of pressure. What you do perceive is this: Behind the tympanum is a certain cavity filled with air, and a greater pressure on one side of the tympanum than on the other gives rise to a painful sensation, and sometimes produces rupture of it, in a person going down in a diving-bell suddenly. The remedy for the painful sensation thus experienced, or rather I should say its prevention, is to keep chewing a piece of hard biscuit, or making believe to do so. If you are chewing a hard biscuit the operation keeps open a certain passage, by which the air pressure gets access to the inside of the tympanum and balances the outside pressure, and thus prevents the painful effect. This painful effect on the ear experienced by going down in a diving-bell is simply because a certain piece of tissue is being pressed more on one side than on the other; and when we get such a tremendous force on a delicate thing like the tympanum we may experience a great deal of pain, and it may be dangerous; indeed, it is dangerous, and produces rupture or damage to the tympanum unless means be adopted for obviating the difference in the pressure; but the simple means I have indicated are, I believe, with all ordinary healthy persons perfectly successful.—*Nature.*

STEEL BOILERS.

The annual report of the Chief of The Bureau of Steam Engineering, U. S. N., has been received, and among other interesting matter we find, on page 10, these paragraphs concerning steel boilers and the cost of them, as made in the Washington Navy Yard:

"It is proper in this connection to call attention to the good results already obtained by the use of mild steel instead of iron in boiler construction, and the promise that even better results will be seen by the longer use of boilers made from this material.

"Previous to 1879–'80 boilers constructed of iron for the navy by outside parties and in the navy yards cost from 27 to 40 cents per pound, including grate bars and other cheap fittings, and, although made from the best iron procurable, would ordinarily require extensive repairs after a full cruise of three years, and very extensive repairs, or entirely new boilers after two such cruises.

"With the mild steel now used by the Bureau in the boilers constructed in our navy yards during the last four years, we are making such boilers at an average cost of 20·68 cents per pound (the lowest figures being 17·01 cents, and the highest 23·33 cents per pound), and it is expected that this cost will be further reduced by the use of the improved appliances for handling and working this material which have been put up in several of the navy yards.

"Thus far the Bureau has not had to make repairs of any extent upon boilers made of this material, but sufficient time has not yet elapsed to give them full trial to develop what the ordinary lifetime of such boilers will be.

"The *Nipsic*, however, was the first vessel fitted with these steel boilers, and after returning from a cruise of over three years, during which time she steamed some 40,000 knots, her boilers giving most perfect satisfaction in their working, with not $1 of expense in repairs for the cruise; and after being cleaned and some slight repairs made, were ready, and are again in service, in first-class condition.

"The Bureau considers that the stand which it took, insisting upon a tensile strength not to exceed 60,000 pounds to the square inch, with a ductility in 8 inches of not less than 25 per centum, together with its efforts to reduce to a minimum the possible number of riveted joints, for leaks, corrosion, &c., by demanding and obtaining the largest sheets that could be manufactured, has tended largely to raise the standards of excellence of material and the size of plates as now made by the principal manufacturers of the country, and that the stimulus thus given, with the honorable rivalry and zeal of our principal manufacturers using the superior products of American mines, will yet produce a still better material in maximum sizes of plates and at minimum cost."

GRADING OF LOCOMOTIVE ENGINEERS ON THE PENNSYLVANIA RAILROAD.

On the Pennsylvania lines the enginemen are classified into four grades. The new men are in the fourth class, and it takes a year to go through each class until the fourth year, when they are called first class. Engineers on helping engines receive from $2.55 to $3.60 per day, depending on classification. The men running through freight engines receive from $3 to $4.10, according to their classification. All passenger enginemen receives $3.80 per day. The passenger men have to, as a rule, run many years on freights before they are promoted to run passenger, and as a result they are competent and careful men, fully capable of performing the duties assigned them. They must also be thoroughly posted in the rules and regulations of the company, and as the company have 425 rules in their book of rules and regulations, most of which relate either directly or indirectly to the running of trains, they must be well understood. Most of their engineers are promoted firemen. The fireman commences on the yard engine at $1.20 per day. From this work he is put on the extra list of road firemen, and when freight is heavy he can earn fair wages, and if he is attentive, sober and industrious he will get a regular engine to fire, and his pay will be from $1.80 to $2.20 per day, depending on the trip that he goes out on. He is first put on a freight engine, then from that to a passenger engine. At all times he is expected to use every endeavor to keep up the necessary pressure of steam, to fire so as to make the least amount of smoke, and save as much coal as possible. Firemen are allowed a certain amount of coal per car per mile, and they receive a cent per bushel for all that they save on that allowance; the engineers also receive a cent per bushel. When firemen are needed, those longest in the company's employ are examined and, if competent, are given an engine to run.—*Railway Age*.

New York City is to have a cable road in operation soon, starting at 140th street and Tenth Avenue. The route is not stated as yet, but there will probably be a demand for good engineers on the premises. The building is not up, so there is no immediate need for them.

Persons who cannot get The Mechanical Engineer from Newsdealers, can have it sent three months for fifty cents.

REFRIGERATION BY COMPRESSED AIR.

Cold storage warehouses are common in all large cities for the preservation of food supplies of all kinds during long periods of time. They are huge refrigerators in fact, in which a temperature just above the freezing point is maintained constantly. This is obtained by various systems, one of which, that by compressed air, is here described as to the principles involved. It is from a report on such a machine by a Board of Naval Engineers:

"The special object of the machine in question, and for which alone it was designed, is to furnish dry air of very low temperature, to be delivered into an air-tight chamber, constructed with non-heat conducting floor, ceiling, and sides. A constant, but very slow current of the refrigerated air circulates through and out of this chamber by means of a small outlet pipe in the ceiling, fitted with a valve. The circulation is just sufficient to maintain the desired low temperature by the replacement of air that may become too much heated, by freshly refrigerated air. Of course, the quantity required of the latter, per unit of time, depends on the atmospheric temperature and on the more or less non-conductibility of the material of which the chamber is built. This chamber is used for the storage of fresh meat to be preserved for very long periods from putrefaction. Notably, this is an important employment of the system on board trans-oceanic steamers freighted with fresh meat for a market in foreign ports. The dryness of the refrigerated air is a very valuable factor in this connection, as air of a low temperature, if containing much moisture, is unsuited for the purpose, the meat becoming mildewed after a short exposure in it. The proper temperature for the chamber is found to be a few degrees above the freezing point. It is not desirable to freeze the meat, but only to keep its temperature sufficiently low to prevent decomposition.

"The refrigeration of the air is produced by a purely mechanical method, in conformity with the mechanical theory of heat; no chemicals are employed, and the atmospheric air is the only substance operated on. The air is first compressed in a cylinder to a convenient degree by a steam engine, and its heat of compression due to the work performed upon it, extracted by subjecting it in pipes exposing sufficient surface for the purpose to the external air, or to water, or to both, until its temperature falls to that of the atmosphere, the pressure being meanwhile maintained by the steam engine. Then the compressed air is admitted to a cylinder in which it acts expansively upon a piston and does work, the pressure of the expanding air being always equal to the resistance against which it acts, and for every $789\frac{1}{4}$ foot-pounds of work performed by the expanding air one Fahrenheit unit of its contained heat is extracted, this quantity of heat being transmuted into that quantity of work. Finally, the air thus refrigerated is delivered into the chamber where its low temperature and the dryness resulting from that lowness are to be utilized. Of course, instead of being exhausted into a relatively small chamber, the refrigerated air could be distributed by proper pipes and registers through the apartments of a vessel, which would thus undoubtedly be supplied with air of low temperature to any extent that the required space and weight could be allowed for the refrigerating machine, for the fuel needed for its steam engine, and for the distributing pipes.

PRINCIPLES INVOLVED.

"If a given mass of air be taken at a given pressure, compressed to another, and then expanded back to the original pressure, its temperature remaining constant during these operations, the power developed or work done by its expansion will exactly equal the power exerted or work done in its compression, supposing the mechanism by means of which these operations are produced to have neither friction nor to leak air.

"If there be friction and air leakage, the power developed by the expansion will be less than that exerted in the compression by the amount of the friction and leakage.

"But if the air be kept at constant temperature during its compression only, receiving no heat during its expansion, then, during the expansion, its temperature will be lowered by the annihilation of so much of the heat contained in it as is equivalent to the power developed during the expansion, the air becoming more and more refrigerated as it is more and more expanded, and its pressure becoming less and less in the compound ratio of its expansion and refrigeration, so that the power developed during the expansion will be less than that exerted during the compression by the amount of the lessening of the pressure due to the refrigeration.

"As the air on which the operations of compression and expansion are performed is taken from the atmosphere, the atmospheric pressure is their lower limit of pressure, and the final pressure of expansion should always equal it. There is, however, no upper limit of pressure, the compression being conceivable to any degree, and the higher this upper limit the greater will be the expansion.

"The greater the expansion of a given mass of air expanded without receiving heat, the greater will be its refrigeration, because the more it is expanded the more power it will develop, and the refrigeration is directly proportional to this power. But the degree of expansion possible for the air can only equal the degree of compression it received, or, in other words, the compression and the expansion can be only between the same pressures, and will have an invariable relation. And as the refrigeration is proportional to the expansion, and as the expansion is proportional to the compression, the refrigeration will be proportional to the compression also. Hence, as the power producing the compression is the cost of the refrigeration, there is no economic gain in the production of a given quantity of refrigeration represented by mass of air multiplied by fall of temperature by giving the air a greater degree of compression in order that it may have a corresponding greater degree of expansion. All degrees of expansion and compression have the same economic value; that is to say, the expenditure of the same power in compressing a given mass of air, let the degree of compression be what it may, produces the same quantity of refrigeration by its corresponding expansion.

"If, however, the object be merely to produce the minimum temperature in the expanded mass of air, then its compression at constant temperature should be carried to the highest practical limit in order that its expansion may be proportionally great and its resulting temperature correspondingly low. Nevertheless, nothing is economically gained or lost as regards quantity of refrigeration so produced, the power cost being always proportional to this quantity and unaffected by the final temperature. The minimum temperature of compression is, of course, the atmospheric temperature.

"The power developed by the expanding air is, of course, applicable to the compression of air in conjunction with power derived from other sources.

"The entire refrigerating effect is produced by the conversion of heat into work during the expansion of the air overcoming a resistance; and for the refrigeration to be a maximum, this resistance must never be less than the pressure of the expanding air. Heat and work being mutually convertible in the fixed relation of $789\frac{1}{4}$ foot-pounds of work as the mechanical equivalent of one Fahrenheit unit of heat, the fall of temperature in one pound of air doing work by its expansion is one degree Fahrenheit for every ($789\frac{1}{4} \times 0{\cdot}2382 =$) 187·99935 foot-pounds of work so done.

"When the air expands without overcoming any *external* resistance its refrigeration is very slight, being due to only the *internal* work done upon it by its contained heat in overcoming its own cohesion. The experiments of Joule and Thompson on this subject showed that when air expanded without doing external work its temperature fell five degrees Fahrenheit for the difference of twenty-one atmospheres between its initial and final pressures; and that this fall of temperature was directly proportional to the fall of pressure, which would give for each difference of pressure of one pound per square inch, a fall of temperature of 0·01621 degree Fahrenheit.

"If the air be not compressed at constant temperature, but have, during its compression, an increasing temperature caused by the work of compression done upon it, and if this additional temperature so obtained be abstracted by external cooling appliances after the compression has ended and before the expansion has begun, then the whole of the work expended in overcoming the pressure due to the heat of compression is lost, for the quantity of air compressed is the same whether the compression be done at constant temperature or increasing temperature, and the power or work recovered from the expansion is the same, because the same quantity of air at the same temperature will be expanded the same degree or number of times in both cases. The power developed by the expansion has a fixed relation to the power exerted in compression only when the compression is done at constant temperature.

"If the expansion, instead of being carried down to the atmospheric pressure, is terminated before that pressure is reached, and the air be then discharged with excess of pressure into the atmosphere, whose resistance is consequently less than that of the expanding air, the latter will expand to the atmospheric pressure, and in so expanding will do work, though less in quantity than if expanding against a resistance equal to its pressure, and will undergo a refrigeration proportional to the work done in expanding against the atmospheric pressure. Of course, the atmosphere upon which the work of this expansion is done undergoes a heating equivalent to the refrigeration experienced by the expanding air.

"If the compressed air, after having its temperature reduced to that of the atmosphere, be made by mechanical apparatus to commence its expansion at a lessened pressure, in which case the same quantity of air will be expanded down to the same atmospheric pressure, but the work done by its expansion will be less than if the expansion had been commenced at the maximum pressure, and the refrigeration will consequently be less; and, further, the power recovered from the air thus expanded will be less."

A DANGEROUS "SAFETY APPLIANCE."

The Bridgeport, Conn., *Standard* gives the following description of the arrangement adopted on the New York division of the New York, New Haven & Hartford for side-tracking a train if an engineer undertakes to run upon an open drawbridge:

"At the center of the bridge has been placed a crank apparatus under the direction of the draw tender. When the draw is to be opened the tender turns the crank partly around, and by so doing throws up a signal on each side 1,400 to 2,000 feet from the bridge, warning the engineer to stop his train, and at the same time throwing up the home signal. Both of the signals are semaphores, the distant signal is green and the home-signal red. The draw-tender then turns a lever half way round, and resumes his crank, one turn of which sets the derailing switch by drawing the bolt that holds the switch in position for the main line; the derailing switch guides the train into the sand bank, providing the engineer has neglected to stop his train by the aid of the road signals. The bridge-tender having performed these operations, the crank is again turned, drawing the bolt holding the draw in position; and then the draw is in condition to be opened by the ordinary means. After the draw has been closed, and while the signals are still in position, one turn of the crank sets the switch for the main line, another manipulation drops the signals and another fastens the draw. The draw can not be opened before the signals and the derailing switch are set, and the signals cannot be dropped until the draw is again securely fastened. Absolute safety is thus obtained."

[This does not seem to us to be the case. We think the train is in more danger from the bridge-tender with all the motions he has to make than from the possibility of the signals being overlooked by the engineers.—EDS.]

COMPOUND LOCOMOTIVES.

Many contradictory reports have been circulated respecting the performance of the compound locomotive which is having a trial on the Boston & Albany Railroad. We are informed on excellent authority that the engine works well. but is not making the saving in fuel which had been anticipated. The engine is in regular service, running every day. Mr. Dunbar, the patentee of this method of arranging the compound cylinders on a locomotive, is at present in South America, but on his return he may be able to suggest some improvements which will secure greater economy. Mr. Dunbar is a practical man, having had considerable experience with locomotives, and is well known in connection with the packing that bears his name. Compound engines have been singularly successful on board ship, and therefore their possible development on locomotives is at once an interesting and important problem.—*Railroad Gazette.*

We do not see the exact connection between a marine compound engine and a locomotive. In the former the work is continuous and uniform; in the latter it varies constantly; this is against the compound engine for there are periods when the low pressure cylinder would get little or no steam.—EDS.

CASSELS' MAGAZINE OF ART FOR MAY is quite equal to previous issues. The engravings are all that could be wished in point of execution and printing; we wish we could add also in point of selection, but we must object to the full page engraving "*A Silent Colloquy*" which is not only disagreeable as a subject—(a man interviewing a skeleton) but presents no especial attraction in other ways. "*Pictures at Leeds,*" is beautifully illustrated, and the work as a whole is indispensable to all who love art for art's sake.

A SHORT TIME AGO the American Humane Association of Boston offered a prize of five thousand dollars for an improved cattle car, to stimulate the inventive ability of the country. One of its conditions was that the patents on the approved car should be given to the Association, that the car might be offered to the railroad companies free from royalty.

But the owners of the best inventions decided not to compete for the prize, thinking that their cars would prove more valuable to them than the five thousand dollars. Accordingly, the prize could not be awarded. The offer, however, caused the construction of cars which meet the requirements of the law, and the trustees of the fund take this way of making known the fact to officers, directors and stockholders of railroad companies, and to all humane people whose hearts have been touched by the atrocities of this traffic.

Gold medals have been given to the persons and companies whose cars are worthy of commendation.

The great success of refrigerator cars is lessening the number of animals transported alive; but there must always remain such a traffic in them as to make the improved car a permanent necessity.

It is said that neither the association nor any of its officers have a pecuniary interest in any of the cars.

THE TELEPHONE has been a great boon to the public, and a still greater one to paragraphers, who find in it the source of alleged humerous anecdotes, illustrating the stupidity of the average person. The last one of these narratives asserts that a feed-dealer received an order per telephone to send a quantity of hay to a certain street number. On inquiring who it was for he received the indignant response: "Why for the caow, of course."

IT IS INTERESTING TO NOTE that paper for making marine charts must be, as far as possible, without shrinkage in any direction, for obvious reasons. American paper is not so good as French for this purpose, says Lieut. John E. Pillsbury, U. S. N.

THE EMPLOYEES AT THE DRY DOCK SAW-MILL at Mobile were badly frightened not long since by a blaze of fire suddenly enveloping a log that was being ripped in two. When the machinery was stopped it was found that the teeth were all knocked off the saw. On cutting into the log a 6-inch iron shell was found near the center. The tree from which the log was taken grew in the vicinity of the Spanish forts, near New Orleans, and it is not certain whether the shell was embedded there during Jackson's famous battle or at the capture of the city by Farragut in 1862. The fuse and powder were found to be in good condition, and it is considered remarkable that an explosion was averted.
—*Iron Age.*

IN AN INQUIRY as to the present condition of the English navy, and its ability to maintain the prestige of the nation, the London *Engineer* makes this remark:

> "An attack by any European country hardly suggests itself to an Englishman. We only ask in what way are we to protect our commerce from attacks, bearing in mind that England is said to have a stock of food only sufficient to last for six months at the most, occasionally for three months only, and that being an island our shipping trade is absolutely necessary to keep us from starvation.

This seems to be rather close work.

"IT IS PROPOSED TO BUILD IN NEW YORK a tramps' lodging-house, in which lodging, bath and breakfast shall be given to vagrants in return for a half-day's work."

If the breakfast, etc., is no better than the work gotten out of tramps everybody will lose on this scheme.

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ENGINE OF THE TUG-BOAT "DELAWARE"—P. R. R. CO.—WITH JOY'S VALVE-GEAR.

It is well known that, with the link-motion, it is impossible to obtain an even distribution of steam coupled with an equal lead, and in setting for one the other is seriously impaired, the inequality increasing with the increase of expansion. With high grades of expansion and the link-motion, as usually constructed, the lead becomes excessive, and the point at which steam is admitted is so considerably in advance of the stroke that it does not give a satisfactory result for slow-running types, such as marine engines, etc., and consequently in these an additional valve and independent gear are usually employed for expansion.

The Joy valve-gear is a combination of two motions at right angles to each other, and by the various proportions in which they are combined and by the positions in which the moving parts are set with regard to each other, it gives both the reversal of motion and the various degrees of expansion required. Eccentrics are entirely dispensed with; the motion for the valve is taken direct from the main rod, and by utilizing independently the backward and forward action of the rod, due to the reciprocation of the piston, and combining this with the vibrating action of the rod, a movement results which is employed to work the valves of engines using any combination of lap and lead desired, and giving an almost mathematically correct cut-off for both sides of the piston for all points of expansion, intermediately, as well as a much quicker action at the point of cut-off and exhaust than is given by a link-gear.

In operation, the action of a valve with this motion is similar to that of a tappet valve-gear, but without any jerks and jumps.

In the Joy valve-gear, the lap and lead are opened by the action of the valve levers, and the port is given by the incline of the curved slide in which the center of that lever slides, and the amount depends on the angle given to that incline; consequently when these two actions are in unison the motion of the valve is very rapid, and this occurs when the steam is being admitted. Then follows a period of opposition of these motions, during which time the valve pauses momentarily, this corresponding to the time when the port is fully open. Further periods of unison follow, at which time the sharp cut-off is obtained.

As to compression with this gear, owing to the peculiar movement given to the valves (*i. e.*, the series of accelerations and retardations referred to), while the lead is obtained later, and quicker, the port is also shut for compression later and quicker, doing away with the necessity of a special expansion valve and allowing the main valve to be used for expansion, as the compression with properly designed valves is not enough even at a cut-off of ·25 to injure the action of the engine.

In proof of this it may be mentioned that the engines of the British twin-screw armored cruiser *Amphion* (5,000 horse-power), fitted with the Joy gear, depend entirely on the main valve for the cut-off.

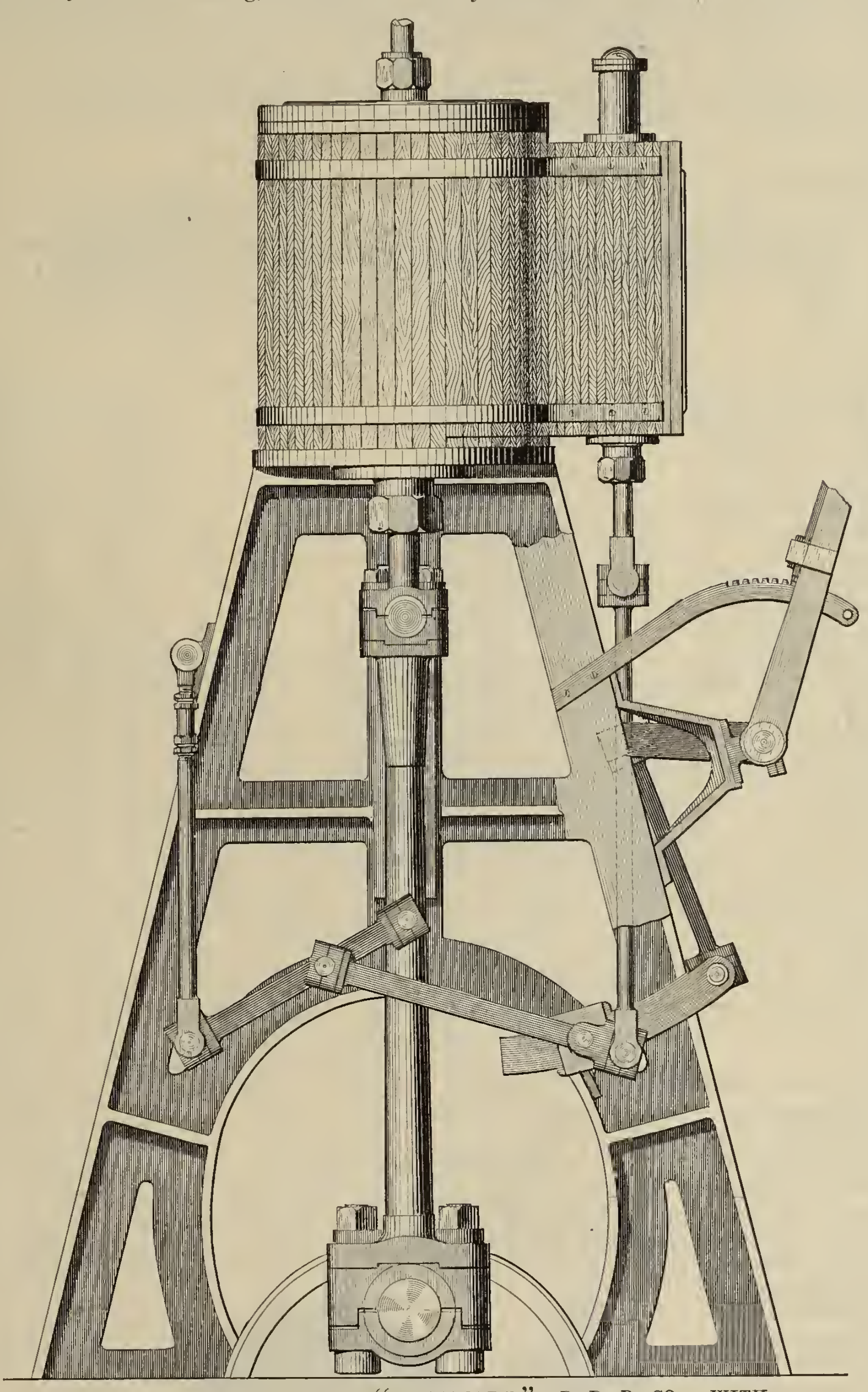
The advantages claimed for the Joy gear, as compared with the link motion, are briefly stated as follows: It is less costly by at least 30 per cent.; it permits simpler arrangement of the engine, also saving cost; its action is more correct, giving equal lead, port and cut-off; it saves ship-room by shortening engine space; is more accessible and easily kept in order when running, and is more easily overhauled when needing repairs.

The first marine engines to which this motion was applied in the United States were those of the steamship *Mexico* (cylinder 30″ and 60″, stroke 54″), belonging to the California & Mexican S.S. Co. of San Francisco. Mr. Birmingham, the agent of that line, says, 10th March, 1884, that it gives entire satisfaction, and after two years' use the wear on the working parts is barely perceptible. One of the advantages of the Joy gear is that it permits the steam to follow further on the upstroke of the pistons, thereby balancing the weight of pistons, etc., and another is that the point of cut-off can be changed without increasing the lead.

This valve-gear was patented in the United States 10th January, 1882. It is, as we are informed, now on from 60,000 to 80,000 horse-power of marine engines, including such vessels as the Italian ironclad *Italiano*, H. M. S. *Amphion*, and other similar ships, ocean and channel steamers, East Indian Government despatch boats, Pennsylvania R. R. Co. tugs, etc., etc.

Overhauling for repair and taking up wear is easier with the Joy gear, as the parts are removable, independently of each other, and eccentrics are done away with.

We are indebted to Mr. H. S. Hayward, Superintendent Motive Power, Pennsylvania Railroad Co., for this drawing and for information, and we are given to understand that the operation of the gear is entirely satisfactory. The engines turn up very smart, and are easily handled. Mr. Wayland Turner is the resident agent for Joy's valve-gear in this country, and his address is Box 1050, New York P. O.



ENGINE OF THE TUGBOAT "DELAWARE"—P. R. R. CO.—WITH JOY'S VALVE-GEAR.

CONCERNING the patenting of inventions already patented we have commented previously. Another case has recently come to our notice. Several years ago Captain John Ericcson made a piece of ordnance which was reinforced by wrought iron plate disks shrunk on a central tube, and that gun is now on the Cob Dock in the Brooklyn Navy Yard. On April 1, 1884, a patent was granted to Frank H. Durell, of Bay City, Mich., for a weapon identically the same in principle.

TO PREVENT SPERM OIL from gumming is the title of a recipe in a handbook, and then follows a list of chemicals one is to mix with it. Pure, unadulterated sperm oil never gums under any circumstances. We have put old machines away covered with it and found it, a year after, as fresh as when first applied, but this was New Bedford sperm oil.

JOHN ROACH is building an oscillating engine for a steamboat to run on the Sound in the service of the *Providence & Stonington S.S. Co.* It is to be compound, 42″ × 78″ × 10′—side wheel, and is the first of its class made in this country in many years.

THE *American Machinist* says:

"Some of our scientific contemporaries are exercised in a discussion of the momentous question: "Does the piston (of a reciprocating steam engine) stop at the end of the stroke?" Debating clubs were in the habit of wrestling with this question some years ago, but so far as heard from it was always too much for them. It is extremely fortunate that the builders of steam engines will be able to provide, somehow, for a change of motion while this question is being scientifically answered."

If our friends will remember how much they have published themselves upon this subject they will see that their reproof is rather ill-timed.

PERSONS who cannot obtain THE MECHANICAL ENGINEER from newsdealers can have it sent three months for fifty cents.

USEFUL INFORMATION.

Among the questions most frequently asked of our inspectors when making their visits are the following, which are of such general interest to engineers as to warrant publication :

1st. How much water per pound of coal should be made into steam at 60 pounds pressure per square inch with 60-inch tubular boilers properly made, well set, and carefully fired?

Under the above conditions, from 8 to 10 pounds, dependent somewhat, of course, upon the quality of the coal, and the temperature of the feed water.

2d.—How much more coal per pound of water does it take to carry 80 pounds per square inch than it does to carry 60 pounds per square inch?

This question could with more propriety be put as follows: How much more heat does it take to make a pound of steam at 80 pounds pressure per square inch than it does to make a pound at 60 pounds per square inch ?

Practically, no more coal will be required ; *theoretically*, about $\frac{4}{10}$ of one per cent, or about $\frac{1}{250}$ part more.

3d.—Do you get enough better results from steam of 80 pounds per square inch than you do from steam 60 pounds per square inch, to pay for the extra wear and tear of boiler and engine?

Depends entirely upon conditions : If you can *make use* of steam of 80 pounds pressure it pays to use it ; there are conditions, however, where 60 pounds, or even less, would be decidedly more economical.

4th.—How much more heat do you get from pipes carrying 60 pounds pressure than from pipes carrying 10 pounds pressure ?

Two and one-tenths per cent. more heat will be given out per pound condensed from steam of 60 pounds pressure than from steam of 10 pounds pressure, in falling from the temperature due to the respective pressure of 212 degrees Fahrenheit.

5th.—What proportion of direct heating surface to the volume of a fairly protected room is required to maintain the temperature of the room at 60 degrees F., in buildings heated by steam ?

From $\frac{1}{75}$ to $\frac{1}{250}$ according to size and exposure of room.

6th.—How much is a given amount of steam reduced in bulk by compressing it from 60 pounds per square inch to 80 pounds per square inch ?

About 20 per cent. See any steam table.—*The Locomotive.*

BOOKS FOR ENGINEERS AND MACHINISTS.

We quote elsewhere from our contemporary, the *American Engineer*, an excellent article on the subject indicated in our caption, and cordially endorse its arguments against the further production of such works as are there condemned. Our contemporary is very lenient to the person it has in mind, thinking, perhaps, that "the game is scarcely worth the powder," but when alleged technical works, like the one criticised, and many similar by the same writer, are compiled by first begging electrotypes from publishers and then writing up to them, it is quite time that the reading public should be warned of their character.

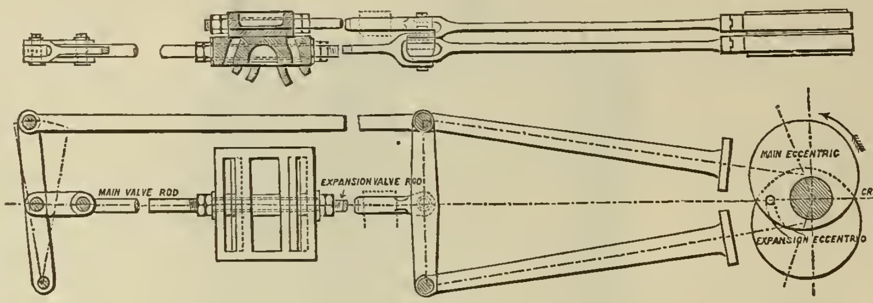
A miscellaneous mass of machinery, crudely arranged as to character, is of no value as a technical work, and should not be put forward as such. It is in the same category as manufacturers' circulars, which, doubtless, are often laid under contribution for "matter." Our contemporary is quite correct in saying that reviews of technical works should be conscientiously made, but a difficulty arises in the fact that there are but few reviewers who are competent to discriminate.

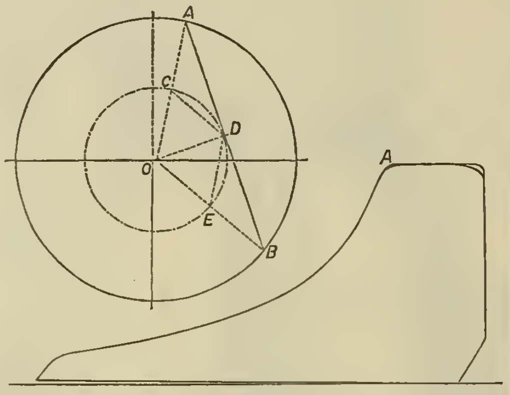
The saving effected by the cable system of propelling street cars is strikingly shown by the fact that a 375-horse power engine operates ten miles of double track road in Chicago, doing the work of nearly 2,000 horses.

ENGLISH'S VALVE-MOTION.

We illustrate herewith a valve-motion which is new to us. It is an English device, and the inventor's name is also English. We quote from *Engineering*:

"On the back of the main slide is an expansion slide without lap, which derives its motion from the center point of a link connecting the ends of the main and expansion eccentric rods. The travel of the main slide is reduced, by means of a lever, to one-half the movement of the main eccentric rod, and the effect of these combined movements is to cause the relative motion of the expansion valve, compared with that of the main valve, to be always constant in amount, giving a cut-off of uniform maximum sharpness at any point of the stroke, while the point of cut-off follows the shifting of the expansion eccentric round the shaft.



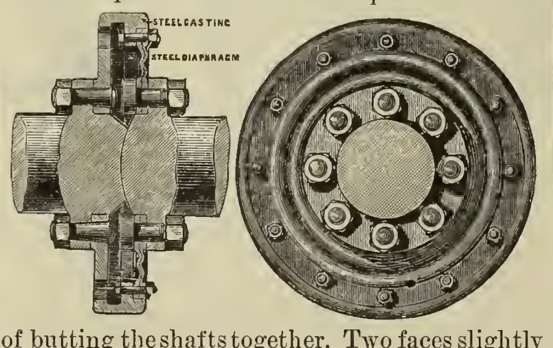


We give Zeuner's diagram illustrative of English's gear, and it will be clearly seen that the line, *C D*, remains constant in length and parallel to *O B* in all positions of the latter, *A O* representing half the throw of the main eccentrics, *O B* half the throw of the expansion eccentric, *O C* half the travel of the main valve, and *O D* half the travel of the center of the link. *C D* or *O E* represent half the travel of the expansion valve relatively to the main valve.

"The indicator diagram shows an early cut-off, the point, *A*, at which the steam ceases to enter being very clearly marked. The expansion line is very distinct, also the points of release and compression. It has been patented both in England and abroad."

A FLEXIBLE COUPLING.

A shaft-coupling which is in a measure elastic, or flexible, is here shown. The engraving gives all the details on its face. There seems to be no special value in the expensive method of butting the shafts together. Two faces slightly rounded from the center would answer the same purpose, with an advantage in point of cost of construction.



A. E. Barthel, Box 2837, N. Y., sends us one of the handsomest colored circulars of his new method of lubrication that we have ever seen. The lithographs of oil-cups show some fine effects in rendering brass work, and all interested in mechanical art-work, as well as lubrication, should send for it.

GOLD AND GOLD LEAF.

Eighteen-carat gold is considered a very high grade by jewelers and goldsmiths, but in our business it is next to worthless. Twenty-four-carat gold is absolutely pure. Eighteen-carat contains one-fourth adulteration, while the metal that we use is adulterated with foreign substances only one carat, or one twenty-fourth part. It seems strange that sign-painters, picture-frame makers, and bookbinders should require a finer quality of gold for their work than is required by a jeweler, but such is the fact. When a circus manager advertises golden chariots in his street parade he is near the truth. From my experience as a manufacturer of leaf gold I know that many circus chariots are covered with from $100 to $200 worth of pure gold.

There is a composition known to the trade as "florence leaf," one-fourth the value of genuine gold leaf, which is sometimes used by book-binders and others on temporary work, instead of the genuine article; but in the course of six months it loses its color and turns black. Gold leaf on a sign-board will be as brilliant twenty years hence as when newly applied. Nothing but the purest gold possesses sufficient ductility to be beaten into a thin sheet without breaking. The finer the grade of gold the thinner it can be beaten, so what we lose in using an unadulterated article is gained by the increase in surface which a given weight will cover. "How much surface do you think a gold dollar can be made to cover ?"

The reporter placed his guess at "a square yard."

There was a smile on the gold-beater's face at such an exhibition of ignorance. "Any man in this shop," he said, "can beat a gold dollar into 100 squares of four inches each. That would make 400 square inches, or thirty-three and one-third square feet. Two rooms, each sixteen and one-half feet square, may be carpeted with a flawless sheet of gold beaten from one single dollar. It has been estimated that 280,000 sheets of gold leaf go to make an inch. Two hundred sheets of uncommonly thin writing paper will make the same thickness, which shows us that it will require 1,400 sheets of gold leaf, placed one on the other, to make a sheet as thick as thin paper.

Any painter who has handled gold leaf knows how difficult it is to convey the leaf from the tissue-paper books, in which it comes to them, to the painted surface without more or less loss and crumpling of the impalpable substance. The slightest breath of air, or even a trembling of his hand, will make the leaf double on itself and shrivel into a shapeless mass, even after it is brought in contact with the paint. The delicacy of touch possessed by the girls who give the leaf its finishing touches may be understood when it is known that they are required to lift the gold leaf from the mold, trim it into sheets three and three-eighths inches square, patch up any flaws that may be found in them and finally place them in the tissue-paper books, ready to be sold, with such rapidity as to be able to make fair wages when paid at the rate of three cents a book.—*Cincinnati News-Journal.*

Job was a sorely tried man, but there was one thing he escaped, or we believe he would have succumbed—that is—reading the statements of free-traders. The sublime indifference to facts, the serene unconsciousness, or ignoring of every other issue save buying and selling, the irrelevancy of their issues, the cast-iron effrontery of their propositions, cause sane men to regard them with amazement and concern.

Richards & Co. Patent Solicitors, have removed from 52 Broad street to 24 & 26 Fourth avenue, N. Y.

Steel boiler-heads as large as 106″ in diameter and $\frac{5}{8}$ths thick are turned out in one piece in Pennsylvania.

NEW DECORATIVE PROCESS.

"This is entirely new and interesting, both as a curiosity and as a work of art," said the Manager of the Union News Company recently. He drew aside a curtain and exposed a likeness of Vanderbilt. It was done on a marble slab about 24 × 30 inches and one inch thick. The surface of the picture was as smooth as glass.

"The likeness appears on the other side of the slab equally as good. It is not only on the marble, but in the marble and through it, and cannot be eliminated from it. You may grind on it with pumice stone and you cannot hurt it. So long as even a shaving is left the portrait remains unharmed. Split it up with a saw and every slice is two portraits. The portrait is lifelike.

"I saw the greater part of the work done in making this picture. The portrait is painted on one side of the marble, whether in oil or not I do not know. When dry, the slab is rolled into an air-tight oven of moderate temperature. After being subjected for some time to a slow steaming process, the slab is suddenly transferred to another oven with a temperature of 300° and kept there till the process is completed. When removed, the colors are found to have penetrated the marble, and the picture appears on the other side.

"I have seen billiard balls subjected to the same process, hundreds of them at a time, and beautifully colored. One of them sawed in half shows the same coloring all through. Handsome chess and checker boards are made in the same way. In fact, a great variety of beautiful and durable work may be done. Wood may be similarly treated. Similar portraits of Bismarck, Gladstone, Disraeli, Gambetta, John Bright, and a few others are being made, to be placed on exhibition in May. Some will probably be sent to this country at an early day." —*N. Y. Sun.*

The *Springfield Republican* is a smart paper, full of zeal in gathering news in its locality, but it needs to curb the enthusiasm of those in its employ whom it sends out to write up locomotives. Witness this paragraph from its issue of April 27th:

> "Of all the new and old-fashioned locomotives which have been tried on the Boston & Albany road, none have succeeded so well as those made here from the plans of A. B. Underhill, Superintendent of Motive Power. 'No engine made,' said Mr. Westinghouse, inventor of the Westinghouse air-brake and engine, in Boston the other day, 'will do so much work with such economy of fuel as the Boston & Albany locomotives of the Underhill pattern.' Mr. Underhill's idea, worked out in these machines, is simply that steam at high pressure will do more work than at low pressure with the same consumption of fuel. His high pressure locomotives have already become so famous, although but 11 are yet made, that the Pennsylvania Railroad Co. is expected soon to send here one of its officials to see how well the engines work. It has been recently suggested that Mr. Underhill's scheme of construction could be made to work admirably on marine engines, although condensing in a tight box is quite different from condensing in the air."

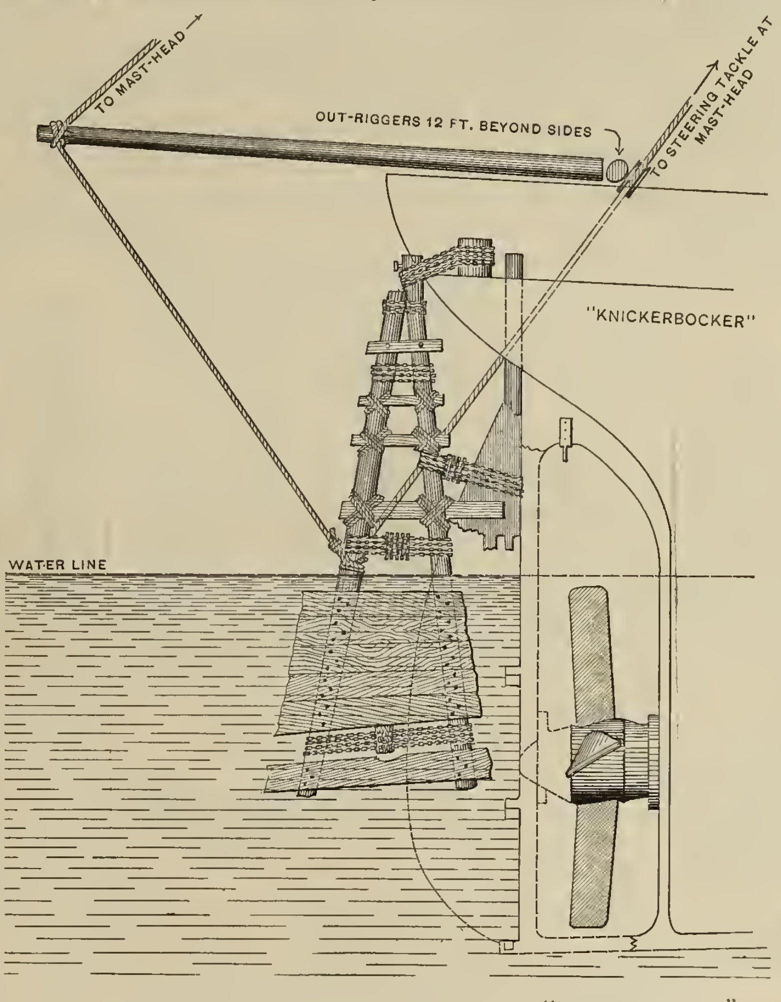
So it is, quite different; for in one case we get a vacuum and in the other we get none. Moreover it will be news to engineers that Mr. Underhill is the inventor of high pressure steam, or the discoverer of the superior economy of 170 lbs. per square inch over 135 lbs. per square inch. It has been quite obvious to many for some time. Mr. Underhill has a hard road to work, and fast time is demanded of him. The only thing he can do is to raise the pressure.

◆

John Elder & Co. are pushing on rapidly with the two large Cunarders they are building. These vessels are expected to beat any vessel afloat, and have engines far larger than any hitherto built, one single crank weighing no less than 27 tons; the boilers will have 72 furnaces, and the speed is expected to eclipse even that of the *Oregon.*—*London Truth.*

JURY RUDDER BY CAPTAIN FRANK KEMBLE —S.S. "KNICKERBOCKER."

The steamship *Knickerbocker*, Captain Frank Kemble, of the Cromwell Line, from New Orleans, arrived at this port on Wednesday morning, April 23d, steering with a jury-rudder rigged at sea. Captain Kemble reported that during a heavy northeast gale on Sunday afternoon, about 120 miles S. S. W. from Cape Hatteras, the rudder and rudder-post were carried away. During the continuance of the gale the steamer was steered by towing a heavy hawser astern, which by judicious use of the sails enabled the Captain head on to wind and sea, and to proceed on the voyage toward New York. Captain Kemble at once set to work to build a jury-rudder on deck, made from cargo gaffs and spars, with crosspieces securely nailed and fastened with strong lashings and strains, as shown in accompanying drawing taken on the dock from the rudder itself. On Tuesday morning the weather had sufficiently moderated to enable the Captain to get the rudder in position, and to secure it in place, further protected by guys running along each side of the ship to the deck amidship, and kept from getting foul of the propeller by guys running to end of spar projecting over the stern of the ship, then steering by lines running through blocks at the end of another spar (placed amidships), thence to blocks on mast and so down to the deck. Thus rigged, the ship was readily and successfully steered to her destination, refusing all assistance coming in past Sandy Hook and up channel to the Quarantine Station at Staten Island. Captain Kemble telegraphed to his owners and came to wharf a little later, employing only a tug to assist the ship into her berth at Pier 9, N. R.


TO MAST-HEAD
OUT-RIGGERS 12 FT. BEYOND SIDES
TO STEERING TACKLE AT MAST-HEAD
"KNICKERBOCKER"
WATER LINE

JURY RUDDER BY CAPTAIN FRANK KEMBLE.—S. S. "KNICKERBOCKER."—SCALE ABOUT ONE-EIGHTH OF AN INCH TO THE FOOT.

The *Knickerbocker* is a large and valuable steamer and had full cargo and 40 passengers. The vessel and cargo were probably worth at least half a million dollars. Captain Kemble deserves great credit for his ability in improving this successful and ingenious steering appliance, which enabled the steamer to complete her voyage without other assistance, saving her owners and the underwriters from large salvage and other expenses and trouble which follow accepting assistance at sea.

◆

According to a paragraph in the *Age of Steel*, one firm in the West made ninety car-loads of sealing-wax last year.

A correspondent writing from Pittsburgh says:

> "Will you please tell me what is the matter with the *Letters to the Editor* in No VIII? Outside of *The Professor in the Machine Shop* I have learned a good deal from that department, and this is the first time I have 'felt lonesome' in three years for want of it."

The absence of correspondence in that issue was for the best reason in the world: None came to hand. It was rather an unusual circumstance, but one that we exercised no control over. Our correspondence always falls off in warm weather, and on the approach of it as engineers are generally too busy in fitting out and getting ready for summer, to attend to it.

◆

Persons with prejudices sometimes sneer at our Navy and ask what it has ever done, and why we should be taxed to support one when the country is not at war? As to what it has done when it had the chance—during the rebellion—the books of the Department show that 733 blockade-runners were captured, whose value was over $26,000,000 at the lowest appraisals, and in many cases cargoes were destroyed without valuation.

A correspondent of the *Mechanical News* says:

> "The engineer's pride in the best machine, his better care, are matters that cannot be expressed in figures, but they exist and should be recognized. When I build my shop it shall have a first-class engine, first-class boilers, a cool and comfortable boiler-room and engine-room, everything properly and comfortably arranged, and I shall look for corresponding longevity in the coal pile."

This must be the coming man we are all looking for.

The bills which were to annihilate property and capital vested in patents have all been "recommitted for further investigation," which means in plain English that those who voted to steal the rights of individuals are very glad to kick the business into the nearest and darkest corner, and pretend they never heard of it.

That such bills could ever pass beyond a mere reading of them, much less be voted upon, shows how little the average representative knows of the business of the country, or what it largely rests upon. Aside from the moral attitude of the Government, in proving false to its plainly stated agreements, making patents public property, would create a wilder panic in twenty-four hours after the passage of such a bill than the sun ever yet shone upon.

◆

A correspondent in Louisville, Ky., asks us to say something upon the subject of lapping out holes in locomotive parts, by which he means grinding out holes in bushes that have been hardened. We do not know of but one way of doing this, which is by means of flour-emery and oil used on a lead or copper mandrel. We fancy also that very little of this kind of work is done nowadays, except in cases of emergency. Locomotive parts are not hardened, in our experience, neither in the bushes nor in the bolts.

◆

Evidently William Munzer, builder of the Munzer Corliss engine, is not prostrated by dull times, for he has just moved into a new and enlarged shop at 204–210 East 40th street, N. Y., said removal being necessitated by the demands of his growing business. Mr. Munzer is a thorough, practical engineer himself, and gives his personal attention to details, hence his prosperity, doubtless.

◆

If a man gets only one idea in a year out of his trade-paper he has great gain. Two or three dollars for an idea! it is cheap at twice the price.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

OF INTEREST TO FOREMEN.

Editors MECHANICAL ENGINEER:

Mr. Moulton's appeal to his friends in your last issue as to the correctness of his position, makes me bold to say a few words. I presume I may be considered one of his friends, having read his articles since their commencement. Now, I think he goes a little too far; and when he talks about using the sledge, shows that he is going on a wrong principle. Why? Because a foreman may not always think of the best way to do a job, as he has so many to think of at once, and if he is a good foreman he is always willing to accept suggestions from workmen. In fact I am convinced that, generally speaking, the best foremen are the least competent to decide mechanical problems.

Laying out work, and directing others so as to keep everything going to the best advantage, is an art by itself, and is not necessarily connected with mechanical ability, any more than with the ability to climb a tree, or play a flute.

One of the most successful men in charge of work I ever knew, kept a good man on job-work,-principally for consultation. All the men wondered why he was kept there at the best pay, on common work, when a cheaper man could have done it just as well, and probably more of it; but the boss knew why, and so did I, although he never told me.

Right here comes the issue of mechanical jealousy. Musicians have the reputation of being the most jealous people in the world, but I am satisfied (and I have had experience with both) that mechanics are just as bad, if not worse. Mechanical jealousy, Mr. Editor, is the *curse* of nine-tenths of the shops in America. Suppose I am the best mechanic in the world, shall I therefore undertake to oppose everything not mine? Is it not the place of a foreman to consider suggestions from his workmen, and if found better than his own, adopt them? Would it not have been better for Mr. Moulton to suggest the tap to the foreman in the first place, rather than wait till he had spoiled half a dozen nuts? Of course I am assuming now that the foreman was a gentleman. Now, don't laugh, because I don't mean a dude, nor, necessarily, a superintendent of a Sunday-school, but simply a man who has some regard for the feelings of others, and tries to treat his workmen as he would like to be treated.

Mr. Editor, it does not pay any proprietor to have a foreman who is not a gentleman. I will say this much about myself: I have had charge of work, and never swore at one of my men yet, and have always listened to suggestions when offered, and have had some very good ones from the commonest men. Why? Because a man who works over a certain machine day after day sees things that the foreman cannot see.

These ideas may not be original or valuable, but they are the honest opinion of one who is interested in the subject, and who believes that it is business to allow workmen to think a little for themselves.

BOSTON, Mass. MACHINIST.

REPLY FROM MR. MOULTON.

The above letter was sent to me by the editors for a response, and having read it carefully, *verbatim.* and between the lines, as the saying goes (that is, mastered the writer's spirit and mood when writing) can endorse the most of what he says as eminently sound and sensible. I am sorry to make any reservation in so kindly a criticism, but if we differ on any points in the above it is only in degrees, not in kind.

There are foremen and foremen, and what is correct of a situation is not so as regards a class. There are certain localities where a foreman only holds his place by virtue of autocratic ways and arbitrary measures, and there are others where his office is a sinecure, for the men are so intelligent and so well informed that he has little to do. In some shops every man is a foreman, in the best sense of the word, being fully capable of carrying on the business and directing the work, but not in all shops is this the case. Where it is not, a different sort of man is needed as the head.

As to suggestions from the men I can see where it would be useful, and where it would be mischievous. It is not a privilege to be intrusted to a shop at large. I am free to confess I am afraid of it. A foreman is supposed to be at the head because he is the best man to be had, all things considered, for the situation. If he is not, by the law of natural selection, he subsides in due time. Discipline in a shop is as necessary as the same in the army, or on shipboard; without it there is nothing but confusion. The mate may be a better navigator than the captain, but he must not offer the latter any advice, and, to cut it short, I am afraid that bestowing the privilege, indiscriminately, on workmen to tell the foreman how work should be done, would do more harm than good.

Certainly, administrative ability is a very important qualification in a foreman, but so is the mechanical faculty, and the perfect foreman is he who has both; but alas! none of us are perfect in this world, and being conscious of it we put our best foot foremost to distract attention from the lame one.

I am also free to confess that, as an old-timer, I would not keep a man in the shop for consultation. It would be a rare man who in such cases would not plume himself on being the power behind the throne, and credit himself with deciding questions that were critical when I had not the ability to do so. I can see how schisms and cliques would be formed, to the ultimate disadvantage of the business carried on.

What my friend says about shop jealousy is true, but not of musicians and machinists only, but of all born of woman. Did *Machinist* ever have any dealings with artists, or professional people of any other class than musicians? If he has had he would find that this evil spirit pervades every breast at times, save only those who are born without it. We think machinists are the most jealous people in the world, because we see more of them, we live among them and are of them, but all other classes of men are tinged with it as well. Jealousy is the tribute mediocrity pays to merit, but I don't think that machinists are the only men cursed by it.

> "Of all the passions jealousy is that which exacts the hardest service and pays the bitterest wages. It's service is to watch the success of our enemy and be sure of it."

I came across this passage once, and it struck me so strongly that I have remembered it ever since, though I may not have quoted the exact letter.

I have nothing but hearty commendation for that portion of *Machinist's* letter which says that a foreman should be a gentleman, and have consideration for the feelings of others. Unquestionably he should, and a man who has not this, in one form or another, will never succeed. A brute will be run out of the shop, and should be. A foreman who has consideration will succeed, even if he is not so good a mechanic as he might be, for all the boys will turn to and help him out. I remember a foreman I worked under once who was, I think, about the wildest slouch on work I ever saw, but he was also one of the kindest-hearted men in the world. He wasn't a fool by any means, but his forte was to be always genial and pleasant, without being a sawney or a sap-head, and every machinist knows what this vague epithet means in a shop. There never was a more orderly, business-like shop than this, for what "Jim" didn't know the men did, without being told to.

Machinist says his ideas are neither original or valuable, but I beg leave to differ with him as to the last. They are of great value to all who may chance to read these communications. They lead others to think and perhaps some who are afflicted with the evils pointed out, may see the error of their ways and mend them. I say with the editor of this paper, that all criticism is valuable to every one. It never misses its mark, it hits some one, where it is publicly printed, and it is a very great educator. The critic's task is a thankless one, for even those who profit by what he says sometimes misinterpret his motives, but when these are sincere he is a benefactor. I love the critic.

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THICK AND THIN BOILER-PLATES.

Editors MECHANICAL ENGINEER:

DEAR SIR:—In your issue of May 3rd, in an article headed "Are thin fire sheets useful and necessary?" you concluded with the following interrogatory:

> "Does it make any difference whether heating surfaces of steam boilers are thick or thin?"

The law, as applied to the use of steam boilers for marine purposes, makes it necessary to increase the thickness of the shell in proportion to the increased diameter of it. Therefore it seems in order to have large boilers carry high pressures, thick sheets of metal are necessary.

In reply to the concluding question I would state that in an article in a contemporary from a boiler-maker accustomed to repair boilers of various styles of construction, he states that in cutting away defective plates the surface exposed to the action of the fire is exceedingly hard in a thick plate and has all the appearance of crystallization. This he claims shows that the water contained within the boiler only protects the metal to a limited extent of its thickness. This limit he fixes as correctly reached by the provisions of law which specify that "no boiler which the heat is applied on the outside of the shell thereof shall be constructed of iron or steel plates of more than twenty-six one hundredths of an inch in thickness."

In a recent article, Mr. W. Barnett Le Vau, who is so well known to the readers of THE MECHANICAL ENGINEER, expressly states that very thin plates in the shell of a boiler cannot be caulked, and very thick plates cannot be riveted so as to retain the same proportion of strength as thinner plates. Practically, he fixed the least limit at 25-100ths of an inch, and the highest at 75-100ths of an inch. And he asserts that where the fire is brought in contact with the shell or fire-box of a boiler its thickness should not exceed 31-100ths of an inch. In proof of which he submits the fact that the Baldwin Locomotive Works in their large practice have found this latter fact to coincide with their experience in repairs to a large number of locomotive fire-boxes. This he claims is due to the fact that the heat in a boiler-furnace may reach 1,500 degrees, which, in contact with the metal of excessive thickness, cannot be conducted fast enough to the water, so that in consequence the fire-side of the metal becomes overheated and thereby injured, and reduced in thickness at the expense of the heat destined for evaporation. The loss entailed, he claims, by the use of excessively thick metal exposed to the action of the fire is therefore two fold—the unnecessary expense of metal and labor in the construction of the boiler, and the wastefulness in the consumption of fuel. Mr. Le Vau also states that there is a very decided objection to excessively thick metal in the danger from explosion that is likely to occur at any moment, due to the reduction of the plates below that sufficient to withstand the safe working pressure. For these reasons he claims that iron in contact with fire should not exceed in thickness the amount which has been found by years of experience to be the maximum for the proper conduction of heat, so that there will be no reduction of thickness from the action of the fire.

In your article referred to, you confess to have said nothing about the question of durability of fire sheets of various thicknesses, the data for which you state is not at hand. Under this head M. Peclett correctly observes that "under ordinary circumstances the quantity of heat which a metal plate has the power of transmitting is far greater than what it is really called upon to transmit. To expect, then, that the plate will exercise a greater power of transmitting heat to some other body than that body possesses of receiving and absorbing it would be a physical absurdity. It is manifest that the heat absorbing power of steam is so inferior to that of water that a much less quantity will be taken up in given times by the former than by the latter. Again, since no more heat can be transmitted through a plate from one side than can be taken from it by the recipient on the other side, the transmitting power of any given surface must be absolutely dependent upon the absorbing power of that recipient, whether it be water, steam or air. If from any circumstance the water be prevented or delayed in gaining access to the plate the steam will in a like degree be obstructed in leaving it, the presence of the former being the very means by which the latter will be effected."

NEW YORK. THREE STARS.

[We shall have something to say on this subject in another issue, and are much pleased that correspondents have favored us with their views.—EDS]

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THICK OR THIN SHEETS FOR BOILER-PLATES.

Editors MECHANICAL ENGINEER :

In your issue of May 3d, you ask the question if it makes any difference whether the heating surfaces of boilers are thick or thin for economy of fuel. On consideration of this question I find that in large diameter boilers, of the tubular type, the amount of plate-surface is quite small as compared with the tube-surface. Take, for instance, a 5 ft. boiler 15 feet long, with 80–3″x15 ft. tubes, and we have in the shell, say 112 ft. in the tubes 900 feet, about 8 times more surface in the tubes than in the shell. Now, if we give this boiler a rating of 12 ft. heating surface per h. p. we have 84 h. p. The length of run for the heat in this boiler is, say, twice its length, 30 ft., and the greatest heat is applied to the plates, which will be $\frac{3}{8}$ths thick. Now, we will compare this with an all-plate heating surface boiler, which will have 10 ft. of heating surface per h. p. and it must have 840 feet. This would be obtained in a 7ft. diameter by 28 ft. Lancashire boiler, which at ordinary pressure would be rated 84 h. p. The plates in the shell would be 7-16ths, and in flues $\frac{3}{8}$ths. The run for the heat in this boiler, with furnaces in the ends of the flues, would be 3 times its length, which would be 84 feet. This length of run is obtained by splitting the heat after it gets through the flues and returning it upon each side to the front end, and then returning it to the rear through a flue under the bottom of the boiler. Here we have the American type of boiler and the English type compared. Now, which will produce the most result for the same amount of fuel burned in a given time with each of these boilers? I think there is no doubt but that the Lancashire boiler would show the best result from the fuel. Why is this? One has all thick plates internally fired with longest run, the other is externally fired and has eight of tube-heating surface to one of plate, and twenty per cent more total surface than the other, but only about 1-3d the length of run.

If the combustion of the same amount of same kind of fuel burned in a given time in each boiler is alike in both, why should not one produce as much result from the fuel as the other? In the tubular boiler we know that the total heating surface is not as efficient as the total heating surface in the other. What the loss from radiation would be is not known (I think), but to speculate upon it, I should say that this loss would be about equal, considering the surface of brick work exposed in each boiler. This being the case, where is the difference in the effect of the fuel produced. Is it in the better combustion, on account of the large flues, and longer run, which gives more time for the absorption of the heat? These are questions which should be solved by practical experiment in our scientific institutions, and given to the people of this country so that they may know what results to expect from the several kinds of boilers under the conditions used, and equal conditions.

Some years since I saw a published statement that Krupp had tested two boilers of same type and dimensions, one having plates $\frac{3}{8}$ths thick, the other with $\frac{1}{2}$″ plates, burning the same weight and the same kind of fuel in the same time under each. He found the evaporation much greater in the $\frac{3}{8}$ than the $\frac{1}{2}$″ boiler.

You ask does it make any difference whether the plates are thick or thin? I think it does in the same types of boilers, under the same conditions and doing same duty, in a given time. The thinner boiler would (in my opinion) show a decided economy of fuel over the thicker boiler, but in boilers of different types the losses in one may be made up by gains in other respects and *vice versa.*

There are many things yet to be learned about boilers, in all respects, and the question you ask should be

decided at once. This one also: What is the gain or loss in fuel with the several kinds of metal plates of same thickness, the several grades of iron and steel plates and also copper and brass? Will a steel-plate of same thickness as an iron one evaporate more water for the fuel consumed? If we take common kettles for a test one having $\frac{1}{4}''$ bottom, the other $\frac{1}{2}''$, and into each put the same amount of water at the same temperature, both kettles being of the same size, and with the same area of grate; if we burn wood under these kettles until we bring the water to a boil, then, starting from this point with clean furnaces, with weighed wood of the same kind and condition and burn the same weight in a given time under each kettle, which will show the most evaporation? The element of time must not be left out of this consideration, because we want to know whether the thick plate will convey as much heat as the thin one from the same amount of fuel burned under the same conditions. The comparative security of thick and thin plates in boilers against their liabilities is quite another thing.
OBSERVER.

* * *

NOT AT ALL UNCOMMON.

Editors MECHANICAL ENGINEER:

About four weeks ago I saw a locomotive boiler that had exploded. The rupture commenced above the water-line; the iron appeared to be good, and the pressure at the time was 70 pounds per square inch. Since then I have examined a piece of boiler-plate that was 10" wide, and 52" long that had been cut off of the bottom of a locomotive fire-box. A good deal of this piece was only 1-16th of an inch thick, and in one place that had given out, but had done no harm (more than to cause a rupture about one inch long). It was only 1-24th of an inch thick. This boiler carried 140 pounds per square inch.

What I would like to know is this: If this old piece of corroded plate had been placed in the top of the shell, instead of the leg, would it have stood 140 pounds per square inch? If not, why not? Will you be kind enough to answer and oblige a young engineer.

DETROIT, Mich. WM RYMER.

[We should be very glad to answer our correspondent if we knew how, but we cannot. We have seen the same thing in his own locality. Nearly thirty-years ago (1855), we were on the old steamer *Bay City*, which at that time ran between Detroit and Sandusky. One day in putting a soft-patch on the water-bottom to stop a small leak we idly sounded the rest of the water-bottom with a cape-chisel, more from want of something better to do than any other reason. That cape chisel went through the water-bottom in a dozen places, as if it had been paper. As a matter of fact there was no thickness perceptible in the iron.

And yet we had carried constantly between 35 and 40 pounds of steam on the boiler. Since that time we have seen a similar condition of things above and below the water line in boilers that were at work daily, and all engineers of experience have seen the same thing. An ex-naval engineer has said to us that he stuck his knife through the waist of a boiler, just behind the fire-box, in the Naval Service, and that boiler had given no signs of fatigue in any direction. We have also made inquiry of professional men who are supposed to have an intimate knowledge of, and acquaintance with physical laws, and they have given the same answer that we give here—"I don't know."

Why a boiler with plates corroded to less than one-fourth of their original thickness over a considerable area, should stand any approach to working pressure is a question we cannot answer.—EDS.]

* * *

MR. "BAX" PAYS HIS RESPECTS TO THE YOUNG MAN WITH AN OFFSET IN HIM.

Editors MECHANICAL ENGINEER:

Upon receiving my paper to-day the first thing that attracted my attention was "*One of the Other Kind*" at the beginning of the page devoted to letters to the editor. The writer cannot be an engineer or he would like to hear something about boilers. I think all engineers like to hear such things, and can generally learn a little something from them. I have had considerable experience in the engineering line and find that I can learn something every day. When I speak of engineers I mean the kind of men who take delight in their work and like to have everything ship-shape in and around their engine rooms; men that try to keep up with the times and who read mechanical papers. There are lots of old fossils in charge of engines who claim to know it all; to such of course, THE MECHANICAL ENGINEER would be of no use.

As to England and English engineers. I think it a good thing to be able to find out what is going on across the water in the engineering line without being obliged to cross over to get the information. In one of my papers I find a cut of a modern English locomotive. I compare it with one of the latest by the Baldwin Works, and I am thus enabled to see how much the English engines are behind the times, with their cranked axles, inside cylinders, with steam chests and valves exceedingly difficult to get at and costly to repair, rigid wheel-base, no cabs worth speaking of, and, althogether about as uncomfortable machines for a man to ride upon as ingenuity could devise. All this and more I am able to learn from my paper.

The writings of Mr. Moulton are, your correspondent pretends to believes "the worst kind of silliness." I feel sorry for Mr. Moulton, for of course he will never write any more after reading the letter alluded to. The editor seems to think the writer of it must have an offset in him somewhere. I think that there is such a decided offset in him that it amounts to a crank. I trust Mr. Moulton will keep right on and let us hear more about the Professor.
BAX.

NEW JERSEY.

* * *

A DISSENTER.

Editors MECHANICAL ENGINEER:

In THE MECHANICAL ENGINEER, No. 7, is a letter from a young man in trouble with his cut-off valve. I am somewhat surprised at the sympathy and consolation bestowed on him, by your saying that he had done all that could be done. This statement has a tendency to make the young man think he knows it all, or that he is as smart as they make them All this in a measure tends to stunt his growth in engineering requirements, and will most assuredly prevent his rising above the "average grade," as from the general tenor of his letter he looks upon himself as a smart Alec. You, Mr. Editor, know how it was with yourself in early days.

I fail to see what the crank-angle, piston position, or rod-ratio has to do with equalizing point of cut-off, that is at any point within the limit of cut-off valve. In regard to your reference to Auchincloss link and valve motion, page 61, I always supposed that table referred to main valves, and with the ratio of crank to rod of $7\frac{1}{2}$. In the case of the main valve, its an open question whether to disregard lead opening and give equal cut-off is not the best mode of setting valve. Please look over the matter carefully and "cut-me-off" if I am wrong.

I would find no difficulty in equalizing a cut-off by leaving the eccentric alone and shortening or lengthening the eccentric-rod. The writer of the letter I mentioned would confer a favor on your readers by telling them the diameter of the cylinder, and the rule by which he calculates an engine with 45-inch stroke to be 20-horse power.

ISHPEMING, Mich. ECCENTRIC.

[We do not derive the impressions which our correspondent does from the letter he refers to.—EDS.]

* * *

PROGRESS OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors MECHANICAL ENGINEER:

Frank M. Merrill, of the Crosby Indicator Company, Boston, Mass., delivered a lecture upon the Indicator, its uses, and benefits before the Detroit Association of Stationary Engineers, on Tuesday evening, April 22d, which was listened to by the best engineers and most influential steam-users of the city.

Organizations of associations of stationary engineers are progressing The following have been organized within the past few weeks:

Leavenworth, Kansas; R. R. Rees, 323 Shawnee st., secretary.
Peoria, Ill.; J. C. Henry, 615 N. Adams st.
Queen City, of Cincinnati, O.; R. A. Deford, 189 Livingston st.
Minneapolis, Minn.; Geo. L. Johnson, 616 5th st.
North Pueblo, Col.; B. C. Roos, South Pueblo.
Nashville, Tenn.; Geo. M. Barker, corner Cherry and Union streets.
St. Joseph, Mo., John C. Gardner, 1119 North 4th st.

Advices show that in the near future Cleveland, Zanesville, Columbus and Dayton, Ohio; Grand Rapids and Adrian, Mich.; Lincoln, Neb., and about a dozen other places will organize. We now have 53 associations and over 2,000 members.

DETROIT, Mich. A. M. DAVY, Sec.

* * *

TO THE MEMBER OF THE "BOILER ASCENSION ENGINEERS."

Editors MECHANICAL ENGINEER:

In the last number of your paper I read a letter headed "*One of the Other Kind*," in which the writer expresses his opinion of THE MECHANICAL ENGINEER. Judging from the tone of the letter, I must say that the matter looks very serious—for the young man. The editor-engineer says in his criticism that "there is very little to be learned about boilers for engineers." Probably engineers of his ability do not need to learn much, as quite a number of them have been in the highest positions, and are well up in velocity, heat and dynamics I have read of some of them being elevated to positions sixty feet higher than the ground—boosted there along with a part of the boiler and some debris. No, engineers "do not like so much about boilers," especially when it is a case of low water and high speed. The critic also calls Mr. Moulton's articles "the worst kind of silliness," etc., but here my disgust turns to pity for the young man, Let him have his own way, for he knows not his doom. The "Association of Boiler Ascension" Engineers will soon lose a valuable member, for the engine lately described in the *Scientifique Americano* and mentioned by you, has ushered in that dread disease—brain-foaming.

But let him beware! The doors of asylums are already open to receive such as him, and if he keeps on in this manner the grim solitude of the padded cell will surely be his fate.

BRIDGEPORT, Conn. JOHN E. BREENE.

* * *

SCREW-CUTTING.

Editors MECHANICAL ENGINEER:

In your issue of May 3rd I noticed an article on screw-cutting. In reference to the same, allow me to state what has been my experience. We will take the screw mentioned as being $1\frac{1}{8}$ inch pitch, and suppose the screw to be 10 inches long. Then, if I understand the principle, it would be necessary to move the carriage back 18 inches for the first multiple (9 inches would be too short), and the next being 18 inches would be too long, on account of the tail stock, to say nothing of loss of time.

My method of doing the work would be as follows: In cutting a screw 10 inches long it would be necessary to move the carriage a little over 10 inches in order to start the tool in. Now, say we multiply the pitch of the screw $1\frac{1}{8}$ inch by a number which will give as a result a little more than 10 inches, thus $1\frac{1}{8}'' \times 9 = 10\frac{1}{8}$ inches, after the carriage has moved along the screw in one direction 10 inches, being the length of the screw to be cut, lay off on the shears $10\frac{1}{8}$ inches first stopping the lathe, throw out the nut and move the carriage back to the mark, throw the nut in gear, and the tool will fall in the thread every time.

PHILADELPHIA. SAMUEL BROOKS.

* * *

STEAM ON GLOBE VALVES.

EDITORS MECHANICAL ENGINEER.

I have been writing some time for some one to open out in regard to that *Steam on Top of Globe-Valves* business, when along comes a letter to you and demonstrates it to be a good thing. I cannot see it in that light. If the steam had entered on the underside of that valve the thread would not have worn away so fast. You know as well as I do that manufacturers do not put any more metal in the ordinary globe-valve than they can help, and never make any allowance for boring out. When seat or valve is worn out the whole thing has to be thrown in the scrap heap, all for the sake of trade I suppose. But, to my idea, steam on the under side is right. It helps to open the valve, saves the thread in the bonnet and the small fastenings on the under-side of the valve, or if the valve is held by a collar and nut on top, the end of the stem takes the pressure, so in my experience, for ease in opening and saving all parts from extra wear, steam should enter globe valves on the bottom. This is the way we put them in, and I have not thrown away as worn out a valve (and there are many of them) in this ship in 12 years. They are in more or less use every day and are in good condition.

H. G. HILL,
Chief Engineer, "Old Dominion" S.S.

* * *

KICKED BY A JACKASS.

Editors MECHANICAL ENGINEER:

I think you carry impartiality too far in publishing such letters as "*One of the Other Kind*," in your last issue. The young man has an offset in him, he is a crank. I have never been kicked by a jackass myself, but I presume Mr. Moulton knows how it feels by this time.

I feel rather affronted, personally, at seeing such an insult to the best modern mechanical writer in the best mechanical paper ever published; more horse sense in it than all the rest combined. Let Mr. "*J. McC.*," if that is his name, stop taking the paper if he don't like it.
J. T. MIDDLETON.

NEW YORK.

* * *

MR. SLOCUM COMMENDED.

Editors MECHANICAL ENGINEER:

I, and others in this vicinity, are much pleased with Mr. Slocum's articles on *How I Served My Apprenticeship*, and have benefitted by them. I would be glad if Mr. *J. Mc. C.*, of New York, who wrote in a recent issue that he could lay out five holes in a flange quicker than by Mr. Slocum's plan, would give his method of so doing.

PETERSBURGH, Va. R. J. STEELE.

[We presume *J. Mc. C.* referred to spacing off five holes by guessing with dividers, though this is only an assumption upon our part.—EDS.]

* * *

MR. MOULTON'S VIEWS ON PATTERN STORAGE REQUESTED.

EDITORS MECHANICAL ENGINEER.

I wish Mr. "Moulton" would write something about keeping patterns. I presume he has had experience. I have an idea that in a small shop, where it would not pay to have one man to look after patterns, a good way would be to have each foreman take charge of patterns for his department, and keep them on his job. This would increase the chance of losing *some* patterns by fire, and decrease the chance of losing all of them. Has Mr. Moulton ever tried this?
MACHINIST.

* * *

THE BABCOCK AND WILCOX COMPANY have ordered 500 tons plate-steel from Pittsburgh and demand as a condition of the order that it shall show from 55,000 to 65,000 lbs. tensile strength, with 20 per cent. elongation in 8 inches, and stand bending double, before and after heating and cooling in water without cracking; analysis is not to show over $\frac{8}{100}$ths of one per cent. of phosphorous. The order has been accepted, and the conditions imposed show the high quality of the material used by the company.

* * *

SOMEBODY has given David Ranck of the *Millstone* a notice, and called him sprightly, which David denies. Every one knows that David lies——under a great mistake, for he is sprightly.

* * *

COTTON SEED OIL is said to be superior for burning in student lamps to any other kind.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but solely matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on the same, or a similar one. Also, a few pages transmitted would enable us to judge of the fitness of the matter for our purposes.

"A DANIEL COME TO JUDGMENT."

Americans are often accused of a fondness for boasting and exaggeration of their own surpassing virtues. If anything is good it is American; if it is bad it is of some other country. Perhaps it is true—this national weakness; maybe Americans do "bounce," as our English friends express it, but we doubt if in our highest flights we could exceed this specimen taken from the London *Engineer.* It is speaking of a recent iron-clad made in England for the Brazilian Government, and it does not mean to lose the opportunity to give us a rap over the knuckles about the *Chicago,* a vessel which is not yet built. We quote:

> "We cannot take leave of the *Riachuelo* without commending her to the attention of the United States Government; and we would ask the Naval Advisory Board, or its ex-members, to compare her with the *Chicago.* This vessel we have fully criticised already, and described and illustrated. It will therefore suffice to say here that the American cruiser is to have a displacement of 4,500 tons, or only 1,200 tons less than that of the *Riachuelo;* and in not a single feature does she compare favorably with the latter. The *Chicago* is to be propelled by twin screws, and she is allowed 18,518 square feet of heating surface, 6,000 square feet of superheating surface, and 800 square feet of grate—nominally more boiler power than that of the Brazilian ironclad. Yet she is expected to develope only 4,800 horse-power, and have a maximum speed of but fifteen and a quarter knots, while her bottom, which is not to be coppered like that of the *Riachuelo,* is clean. Her bunkers will stow 800 tons, the same quantity the *Riachuelo* carries; but she will only be able to keep the sea for six and a half days, and to steam but 1,950 miles. She could not cross the Atlantic. Her armor and her armament cannot bear comparison with those of the *Riachuelo;* while it is more than probable that she will cost at least as much. The two vessels supply an admirable illustration of the arguments which we have advanced—namely, that to design a good iron-clad requires some experience; that no one in the United States possesses this essential; and that much better results could be got by copying the best English practice than can be had from the original American design. It is to be hoped that peace may reign between the United States and Brazil: if not, the *Riachuelo* alone could destroy every ship of war the United States possesses, fighting them half a dozen at a time. The doings of the *Alabama* would be as nothing to her doings; and no *Kersearge* exists in American waters that could destroy her. If the United States want war ships they cannot do better than buy a few in this country, if only to serve as patterns for use in their own navy yards. We do not know which has most cause to be proud of the *Riachuelo*—England or Brazil."

These opinions, the reader observes, are based upon *pictures* of a ship and its engines, which are not yet afloat; concerning which no one knows anything except the persons immediately concerned in building her. If it is a wise child that knows its own father, it takes a much wiser man to tell, under the above circumstances, what a given vessel will do.

If our contemporary is not beyond a little friendly advice, it will take some from us, and wait until the *Chicago* is launched before it empties one of the seven vials of its wrath upon us.

If the sequel does not prove our contemporary to be grossly in error it can empty the whole seven, and a demijohn to boot, upon American engineers, naval constructors, ships, and the country generally. In the meantime let it wait; it is quite within the bounds of possibility that it may not be so wise as it thinks.

WE RESPOND DIFFIDENTLY.

THE MECHANICAL ENGINEER, after quoting our statement of facts relating to the superior economy of the compound over the condensing engine in the Phoenix Mill in this city, adds:

> "This proves nothing as to the relative value of the compound system, for the high pressure engine—turned low pressure for the time being—might very easily get away with one extra boiler and fifteen pounds of steam per square inch, by being out of condition. If the valves of the high pressure cylinder leaked, the steam would simply blow into the condenser all the time, much faster in fact, than it would exhaust into the low pressure cylinder, or the open air."

Following the same line of argument we might say that if the high pressure cylinder had had no piston at all, or if the cylinder heads have been left off, or if the steam pipe had been turned into the open air, it is very possible that the engine would have got away with more than one extra boiler and fifteen pounds of steam. We respectfully submit that to base contradiction of a fact on an "if" is poor logic and not worthy of the brilliant editor of the *M. E.* If we had been trying to convince him that there was a saving offered in the compound system we should probably have confined ourselves to theory and left such out of place things as facts severely alone. We are inclined to think however that even on theory we could sustain our position without resorting to "ifs" to cover the weakness of our argument. When the *M. E.* can produce facts to show that our facts prove nothing we shall be ready to give them respectful consideration.—*Millwright and Engineer.*

We are taught to avoid even the appearance of evil, but if we reply to this we hope we shall not be taken for a controversialist a "disputationist," or an "argufier," all of which are evil things. We do not question the economy of the compound engine in its place, but in the remarks our contemporary courteously quotes from us, we wished to appear as commenting upon the evidence it adduced, which seemed to us—may we say it—rather superficial. The relative economy of high pressure and condensing engines, is sometimes questioned by persons who have attached condensers to engines which formerly worked high pressure; their doubts being based upon the fact that they used more fuel when the condenser was in use than when it was not. The reason of this is readily seen, for steam of atmospheric pressure will flow (leak?) into a vacuum at the rate of 1550 feet per second, while into the open air its velocity is less than half that, or 650 feet per second. Under the circumstances mentioned the engines simply leak into the condenser. We do not think the high-pressure cylinder of a compound engine used temporarily in connection with a condenser can be fairly cited as a "condensing engine" to be compared to a compound engine, for it is not properly constructed for the purposes of comparison. Condensing engines have shown quite as low coal and steam consumption as compound engines, notably under two pounds of coal per horse power, per hour, and under 16 lbs. of steam per horse power. We think these are facts which justify us in the use of the hypothetical "*if.*"

We wish, also, to correct an error our contemporary has fallen into, to wit, that the editors of THE MECHANICAL ENGINEER are "brilliant." Such light as they may possess is reflected from other sources—our contemporary for one.

LIGHT HAMMERS FOR WELDING HEAVY WORK.

It has often been said that we cannot make large forgings in this country because we have no heavy steam-hammers. It is true that we have not—the heaviest not exceeding twenty tons weight of ram—and for this reason: we do not need them. By the system American smiths' adopt, heavy hammers would be useless, they would not be employed if they existed. The popular idea is that large forgings, such as shafts twenty-eight inches in diameter and forty feet long, are drawn down from something—a mass of iron possibly, but where it is made or how it is obtained few know. As a matter of fact, all large forgings in this country are made of billets, welded piece-meal, or one upon another, and for this purpose light hammers, not exceeding six to eight tons weight of ram are used. They answer the purpose admirably, if the work done by them is any criterion.

When a blacksmith welds a job on the anvil he does not immediately come down upon it with a heavy sledge directly the scarfs are laid together; he gives the work a light tap with his hand-hammer to stick the parts together, and the sledge is used "up hand," merely to thoroughly consolidate the work, not to squash it through to the center. Exactly this process is followed in making heavy shafts and other forgings, with, as we have stated, the best results. Welding "piece-meal," or shafts made by this method are the soundest in the center, for this part is the first made. The portion worked on, or under heat at any one time, rarely exceeds five feet in length. Many not familiar with the process would say that "cold shuts" are inevitable, as the lengthening of the shaft goes on, but these are never present, avoidance of them being chiefly due to knowing how not to make them!

A LIVE AND PERMANENT ORGANIZATION OF ENGINEERS.

It gives us great pleasure to note the constant advance of the National Association of Stationary Engineers. Our readers will observe a letter in the usual place from Secretary Davy which is worth reading. He says there are now 53 associations and over 2,000 members, with plenty more within call. This is simply grand—that 2,000 stationary engineers of this country can be found who ignore every other issue except that of personal improvement and pledge themselves to use their best efforts to this end. No man can become a member who has not this object in view.

No demagogues or trades unions, no political or other issues, can affect them; first and foremost is the advancement of the individual by union with others of like aims. We see great possibilities in the future for our friends, if they stick to this platform, and stick they will. Ignoring and casting out the disaffected will make the strong stronger. Purging themselves of those who hang upon their skirts only for place or profit, will make the whole association true to its name, National, and convince steam users that their aims are legitimate and praiseworthy. Not one single act or motion against the peace and good will of steam users can be quoted against the National Association, but all their legislation thus far tends directly to the benefit of employers. These last should extend every facility and aid to them, and they can do much, not only by countenance, but by directly urging engineers in their vicinity to form associations under charter from the *National Association of Stationary Engineers.* The annual convention will be held in September, and we shall look forward with interest to its developments.

A MODERN COMEDY OF ERRORS.

A young civil engineer of our acquaintance informs us that not long since an engineer on a near-by road ran through the wall of the round-house, and when asked by one of the officials in the chief's office how it happened, replied that "the eccentric slipped." The person who received this information took it literally and said he would build a round-house that could not be affected by slippery eccentrics. Not knowing what the eccentric was he asked the engineer, who pointed out the crank. The official studied this gravely for some time, and declared his inability to see how it could slip. On asking another person, the eccentric proper was pointed out to him. Then he got into a great rage and declared the latter was humbugging him, for the engineer (who ought to know) said the crank was the eccentric.

This fable admits of several reflections, one of which is that gratuitous information is not always reliable, and another that it is not wise to undertake improvements in directions persons are not familiar with.

THE REASON WHY.

Scarcely a week passes that friends do not write requesting us to prosecute this or that patent interest of theirs, promising to give us certain high percentages if we succeed in finding them a purchaser. Others write asking us to call at certain works in this city, or near-by towns, and give an opinion upon the merits of some new device they are interested in. We are also offered sums of money to supervise the erection and construction of certain machines, and in the event of success are promised very handsome rewards.

To all such offers we are compelled to reply in the negative. If we had no other business it would be an arduous task to comply with all the requests above alluded to; having another, our friends will see that it is not possible for us to act as a consulting or supervising engineer and manage a paper at the same time. We are not given to magnifying our office; this is, we are sure the first allusion even, that has been made to it, but it is by no means a small task to get up a technical paper, year in, year out. It calls for constant watchfulness to guard against error, for many persons rely upon what we say as being correct, and the consequence of a misstatement in matters of fact, or, as is sometimes the case, affecting life and property, would be very serious.

We wish it to be understood that our time is solely and wholly given to the production of The Mechanical Engineer, and that in no event can we undertake any business outside of it. We thank our friends for their kind intentions, but what we have said will show them why we cannot comply with their requests.

EARLY COMPOUND MARINE ENGINES IN AMERICA.

BY NORMAN W. WHEELER.

I have many times of late years, been asked to give details regarding the compound engine built from my designs for the steam-yacht *Octavia*, completed in the spring of 1865. At the risk of appearing egotistical I will now relate such things as I remember concerning them, but it must be a matter of memory, inasmuch as the records of performance have been unfortunately destroyed, but the drawings still exist, as they were several years ago presented to a young friend, who has preserved them in his collection of antiquities.

The *Octavia* was projected by Thomas W. Kennard, Esq., an English civil engineer, who was at that time engaged in building the Atlantic & Great Western railway, now called the New York, Ohio and Pennsylvania R. R.

Mr. Kennard's avowed object in building the vessel was to ascertain the actual facts as to the behavior of expanding steam, as well as to procure means of recreation, and he also hoped to confound the dictum of a clique of steam engineers who thought they had discovered the inutility of using steam expansively (their notions having been derived from some experiments made on a government steamer on lake Eric), and who were voluble in asserting their own opinions on all occasions. He therefore ordered for his vessel a compound engine, capable of expanding the steam to nine volumes of admission, at least. I then thought a simple engine as good as, or better, than a compound, each having the same grade of expansion, and urged the simple engine, but Mr. Kennard was inexorable, and insisted on having a compound engine, to work steam at 60 lbs. per square inch, leaving me free as air in other respects; neither dictating nor suggesting the style of engine or form of hull. He only directed that the engine should be placed forward of the boilers in order that a perfect view of the machinery might be had from the main cabin through windows in the bulkhead, and urged perfect silence in the working of the engine.

Up to this time I had seen two compound engines. One on the steamboat *Oregon*, which called occasionally at a little lumber-port on the west shore of Lake Michigan—where I grew—and many years later (about 1852), one in the steamboat *Buckeye State* on Lake Erie, which, was designed by the late Erastus W. Smith. The *Oregon's* engine was of the Mississippi type, with one cylinder before the other, and both pistons on the same rod, and with exhaust valves only, on the expansion cylinder. Otherwise it had all the characteristics of the regular Mississippi engine, so far as I can remember, but I am not sure, for up to that time I had never seen the inside of an engine. I was in fact, only a practical cub-millwright and theoretical engineer, my theory being derived mostly from "Comstock's Philosophy."

The *Buckeye State's* engine was, to all outward appearance, a common beam steamboat engine of the period, except that it had one too many pairs of valves, toes, etc., and three piston rods. By inquiry I learned that there was a small cylinder inside the large one, thus, in fact, it was an annular compound beam engine whose dimensions I do not remember;[*] but I do remember that the boat was fast—often covering the distance from Buffalo to Cleveland in ten hours—174 miles. I paid very little attention to this engine at the time I saw it, thinking that a mere boat engine was not worthy of much consideration, but that the locomotive was the machine to tackle and tie to. Perhaps I would not have noticed that the boat was fast, had she not ran in connection with our Cincinnati express, and let us get off on time always in good weather.

Come to think again, I had seen another compound engine, which was a geared steeple-engine, on a blockade runner, but, as she had been chased and caught by a regular man-o'-war I did not think there was anything there to copy safely—for we wanted to produce a fast vessel.

After receiving the carte-blanche aforesaid from Mr. Kennard, and arranging with him that the hull of his yacht should be built in Cleveland, Ohio, as large as could be got through the Welland Canal, and the engines and boilers built at the Jersey City Locomotive Works, under the general management of Mr. W. G. Hamilton, and superintendence of Mr. D. P. Davis, I buckled to at my first compound engine, feeling a little ashamed to be doing work in war time that had no fight in it; save perhaps a little fight with the three-quarter stroke clique aforesaid.

My first move was to seek Erastus W. Smith to ask him about the *Buckeye State* engine. He told me that the coal consumption was about two-thirds that of a common beam engine; that there was less shock on taking steam than in other engines, and that repairs were no greater. To the question why he abandoned that style of engine in his subsequent practice, he said that people who employed him were willing to pay him more for getting up the common-beam engine than for a better; that if he proposed any innovation they seemed to think that he ought to pay them for tolerating it; that he considered it his duty to work especially for Erastus, and so adhered to the easier work and better pay afforded by the common practice of the time.

Oh, that I had taken in this hint, assimilated it, and done likewise! I then searched out all that had been published in relation to John Elder's doings. Up to that time he had built compound engines for some side-wheel ships and thereby saved one or two companies from ruin, and he had built some *geared*, compound screw engines. Mr. Kennard knew John Elder well and when I suggested the building of a direct compound engine, to run 90 to 100 revolutions per minute, wrote him for his opinion, which was favorable. Mr. Elder had wanted to try it, but had not had a chance, his customers had supposed that a compound engine *must* run *slow*.

I fear that I ought to have warned both printer and reader to skip all this in the beginning—but in that case I don't see how I could indicate the proper place to begin, and having read so far it seems superfluous to say they need not have done it. But I shall say something about the engine before I get through.

(*To be Continued.*)

TALKS ABOUT THE STEAM-ENGINE.—No. XV.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

There is one very odd thing connected with the raising of funds for difficult mechanical enterprises. The more ignorant the undertaker is of the real difficulties in the road the more apt he is to succeed in getting money!

The ignorant man promises impossibilities; he does not see the trouble ahead; he is certain that he will succeed; he lives in a paradise of certainties, and has the felicity to know not to doubt; therefore, the still more ignorant financier is impressed, and the result is the money is gotten.

But let a skilled mechanic of large experience go to these same men, he can but honestly say that the problem is difficult, that he believes he has found the true solution, but must acknowledge that in all new departures unforseen difficulties have presented themselves. There is no positive ring in his voice. Nay, worse; his words may halt because he is too modest, and too honest, to assure his hearers that he will succeed where many have failed. The financiers have spread before them all the difficulties. They demand an "inspired" man, not this patient, hard working fellow for a leader, and, after a more or less polite hearing, button up their pockets and refuse to take advantage of a far safer investment than the ignorant man has offered them.

We all know of many cases where knaves have taken advantage of this weakness of men. By persistent assertion they obtain large sums of money for the ostensible purpose of accomplishing impossibilities. The Keely motor is a good instance of this in the extreme, and numerous electrical companies often to a less degree.

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[*] We remember the *Buckeye State's* engine very well, having often been on board of her. The inside high pressure cylinder was 37 inches, and the outside low pressure 80'' by 11'' stroke working at 75 lbs. steam.—Eds.

* * * * *

Cast-iron cranks are frequently used in stationary engines with good results.

Cast-iron is so uncertain that no rules can be given for the sizes required.

Cast iron cranks should certainly be made of soft iron similar to car-wheel iron, and the holes bored with a wide-faced finishing cut, so as to force in the pin and force the crank on the shaft in a manner similar to car-wheels.

Good specimens of cast-iron disk-cranks, counterbalanced, can be found on most of our high-speed automatic cut-off engines. It is certain that excellent results have been obtained with cast-iron disk-cranks. Prolonged use does not seem to develop any weakness in them when properly made.

The point giving most trouble in cast-iron cranks is that they crack very easily if great force is used in forcing in the pin, or forcing them on the crank-shaft. The crack begins at the hole and extends radially outwards, and the exterior layers of iron do not seem to assist the interior layers to support a great stress, as is the case with wrought-iron or steel. The danger of cracking cast-iron cranks has led to the use of tapered pins, having a nut, or key, to draw the pin home with a graduated pressure in some cases. A key in the shaft should be used in all cases.

A wrought-iron over-hanging crank must be calculated so far as the web is concerned, but calculation of the strength of the bosses surrounding the crank-pin and crank-shaft are of little avail, because wrought-iron cranks are generally shrunk on shaft and pin by heat.

When it is intended to use heat, it is best to bore the holes for pin and shaft $99\frac{1}{2}$ per cent. of the diameter of the pin and shaft where they enter, and to warm the whole crank thoroughly to a dull red heat in the dark.

As the crank cools, the inside layers stretch and set, and are backed by the outside layers in successively decreasing tension, and it will be found that, while the outside dimensions of the bosses are increased but little, if any at all, that the inside hole and surrounding layers are so enlarged and stretched as to grip the pin and crank shaft in a very firm manner. Care pays in this thing, and the operator will not find a loose crank or one stuck half way on if he goes about his work methodically.

Particular care must be taken to have the metal thick enough around the pin and shaft to enable a firm set on them without outside stretch in cooling.

One-half the diameter of the hole surrounded has generally been found sufficient thickness to prevent working loose.

Heating, and then cooling a crank, almost always warps it, and it should therefore be subjected to a thorough inspection before use. The use of hydraulic pressure to force on the crank cold and to force in the pin will obviate the danger of warping. Making crank, pin and shaft in one solid piece is a very neat method, but presents difficulties in turning, especially in the case of double cranks, and is expensive.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LIV.

The first pair of guide-bars ever made in the old Detroit Locomotive Works were fitted up by me. These works are now occupied, I am told, by Christie and DeGraff in the manufacture of steam engines, but thirty years ago, or thereabouts, the building of locomotives was commenced there, in the hope of supplying Western railways with them cheaper than they could be had in the East. There were but few built, the causes of discontinuing being unknown to me.

The foreman came to me and asked if I had ever worked on locomotive work? I replied that I had. He asked me where, and I told him in the Lowell Machine Shop, where I served a portion of my time under Superintendent S. F. Gates. The foreman then asked me if I thought I could make a good job of the guide-bars, and I answered, evasively enough, that I saw no reason why I shouldn't. He had to be content with that, for men who had ever been in a locomotive shop, pure and simple, were scarce then in the West, and it didn't do to be too particular. The foreman himself came from Paterson, and was familiar with the modern methods of working. That is by jigs, or templates, as the system was then called, for even at that early day this way of doing work was in force. I had never used any jigs, or templates, although I comprehended their purpose well enough. I fear also that I was more or less prejudiced against them. I looked upon them as mute protests against my ability to drill a hole in the right place, and it seemed to me that they were only the beginning of a system to make workmen without brains. That is, to do away with any special intelligence, or care as to laying out work, substituting therefor cast-iron brains, or jigs with every hole located so that a blind man could do the job as well as one with sound eyes. I guess I am not the only one who ever had this notion; for the matter of that some of the seed still exists, judging from advertisements I see in papers, calling for men who understand jig-work; the advertisers being men who have no occasion for jig-work, or any such system, for they never build two machines alike.

Getting back to the guide-bars again—the foreman showed me the template, which was, in effect, a duplicate guide-bar, having the holes drilled and bushed with a hard steel thimble in each end, and which was to be clamped over the bar to be fitted up. I need not dwell upon this, as every one now-a-days understands it clearly. I did not, at that time, because it was new to ninety-nine men out of a hundred, but the foreman explained it to me in its main features and left me to go ahead. I clamped the template on the bar all square, and taking a drill about $\frac{1}{32}$ *smaller* than the bush, went ahead and drilled the holes. Of course that was a stupid piece of business on my part, and I should have known better, but I did not. I argued to myself that the bush was doing all the head-work, and that I had only to do the hand-work, and to tell the truth I didn't much care how the job came out, for, as I said, I was down on jigs.

When I used the drill $\frac{1}{32}$ smaller than the bush, it was with the idea of reaming to the size of the bush afterward, but this is where I made the mistake, for, as the reader has already perceived, the drill had $\frac{1}{32}$ of an inch to come and go on, and it proceeded to make use of it at once.

The innate depravity of drills is a subject which might well occupy a far brighter pen than mine. Their tendency to go astray when ground perfectly, their abrupt and uncalled for breaking off in holes where it spoils the work to try and get them out, their pure cussedness in many aspects, are themes I need not enlarge upon. I may say, however, that following this inherited trait, my drill in most of the holes I made sheered clear over to one side, but it cut so nicely and melted through the tough wrought-iron so fast, that the mere weight of the spindle on it was almost enough to keep it going. When I had the holes all drilled I filed the burrs off, put on the distance-blocks, clamped all together, and proceeded to ream them out, or was intending to when I was brought up all standing by discovering that the holes wouldn't line. Then I thought I had a fine thing on the man who made the jigs. Who he was I didn't know, for they were made before I came to the shop, but I went to the foreman and showed him the job I had done, and told him that if that was a sample of jig-work I could beat it with a pair of dividers every day in the week.

To say that the foreman was aghast expresses it mildly. He couldn't believe the evidence of his senses.

He felt of the holes, shifted the bars slightly, and humored them in everyway, but all that he could do was to find them "out" when straight edges were put on the sides, and the bars squared in their places. He went for the jigs, calipered the thickness of metal each side of the holes, and found them dead true. He squared my holes in the bars and found they were true also, vertically, and he began to look puzzled. All at once he said: "Fetch me the drill you used." When I brought it he tried it in the jig-holes and then the murder was out.

"Moulton," said he, "didn't you know any better than that."

"Better than what?" said I.

"Why, to use a drill smaller than the bush you drilled through; of course you see now that is just the same, almost, as if you had no bush at all."

I suppose I must have looked stupid enough, for he went on:

"You can see that you gave the drill a chance to dodge on one side $\frac{1}{32}$, when all you had to do was to keep it in the center by making it the size of the bush."

"How could I ream the hole if I had drilled it the size of the bush?" said I. "I wanted to make a first-class job out of this thing, because it is nice work and I know it. I don't know much about bush-work, but I know this—if you had given me this job without bushes, or trees, or anything else on top of it, I would have put those holes plumb through the center, square every way, and you could change the bolts around from one hole to another and never find a fin on the side of the bars where they joined the distance-blocks to show the change. That's the kind of vice-hand I am, one of the old-fashioned sort."

Now the foreman was a sensible young chap, about 24 years old, and a real, smart, driving, good-natured fellow, and when he saw where the trouble was, that my pride was hurt, he shouldered the blame himself, partly.

"Moulton, he said, "I know you can do a good job, and I was at fault in not telling you that the bushes allowed for reaming. Having seen this work done so long and so often, I have become used to it, and fancied that you knew the holes were to be drilled the size of the bush, and then reamed for the bolts. We have all got to live and learn and another time you won't make that mistake. All we have to do now is to get out of it the best way we can. What's to be done to bring these bars right?"

"That's easy enough," said I; "I will put the template on and file out the high side of the hole with a half-round file, and then ream them, though I don't like to do botch-jobs myself."

I did as I have stated, and so far as the result is concerned no one could have told that the bars were not properly drilled in the first place.

That one misadventure learned me more about the jig-system than a months' explanation could have, and it dissipated my prejudices as well, for it showed me that a man never can dispense with the use of brains, and that so far from making good workmen out of poor stock, it requires the very best men to carry it on successfully.

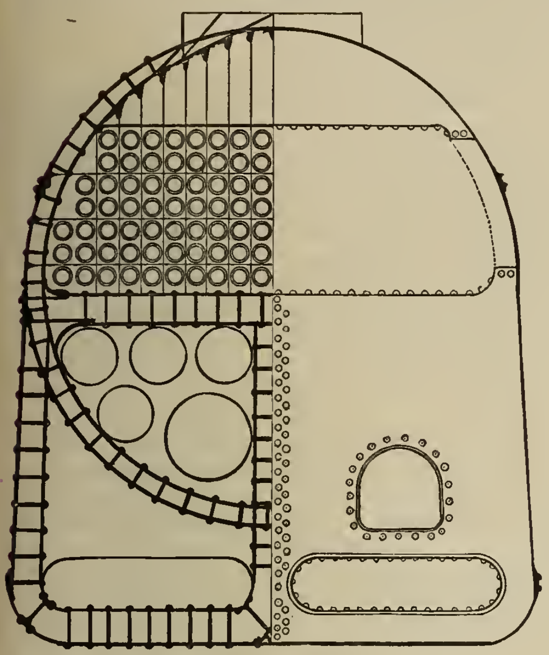
As to the system itself, it is indispensable where work has to be duplicated in quantity, but it is useless where departures from models are tolerated or practiced.

AN ENGLISH COMBINATION MACHINE-TOOL.

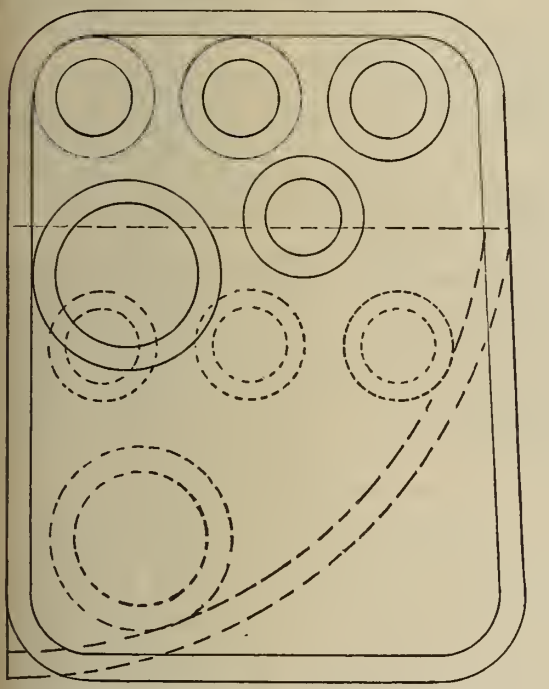
A recent invention is an English machine-tool which is capable of executing a variety of operations, usually confined to special machines. In regard to it *Engineering*, from which paper we take the announcement, says "this is a horizontal boring, drilling, and surfacing machine, constructed for an engineering firm in the United States. The main standard carrying the steel boring spindle, which is 6 in. in diameter, is adjustable vertically and transversely both by hand and power. The spindle is capable of variable feed in either direction, and can be made stationary for surfacing. It can also be withdrawn instantly from the work when required. The two standards which carry the bearings for the boring bars are adjustable in any direction by hand. There are also two portable standards carrying boring heads. These have self-acting feed motions, and are designed for drilling or boring objects simultaneously with the main boring spindle. The whole apparatus is mounted on a strong cast-iron bed-plate, 24 ft. long by 8 ft. wide, accurately planed on the face, sides, and slots.

TYPES OF AMERICAN STEAM BOILERS.—No. 8.

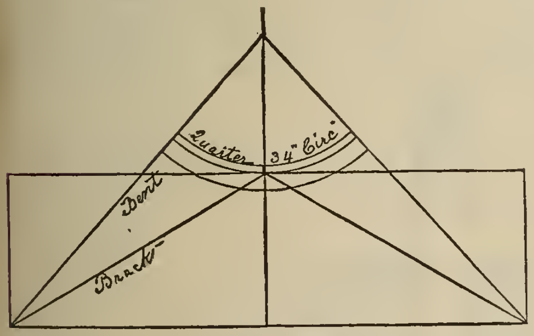
We present herewith drawings of a type of marine boiler which is used on the great lakes to some extent. Our diagrams embrace the principal sheets and positions, but some of them, which are comparatively straight-away work, we are compelled to omit for lack of space. The size of every sheet is given in detail.



FRONT ELEVATION.

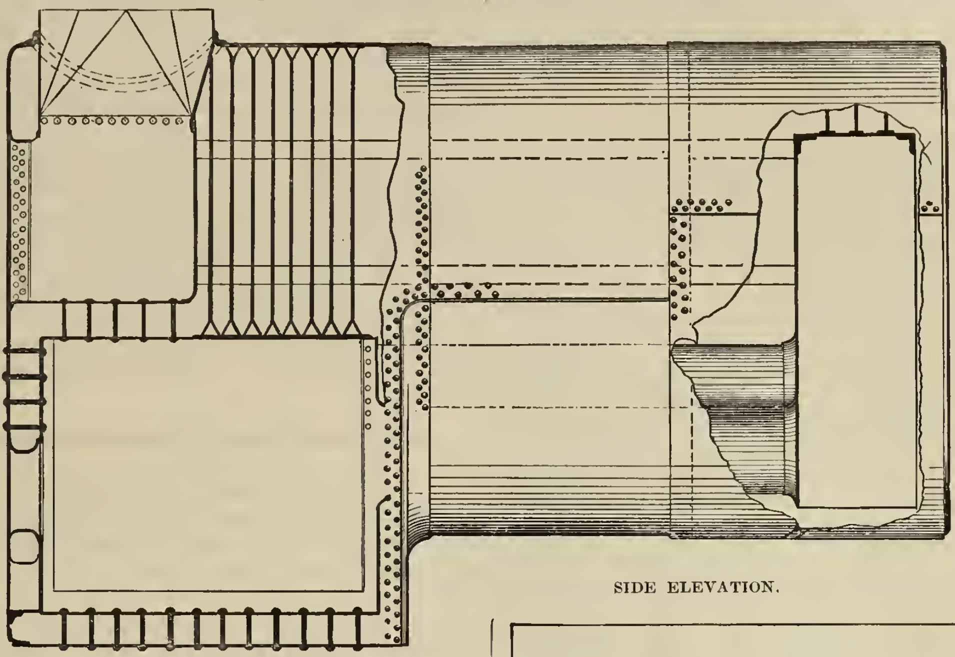


FIRE-BOX FLUE-SHEET—DOTTED LINES SHOW HALF OF BACK SMOKE-BOX FLUE-SHEET.

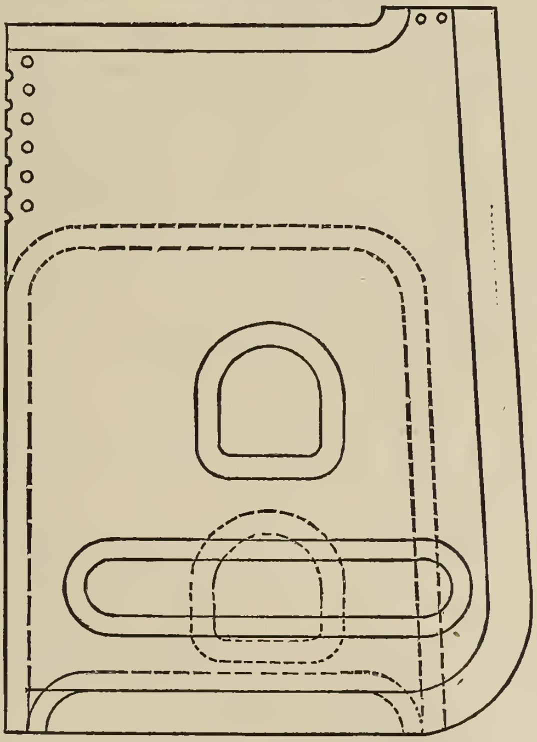


PLAN FOR CHIMNEY.

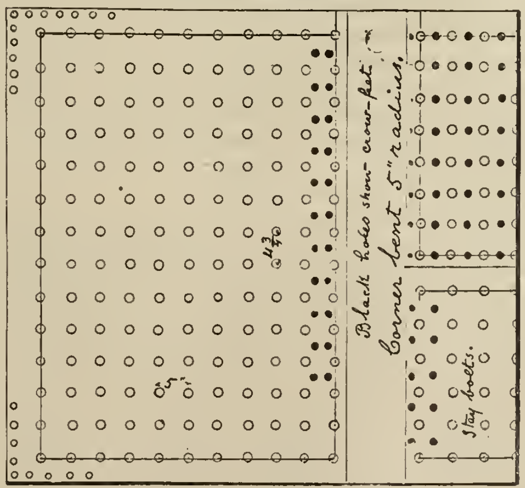
The shell of this boiler is 96″ diameter, 10′ high, and 8′ 8″ wide at the bottom. The length is 15′ 4″. There are 128 tubes, 3″ × 13′; main flues, 10 in number, 10″ diameter, 82″ long. Two of them are 16″ × 82″. The bottom of front smoke-box is 6″ above crown-sheet of furnaces; 5″ water space on sides and 6″ on bottom of fire-boxes, 4″ at back smoke-box, 6″ between furnaces. The stay-bolts and brace-holes are laid off by diagram, care being taken to keep clear of laps in marking the holes. Fig. 4 represents one-half of front head, the draft-hole flanged in to meet and lap the front fire-box head. The door-hole is flanged out, and the side, top, and bottom flanged the one way. The front fire-box head is also shown in dotted lines in same place. The door and draft-holes are flanged out, and there will be a strip laid on the flanges of door through both heads. Fig. 3 is the fire-box flue-sheet, and has four 10″ holes and one 16″ hole, flanged. Dotted lines show one-half of bottom of back tube-sheet. This head will be in two parts, riveted between flues and tubes the same as in the tube and flue-sheet. Fig. 8 is back head of back smoke-box. It has to be in two parts, which can be equally divided at option of layer out. In Fig. 8 is also the front tube-sheet, etc.



SIDE ELEVATION.

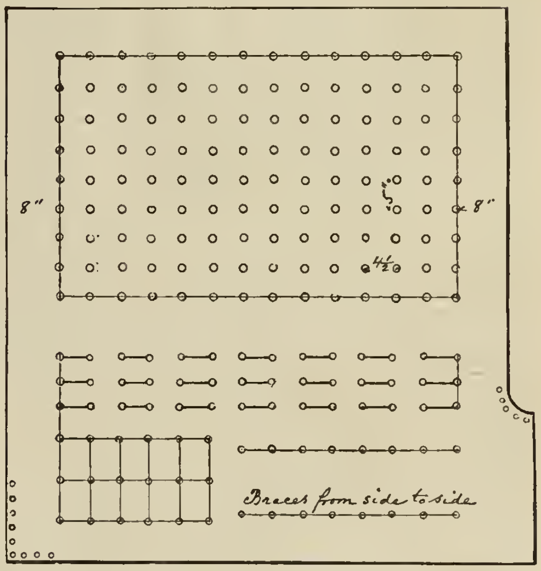


HALF OF FRONT HEAD—DOTTED LINES SHOW FRONT HEAD OF FIRE-BOX.

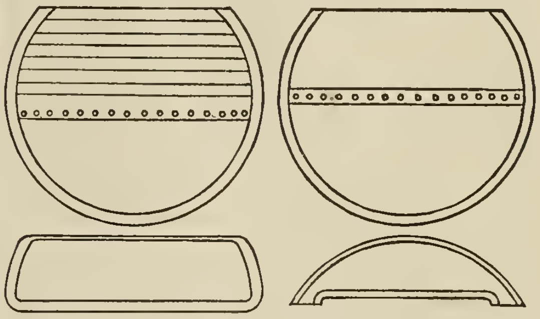


FRONT OF FIRE-BOX SHEET.

The material for this boiler will be as follows: 2 plates, 77½″ × 60″ × ⅝″, front heads; 2 plates, 53½ × 48½″ × ⅜″, (steel) front fire-box head; 2 plates, 60″ × 48½″ × ½″, (steel) back fire-box heads; 1 plate, 91″ × 42″ × ½″, front sheet of back smoke-box; 1 plate, 92″ × 39″ × ½″, front sheet of tube sheet; 1 plate, 92″ × 48″ × ⅜″, bottom part of back head of back smoke-box; 1 plate, 184″ × 22″ × ⅜″, back smoke-box sheet; 1 plate, 88″ × 22″ × ⅜″, crown sheet of back smoke-box; 1 plate, 98″ × 34″ × ⅜″, bottom of front smoke-box; 2 plates, 34″ × 34″ × ⅜″, sides of front smoke-box; 2 plates, 83″ × 80″ × ½″, sides of wagon-top; 1 plate, 126″ × 80″ × ½″, wagon-top; 2 plates, 70″ × 51″ × ⅜″, bottom of fire-box; 2 plates, 63″ × 141½″ × ⅜″, side and crown of fire-box; 1 plate, 124″ × 80″ × ½″, bottom of boiler; 2 plates, 69″ × 24″ × ⅜″, front and back of front smoke-box; 1 plate, 89″ × 28″ × ⅝″, top of front head over tubes; 2 plates, 32″ × 16″ × ⅝″, to go between front smoke-box and shell; 1 sheet, top part of back smoke-box head, 92″ × 34″; 2 shell sheets, 55″ × 154″ × ½″; 2 shell-sheets, 55″ × 155⅝″ × ½″; 1 sheet for door, 9″ × 60″ × ⅜″, in back smoke-box.



SIDE SHEET OF WAGON-TOP.



TUBE AND FLUE-SHEET BACK SMOKE-BOX HEAD.
FRONT TUBE-SHEET AND TOP PART OF FRONT HEAD.

The stay-bolts are marked for distance apart; for the braces, or crowfeet, the layer-out must see that they come right. They should be put on with a few tubes in place, when fitting, to see that they clear. By having a black-board the right size and drawing a diagram, we can get nearly every hole in its place, but one must see that the flanges are alike, so that no haphazard work will be done. Crowfeet on the crown-sheets must have circulation between each leg, and space enough not to fill up with mud or scale quickly. The bottom-sheet, 124″ × 80″, could be got in two parts, say 64″ × 80″, or 124″ × 42″.

REPAIRING A DISABLED BEARING.

A few years ago I was chief engineer of a large mill, where there ran, day and night, 14 engines, ranging in power from 150 to 10 horse-power. I had a house upon the premises, and was available when required, but all the men in my department lived two or three miles away.

I was awakened one morning early by the sound of pebbles thrown against my bedroom window. This proceeding, by-the-bye, had been so often repeated of late as to get rather monotonous.

"What's the matter?"

"Please, sir, will you come to the mill, something is wrong with the Newton engine." I may here remark that all the engines were named mostly after celebrated scientific men.

Dressing as quickly as possible, I went down to the mill, and upon opening the door leading to the engine-room noticed a fearful smell of burnt oil, so suggestive, to an anxious engineer, of fired bearings. And so it proved, in this case.

The engine was a compound, horizontal, condensing engine, of 100 horse-power, and its shaft carried a fly-wheel 18 feet in diameter, and weighing something like seven tons; and also a mortise-wheel, which was 10 feet in diameter, and weighing two tons. The pedestal carrying the fired bearing was upon a wall, beyond the wheels, and anyone could see upon entering the engine-room, that the brass was cut clear away, by the fact that the fly-wheel rubbed the wall. It did not take long to get a gang of laborers and fetch water to cool the shaft and plummer block. This done, the shaft was raised, and the bearing examined. Imagine my dismay when I saw that a deep groove was scored round the shaft in the center of the bearing, at least half an inch deep, and irregular in shape, so that no one could bore a brass having a corresponding fillet to fit it, and, of course, it was useless to think of putting in any temporary bearing that did not fit perfectly.* I sat down and scratched my head, with a clear idea of the *right* thing to do, viz., have a new crank-shaft entirely, but not the ghost of a notion of what I should do, for, with the pressure of work on hand, the engine could not be laid still for a single day. So here was a fine opportunity for an original mechanical makeshift.

A thought occurred to me—I could not say whether it would be successful if I tried it, or a dead failure, but the chances were that, considering that the engine was still, and her work was urgently required, it would be better to *do* than to sit looking at it. I put my thoughts into actual work. I got some gun-metal into a crucible, set some of my men to blow up the fire in the smith's shop—no time for the slower process of heating the brass furnace. I found a piece of ⅛-inch sheet iron, fixed it on the face-plate of my lathe, and cut a hole exactly the size of the ill-used bearing, then cut it into halves. Removing the pieces of brass from the pedestal, I found a steel pin, which had been used as a stop for the brass bearing, and which had caused all the mischief. Unscrewing this, and lowering the shaft to within ⅛ inch of level, and perfectly squaring it with the engine, I placed my halves of sheet-iron on each side of the bearing, and procuring a quantity of stiff clay plastered it round; the sheet-iron cheeks being held on by two clamps. When my brass was hot I poured some oil into the cavity round the bearing between it and the plummer-block, and stationed my men, one with a piece of tin to throw in, another with a stick to stir and stop the dross, and then I commenced to do that which I had never heard of, namely, cast a gun-metal liner in its place, with no boring nor fitting. The metal was poured, and an anxious hour was passed while awaiting the cooling and the result. When cool enough, I had the shaft jacked up, and there was the brass, with a ridge just to fit the groove in the shaft, and a beautiful smooth surface. I coated the surface with plumbago, mixed with a little lard, then coupled the engine up. I concluded that a cap and brass would be superfluous considering the weight of the shaft and wheels, so I started the engine, and ran her dry [a few lines previous the use of plumbago is mentioned—Eds. M. E.] for a quarter of an hour, then stopped, uncoupled the connecting rod, raised the shaft and it was beautifully bored out and fitted the shaft with its groove more exactly than any turner could have bored it. We started work exactly at seven o'clock, six hours after the accident and the same bearing ran without attention for twelve months to my knowledge, and probably is going well now. A piece of suet, occasionally moistened with oil suffices for lubrication, and I never found it warmer than the temperature which kept the suet white and solid, about 80 Fah.

The top cap in this case was unnecessary, and, in fact, was the cause of the breakdown, for the engine-driver placed a blind confidence in the needle lubricator, and seeing that it was full of oil, never tested it to see whether the oil would flow, and when the burning first became apparent he walked about for two hours seeking empty lubricators, while the steel pin was cutting the shaft like a parting tool.—*Amateur Mechanics.*

* * *

HOW I SERVED MY APPRENTICESHIP.

NUMBER X.

BY GEORGE SLOCUM.

"In the first place it is not to be supposed that the buyer of a machine wants to pay for any more screw than is required to do his work.

"In the second place I hardly think the builder would put in more stock than he figured or when he made the contract.

"In the third place it is folly to put any more metal into a machine than is necessary, or to make it any more complicated than need be.

"Now, we'll take a screw 4-inches diameter, with a head 6 inches in diameter, and lever-holes clear through it. Supposing you had a lever 5 feet long and you had right smart pulling to do to press something on, would you stick that lever clear through the hole?"

"I guess not," said I, "for I would be making my lever shorter."

"Why would you?" asked Jones.

"Why, because my leverage is from the center of the screw, and I would stick the end of my lever in 3 inches."

"Now you've hit it. Yes, and you would pull it out an inch or two, if you could, and make your lever 5 feet 2 inches long, wouldn't you?" said Jones.

"I guess I would hunt around for a longer lever, first thing, if I had much pulling to do," said I.

"That's natural. But even if you got one 10 feet long and ran the end of it a foot through the hole, still you would only have a lever as long as the distance from the center of the screw to the end you had hold of."

"Yes, I see that."

"Well, suppose we substitute an 8-inch screw with a 12-inch head, what's the difference if the pitch of the screw is the same? It won't advance one particle further for one revolution, and your leverage is reckoned from the center of screw as before. Besides you have a larger mass of dead weight to move, and greater friction."

"What is friction," said I.

"Friction is caused by one body rolling or sliding upon another. In all these calculations I have left friction out, because I did not know what the resistance of friction was. When I say that it takes one pound at the rim of the pulley to balance a certain number of pounds at the ram—or, when I say that one pound at the crank of that crane over there will balance so many pounds at the hook, I don't mean that one pound will raise that number of pounds for it won't do it. But if I apply power enough to overcome the friction, in both examples, a little more than one pound added to this power will raise the weight or move the ram. It is not the mere inertia of cars and freight that an engine has to contend with in getting a train over the road, it's the friction of the axles, and the rolling friction of the car wheels on the rails that has also to be overcome. If all this friction were to be suddenly wiped out, while an engine carrying 130 lbs. of steam was trying to start a heavy train, why she would walk right away with it. If the friction were completely blotted out and not a particle left, a little 5 ton dinkey-engine could take a heavy train that she could just start over a level road, as easily as a 35 ton engine could with all the friction restored. Because if the dinkey could start the train the least bit, and keep it moving, it would gain in velocity at every revolution of the driving wheels and pretty soon it would be dashing along at a high speed. Can you see into this?" said Jones.

"Yes, I understand you," said I.

"We'll figure on 8 threads, as you said, and see how it comes out."

"All right," said Jones. "We had 2 threads before and now we have 8. We had a 10 ft. lever also. Now by proportion, 8: 2:: 10: 2½. So a 2½ ft. lever will do now what it took a 10 ft. lever to do before. And 2½: 10:: 150800: 603200. So we can stick in a 10 ft. lever now and get 603200 lbs. pressure where before we got only 150800 lbs. Let's see how this pans out. A lever 2½ ft. long describes a circle 5 ft. in diameter. This multiplied by 3·1416 gives 15·7080 ft. And this multiplied by 12 gives 188·4960 inches, that the end of the lever advances to an eighth of an inch advance of screw. For 1 inch advance of screw, the lever will have advanced 8 times 188·4960 inches—or 1508·1680 inches. So 1 pound at the end of lever will balance 1508 pounds at point of screw, or, 150,800 lbs. at end of screw with 100 lbs. at end of 2½ ft. lever—or, 4 times 150800 lbs.—that is, 603200 lbs. with a 10 ft. lever."

"Gosh! Jones, that's nice work, figuring out those things. I wish I could do it, like these mechanical engineers."

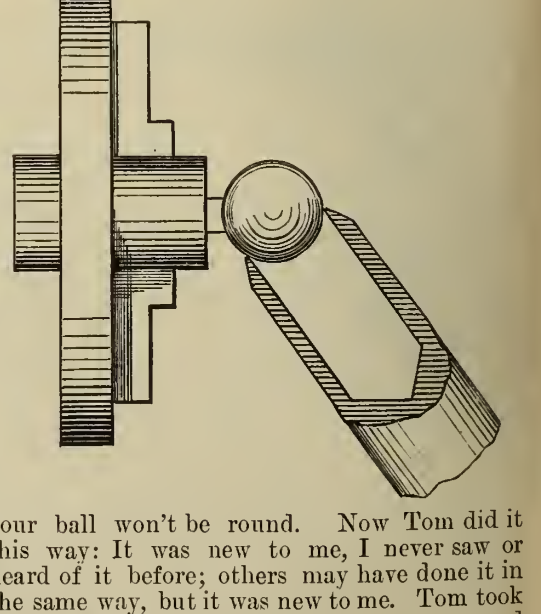
"Well you can if you learn how, and you can learn how if you try, and you can try if you've a mind to. Seems to me that's plain enough."

"Jones, I was going to ask you about screw-cutting. You know I'm on a new screw-cutting lathe now, and I would like to know how to figure out the gears."

"Oh, pshaw! There's been more written about that than anything else about a lathe. You're over there close to Tom Lovelace; ask him, he'll tell you. Besides there is a book published that will give you all that is necessary on that head; it is called, '*Manual of Screw Cutting.*' It is by D. E. McCarthy, and its price is 25 cents, cheap as dirt. Say, did you ever see Tom turn ball-valves?"

"No, what are they? I never saw any."

"I guess not. They're not used on locomotives, that I know of, but Tom had some little brass balls to turn up some years ago for a special purpose; they were ⅝ths of an inch in diameter. If you go down there to Sinclair's lathe you'll see an attachment for turning balls and such like. But if it is not perfect, that is has any lost motion in it, etc., it cannot do true work. And besides, you've got to get the center of the worm wheel *exactly* under the center of your ball, and the point of the tool exactly on a level with the center of the ball you turn, or else your ball won't be round. Now Tom did it this way: It was new to me, I never saw or heard of it before; others may have done it in the same way, but it was new to me. Tom took a short brass rod and chucked it; then he turned it down to nearly ⅝ths; then he cut down with a square nosed tool and got it a little over ⅝ths



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* The groove in the shaft did no harm and did not need to have the bearing fitted to it. Simple babbitt metal would have answered quite as well as gun metal, that is brass.—Eds. M. E.

long; then he rounded over the corners; then he scraped it as near round as he could by the eye. In the meantime he had a tubular tool made like sketch, which shows the whole thing. This tool had a $\frac{9}{16}$th hole, a nice smooth one, drilled in one end of it about $\frac{3}{8}$ths of an inch deep; then the end was tapered and squared up true. It didn't come to a sharp edge, mind; it was blunt about a thirty-second, and was hardened and then oil-stoned. Tom then held the end against the ball, moving it all over as far as he could; kept working it all round until that part of the ball was all right. Then he cut the ball off, and chucked a piece of hickory with a $\frac{9}{16}$ hole in the end of it, and about $\frac{3}{8}$ deep. Now he put the finished part of the ball next to the hickory and held the tool against the ball, working it all over, same as before, and presently he had a nice, smooth—practically speaking—perfectly true ball. You've got to make your tool with a hole in it about the right size, or the ball will kick it off. About $\frac{9}{16}$ for $\frac{5}{8}$—well, from a sixteenth to an eighth less according to the diameter of the ball."

TANKS, AND CUBIC INCHES AND THINGS.

If you want to make a tank to hold a certain number of gallons don't ask the *S———c A———n* for the dimensions. A man did this once and this is what he found out:

> "Please give the dimensions for making a water tank which will hold four barrels of water. A. Make the tank to hold 16½ cubic feet, or if round, 2½ feet diameter, 4 feet 2 inches high, or 3 feet diameter, 2 feet 10 inches high. If square, 2½ feet square by 2 feet 8 inches high."

One cubic foot contains 7.48 gallons, therefore 16½ cubic feet will hold only 123·42 gallons. A standard barrel holds 42 gallons. Four such hold 168 gallons. Moral: The *Scientific American's* tank is too short on one end, or else the water is too long.

The *S———c A———n* tank to hold 4 barrels will only hold 2·89 barrels; it is "too short on one end."

This is the better way to do such simple little things. A United States standard gallon contains 213. cubic inches; in 42 gallons (one barrel) therefore, there are 9702. cubic inches; in four barrels, then, there must be 388·08 cubic inches, which divided by 1728, the number of cubic inches in a cubic foot, calls for 22.457+ cubic feet. Not 16·5 as our erroneous contemporary gives it.

"PRACTICAL BOOKS FOR PRACTICAL MEN."

As an indication of the character of authorship which we periodically condemn, reference may be had to the magnitude of a new work soon to appear, as detailed to us by its author, to the effect that the manuscript alone weighed over 60 pounds. We could not resist the temptation to suggest that he sell the same to a publisher at some fixed rate per pound.

The idea of a man who considers himself capable of instructing mechanics and engineers regarding his work from so material a standpoint as to weigh the manuscript in a scale-pan, seems altogether ridiculous, and yet the sale which manufactured books of this class have, seems to indicate that the portion of the public to whom they are addressed, weighs them in the same accommodating scale.

It is certainly the only method of considering their value, by which they will be found not wanting, and as long as the public balances such material weight by weight of cash, publishing such books will continue with profit to the author and publisher, though with considerably less profit to the purchaser and reader.

It seems to us that well-edited journals specially addressed to mechanics, could do no better work than point out to their readers the exact practical value of works addressed to them, irrespective of fear or favor; sparing no effort to commend the few really valuable and to condemn the host of valueless productions. The reasons should be carefully stated, with extracts illustrating the points touched upon. On the other hand journals more specially devoted to engineers should lose no opportunity of urging competent men in the profession to supply the demand for practical works addressed, and of value to mechanics; for a broad, general and thorough acquaintance with mechanics and engineering is the first requisite for writing elementary works. If there is any difference, it requires more ability to write excellent elementary works than to write more advanced treatises, for it is exceedingly difficult to keep within the exact truth in facts and definitions, when the matter must be presented to less educated or rather less trained minds, in a logical, concise and simple form.

* * * * * *

The same reasoning that stamps the necessity for good books addressed to mechanics, applies almost as forcibly to the necessity for good journals. It is not too much to say that in the latter considerably greater advance has been made, and better success attained than in the former; and if the mechanical and trade journals will, as a rule, be more careful of their book review column than they have been in the past, and present facts rather than flattery, they will bring about a needed reform in the character and type of literary works offered to mechanics.—*American Engineer.*

THE VIBRATION OF STEAMSHIPS.

In ordinary running a steamship will be subjected to certain forces; the most important of those produced by the working of the engines are: The forward thrust; the turning couple of the engine; the sideward pressure of the propeller; the pressure of the reciprocating masses; the pressure of the rotating masses when the position of their center of gravity is out of the middle.

These forces will set up vibration in the more or less elastic hull of the ship. The time which such vibrations occupy is dependent on the dimensions of the ship's extremities, which form the swinging masses, and the extent of the elasticity of the hull. Should the latter force be small, as in the case of a weakly constructed ship, and the mass great, the vibrations would be of considerable duration, and the extremities would swing in slow measures; but should the elasticity be great and the mass small, the vibrations would be rapid. The vibrations would be greatest when the time occupied by a revolution of the engine corresponds with the period of the oscillation of the vibrations.

The phenomenon resembles the movement of a clock pendulum, which receives the neccessary additional power to sustain its motion through the small impulses it obtains from the clockwork on the completion of each oscillation. It is not absolutely necessary for the production of strong vibrations that their period and the revolutions of the engine should coincide, but it is sufficient that one of the numbers should be a multiple of the other. In illustration of this it was instanced that when a screw steamer is first started there is little or no shaking, but as the revolutions increase the vibrations are set up suddenly as if with a shock. It will be seen from what has been said that vibration does not necessarily indicate that a vessel is of weakly construction; indeed the case is conceivable in which the vibrations of the ship may be increased by additional strengthening. The author suggested that vibrations might be lessened by reducing or increasing the revolutions of the engines, or by a judicious distribution of cargo, in which the masses might be placed in the vessel at the extremities, in the center, or at the nodal points of the vibrations. The screw may also be shifted on the shaft so as to alter its position relatively to that of the cranks.

Mr. Yarrow gave his experience in torpedo boat practice with regard to the intensity of vibrations at varying speeds of engines. The propeller had been removed from the shaft, and the engine run without it. When the revolutions were 200 per minute the vibration was perceptible, at 300 revolutions it disappeared, but when the engine reached a speed of 400 revolutions it became severe; at 700 revolutions the movement ceased, but at 800 revolutions it again commenced.—*Institute of Naval Architects.*

AT THE DEAD LETTER OFFICE in Washington a daily average of 14,500 pieces of mail matter are received. Nearly $39,000 in actual cash was found in "dead" letters last year, besides checks, drafts, etc., to the value of $1,600,000.

STEAMSHIP MACHINERY REPAIRS.

Mr. Hamilton, assistant to the chief surveyor of the Underwriters' Registry for Iron Vessels, divides ship repairs broadly into two classes, those rendered necessary by wear and tear, and those entailed by accident. The experience of engineers will differ as to the relative importance of the various details of wear and tear repairs; but all will recognize that the adjustment and renewal of shafting and brasses, rebushing of piston rod and valve spindle glands, reboring of cylinders, &c., form the chief items of ordinary engine repairs. Faulty design appears to be the principal source of evil. Short bearings, short connecting rods, ill-proportioned pumps and pipes, badly designed arrangements for reaching working parts, and unsuitable material, are the chief defects commonly met with under this head. Inferior materials, such as unsound forgings or castings, constitute another fruitful source of evil, added to which the defects arising through inattention of those in charge, have to be considered. Damage through accident often entails renewal of crankshafts, straightening of tunnel shafting, renewing brass linings on screw shafts, or relining the stern bush. Frequently when grain cargoes become wet severe strains are thrown on the structure of the vessel, sometimes bursting up the decks, or throwing the shafting out of line. Breaking of pistons may be caused by unequal metal in the body or ribs of the casting, or an improper taper where the cone of the piston rod is fitted, or to an imperfect fit being made through having a cone and shoulder on the rod, or by having the screw on the piston-rod end too short, so that the nut may be full down, although the piston may be loose on the rod. Repairs are often entailed by the racing of engines in heavy weather, through water being allowed to gather in the cylinders when the engines have been temporarily stopped, through the condenser becoming hot, and thereby causing leaky tubes, through sand getting into pump valves, through piston rings being fitted too tightly, through cylinders not being parallel, or through bearings being allowed to get hot.

The author cites the fact that a well-designed pair of engines will outlive two, if not three, sets of boilers. Among the principal repairs necessary are renewals of combustion-boxes, furnaces, and tubes, re-rivetting and caulking in the neighborhood of the seams and butts in the bottom of the boiler. As in the engine, design may be responsible for excessive wear and tear. Defective circulation, insufficient spaces for cleaning, unequal distribution of stays, placing butts and seams in inaccessible places, so that they cannot be attended to, or even perhaps when building the workman may not be able to make a good job; all these defects may be traced to bad design. To bad workmanship may be attributed the paring, caulking, and patching which is continually going on in some boilers. With boilers, however, matters are improving, owing generally to the greater care which is being exercised in the selection of materials, and to attention during construction. The more general use of drilled holes, or holes reamed to finished sizes, provision for unequal expansion, a more careful consideration of the position of manholes and mountings, are all given by the author as instances of modern improvement.

With regard to corrosion, reference is made to the use of paints, cements, compositions, and zinc plates, as having merits, although no one of these appears singly to meet the difficulty. To inattention may be attributed the collapsing of furnaces, burning of combustion chambers, and the splitting of tubes or tubes plates. The paper quotes examples of repairs required by three steamships, nearly sister vessels, built and engined by the same firm in 1871. The engines originally were of the ordinary compound type, with double-acting air and circulating pumps, and upright tubular condenser with cast-iron tube plates and wood ferrules. The cylinders were 34 in. and 64 in. by 36 in. stroke in one vessel, and in the other two 35 in. and 66 in. by 36 in. stroke. There were four single-ended boilers with three fires in each. Taking a period of about three years after each set of engines was fitted, it was found that the vessels had ran distances of 103,049 knots, 118,978 knots, and 103,500 knots respectively in the same trade, and the expense for overhauling, repairs, and renewals to the machinery in that time was 1880*l.* 7s. 9d., 4159*l.* 8s. 3d., and 2537*l.* 9s. 1d., respectively. Taking these figures, we should get 4.38d., 8.39d., and 5.85d. per knot respectively for all repairs executed. After a short life of about six or seven years it was deemed advisable to take out the old machinery, and in its place new engines of a similar type were substituted, but with single-acting air and circulating pumps. Horizontal tubular condensers with brass tube-plates, cord packings, and screwed glands, were also fitted, in addition to which the old boilers were exchanged for two double-ended ones in each ship, there being six furnaces in each boiler. One of the new pair of engines had cylinders of 36 in. and 64 in. in diameter by 48 in. stroke, the other two pairs having cylinders 40 in. and 70 in. in diameter, by 48 in. stroke. After about three years running they had run 133,952 knots, 131,219 knots and 120,617 knots respectively; while 1124*l.* 11s. 9d., 873*l.* 0s. 10d., and 874*l.* 16s. 9d. were the respective amounts spent for repairs, the proportions being 2.01d., 1.59d., and 1.74d. per knot. The only item not compared is the cost of renewal of india-rubber valves in the original engines, as the new engines were fitted with metallic valves. In the last-mentioned case of the old engines there was a serious breakdown of the pumps, and in the first-mentioned of the new engines two furnace crowns and a new donkey boiler had to be supplied. Mr. Hamilton's paper concluded by saying that the proprietors of these steamers had not provided for proper supervision in the designing and manufacture of the original engines, so that they were built to the manufacturer's specification, whereas the second sets of machinery were superintended in their building by an engineer of experience, who also furnished the drawings.—*Engineering.*

ELECTRICITY FOR DRIVING SMALL LAUNCHES.

Much has been said about the use of electricity for driving small pleasure boats, in lieu of steam engines, and some few of them have been tried in this country. The Institute of Naval Architects in England have lately discussed this subject, a report of which we find in *Engineering*:

Mr. Yarrow says that a return of 45 to 50 per cent. of the power required to charge the cells may ultimately be obtained for driving the launch. By a careful husbanding of the power the boat could be kept running for six hours. The best result obtained with six persons on board, and a displacement of about five tons, and with 71 cells in circuit, was 6·9 knots, the revolutions of the motor being 674 per minute. Each cell when fully charged weighs 56 lb., and is stated to be equivalent to one net horse-power for an hour developed on the shaft; but Mr. Yarrow believes a considerable reduction from this estimate must be made in actual practice. The time occupied in charging the accumulators should be about 25 per cent. longer than that of the giving-off process, so that if the boat be required to run for six hours the charging should occupy seven and a half hours. The process can be effected more rapidly, but a loss of power will result. The leakage of electricity when standing is estimated at from two per cent. to ten per cent. a day. Mr. Yarrow sums up the advantages and disadvantages of the electrical system of propulsion for boats, as compared with steam, as follows:

For the system: Entire absence of noise; great cleanliness; the whole of the boat available for passengers or cargo.

Against it are: The difficulty and delay in frequent charging; greater first cost; greater cost of working, if an engine has especially to be laid down for charging.

Mr. W. H. White stated that a year ago he went into the question of applying electricity to a second-class torpedo boat, and came to the conclusion that it was not possible to do so successfully. Mr. Morgan pointed out that torpedo boats proper are not the only ones fitted for purposes of torpedo warfare, but that the smaller ships' boats, such as steam pinnaces and cutters, are arranged for carrying spar torpedoes, and that if a 36ft. pinnace could be supplied with storage batteries for electrical propulsion so as to get a speed of 9 knots an hour, an immense advantage would be gained in its aggressive power. He was of opinion that a boat of this type might be constructed even in the present state of the subject. Such an expression of opinion carries additional weight coming from an Admiralty constructor.

Mr. Reckenzaun said that with a weight of 2 lb. of motive machinery, including shafter and propeller, one horse-power can be exerted on the screw shaft for one minute, therefore 840 lb. would be required to drive a boat requiring one horse-power to propel it for seven hours; and that if accumulators could be made of iron in place of lead that they would then be better than any motor existing.

THE COMPOUND STEAM ENGINE.

The compound, or "double-cylinder" steam engine, as it is often called in distinction to the non-compound or "single-cylinder" engine, has practically supplanted the latter for marine purposes, is largely used in factories, and has recently been applied to locomotives.

Simultaneously with the introduction of double-cylinder engines, the steam pressure carried in marine boilers was increased, and in general, the ratio of expansion also; so that there were many engineers who were inclined to attribute the economy of the new system, which was indubitable, to these latter changes rather than to the compounding. Indeed, there are many engineers to-day, who hold this opinion,—and although the disputes in relation to the matter, which have for several years occupied so much space in technical journals, are less animated than they formerly were, they have not wholly ceased. The greater number of these discussions have been theoretical rather than practical, and experiments, when they were presented, have frequently proved to be of little value, on account of differences in important conditions. Many experimental results that are valuable have, however, been published; and the writer proposes, in the present article, to give a brief summary of results that seems to be of practical importance and interest, relating as they do, to the various means that have been employed to secure economy in the production of steam power.

The economy of a steam engine, considered as a whole, depends upon the cost of producing the steam in the boilers, and the efficiency of the motor in which this steam is used. Thus, if one steam engine produces an indicated horse-power with 23 lbs. of steam per hour, and this steam is furnished by a boiler which evaporates 8 lbs. of water per lb. of coal—while another engine requires 25 lbs. of steam per hour for each indicated horse-power developed, and obtains its steam from a boiler which evaporates 9 lbs. of water per lb. of coal, the consumption of coal per hour for each indicated horse-power developed will be, for the first engine, 2,875 lbs. and for the second, 2,778 lbs. In order to make a perfectly accurate comparison of the cost of coal or steam per horse-power, the useful power exerted, or the indicated power less the power absorbed by friction of mechanism, should be used as the basis of calculation. As a general rule, however, the useful or net horse-power is not determined, in making experiments, so that it is necessary to refer the expenditure of steam and coal to the indicated horse-power, with the assumption, which is not far from the truth, that the pressure required to overcome the friction of well designed steam engines is practically constant.

In comparing experiments made with different engines, or with the same engine under different circumstances, if the steam pressures vary in the several experiments, as is generally the case, it is more accurate to reduce the weights of steam used, to equivalent weights at the pressure of the atmosphere. This is particularly useful, when the engines are considered in connection with the boilers, since it is customary to compare the performance of different boilers, with respect to their "equivalent" evaporation, or evaporation from and at 212°, that is to say, the evaporation at atmospheric pressure of water whose temperature is 212°.

—*Van Nostrand's Magazine.*

(*Continued in Next Issue.*)

* * *

"WAXED" PAPER is simply tissue paper charged with paraffine. It is used chiefly for wrapping candy in, but is being employed for other goods it is desired to keep air tight, such as tobacco, etc. It is a patented article, and sells for $1 per ream.

* * *

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* * *

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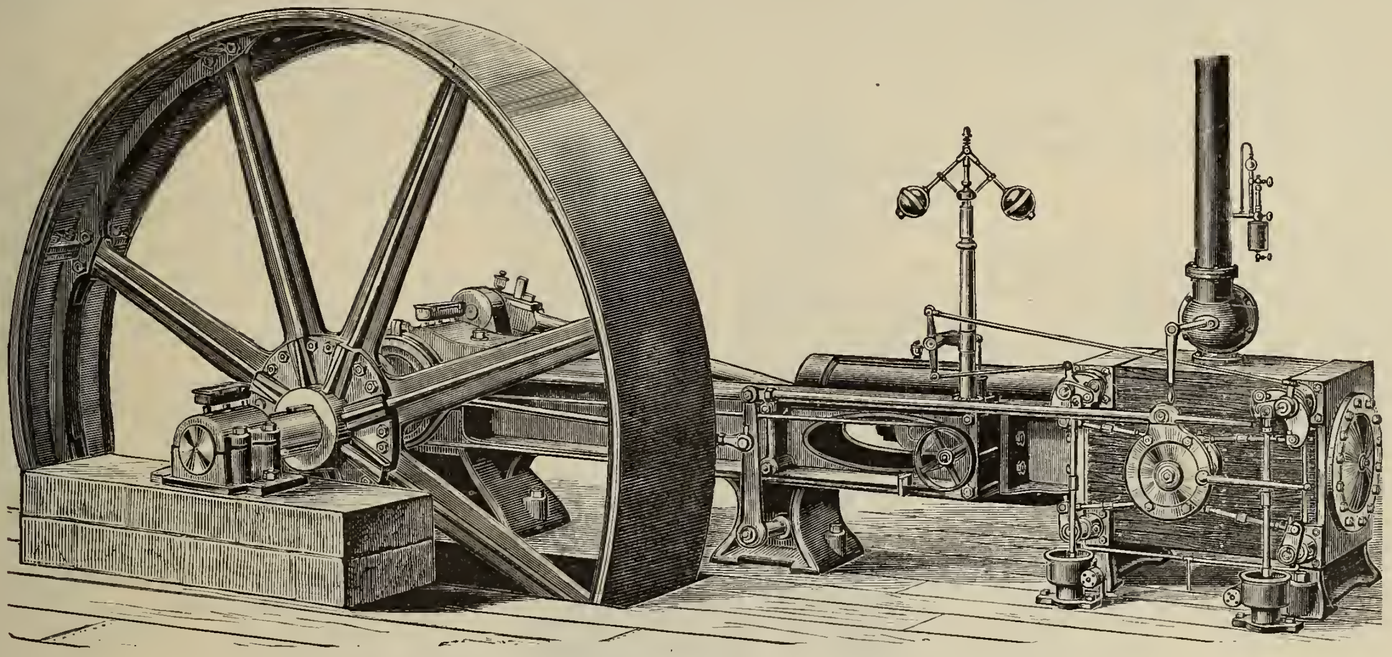
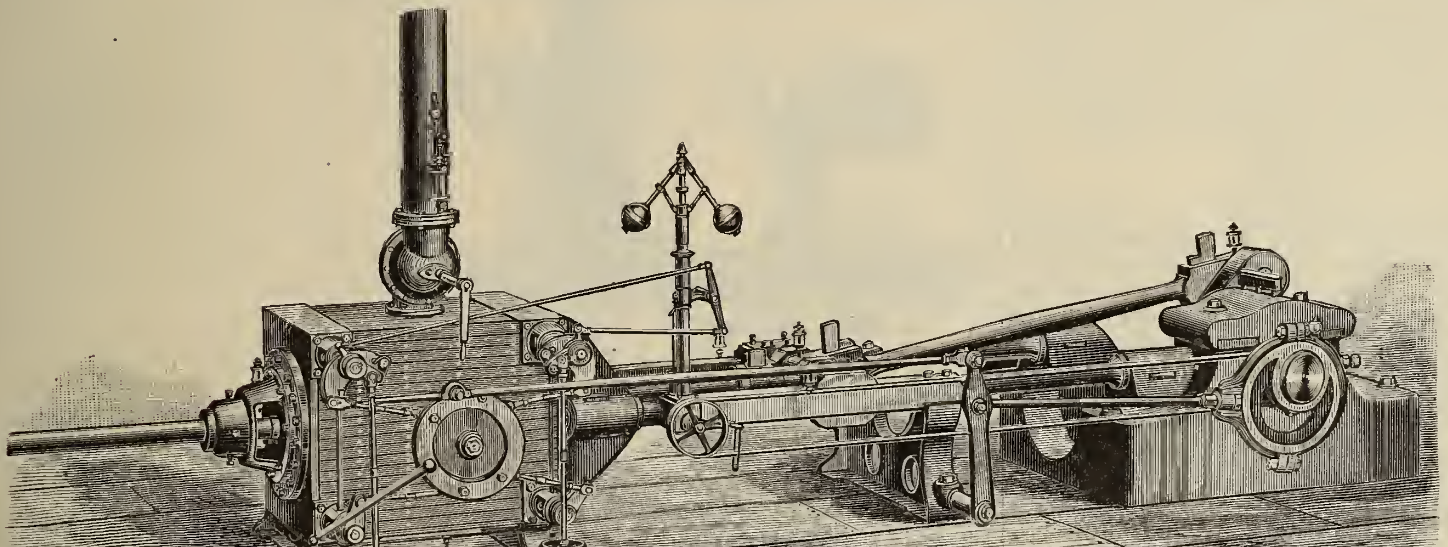
THE REYNOLDS CORLISS ENGINE.

BY E. PALLIS & CO., MILWAUKEE, WIS.

Our engravings represent the Reynolds Corliss engine as built by E. Pallis & Co., of Milwaukee, Wis. This engine has won a deserved reputation in its class, not only for the correctness of its proportions and design, but for the excellence of the workmanship upon it, as well. Although it has been in the market but about five years, in that time over 300 of them have been placed in all situations where steam power is used. If the testimonials volunteered by the purchasers are any criterion, the engines are giving entire satisfaction.



26″ x 48″ Reynolds' Corliss Engine —Showing Valve-Gear.



32″ x 48″ Reynolds' Corliss Engine—With Wrought-Iron Frame.

The lower engraving shows a peculiar form of frame termed by the makers wrought-iron. It is of that metal so far as the girders, or main framing, of the machine are concerned, and consists of two forged bars keyed to the pillow-block on one end and to the cylinder at the other, the guide-bars being formed by square portions in the center. This method has the merit of removing any artificial strains set up by cooling where the framing is of cast-iron; it also affords easy access to all parts for purposes of cleaning, etc., and where transportation is difficult, as in mining regions, is a great advantage, for the parts can be separated and handled much more easily than a long and cumbrous casting in one piece could be.

Respecting other features of the Reynolds Corliss engine, it is claimed that by reason of its superior valve-gearing, it runs with great regularity; so great, in fact, that for flour mills the engine can be coupled direct to the line-shaft. The valves are so proportioned that there is double the wearing surface usual in such valves, and no springs are required on either the steam or exhaust sides. The steel catches which open and liberate the steam-valves are made so that they give eight wearing faces on each piece before they need dressing or tempering, an advantage which is sufficiently obvious without comment.

The reader will also see that one defect, common to the original Corliss engine, has been remedied in the Reynolds Corliss, to wit: the situation of the wrist-pin in the crosshead. This is directly over the center of the crosshead-jaw, or bearing on the guide-bar, and removes any liability of breaking the piston-rod, which is by no means unknown in the old Corliss engine, where the wrist-pin projects several inches in advance of the center of the jaw. Another advantage is that the engine can be worked by the starting bar, by hand, so soon as the eccentric-hook is thrown off the wrist-plate, avoiding pinching the fly-wheel around to get over the center, or for adjustment of any part when under steam. These engines are built either high-pressure, low-pressure, or compound, of all sizes needed by consumers. Fuller details as to prices, weights, etc., can be had by addressing the makers as above.

◆

A friend sends us an account of a locomotive boiler that exploded while standing on the track, and asks if we can shed any light upon it. We cannot; but we think that a light shed upon the inside of the boiler before the explosion would have prevented it. We have no faith in mysteries, or marvels, as connected with boiler explosions. We believe a steam boiler to be an iron structure of a certain strength, according to its condition. When the pressure inside is greater than it can stand it is sure to give way; sometimes disastrously, sometimes not.

◆

A company has been formed in New Orleans to manufacture paper from "begasse." It has been found possible to free the crushed cane from the saccharine matter which will remain after it has passed through the rollers, and that the begasse thus freed makes an excellent pulp, from which a superior quality of paper can be made. Samples were exhibited and pronounced excellent.

One of the most singular features in the scenery of Idaho is the occurrence of dark, rocky chasms, into which large streams and creeks suddenly disappear and are never more seen. The fissures are old lava-channels produced by the outside of the molten mass cooling and forming a tube, which, on the fiery stream becoming exhausted, has been left empty. At one place along the banks of the Snake, one of these rivers reappears, gushing from a cleft high up in the basaltic walls, where it leaps, a cataract, to the torrent below. Where this stream has its origin, or at what point it is swallowed up, is unknown; it is believed that its sources are in the north country.

"The country therefore pays this handful of domestic manufacturers $4,500,000 for glue that would cost, if bought abroad and delivered here, $3,150,000. But on what we do import we pay $80,000, so that the total tax is $1,430,000, or, as the source from which I get these figures states, more than double what would be collected in duties if the whole consumption of the country were imported under a duty of twenty per cent." —*American Furniture Gazette.*

Wait till you destroy the American manufacturer of glue, and you will find out what imported glue costs.

SO THEY DO.

Respecting the mechanical fallacies constantly noticed as new devices calculated to annihilate time and space the *American Machinist* says:

> "Inventors appear every few years who propose to obtain power to increase the speed of locomotives by mechanical devices alone, and, singularly enough, they receive encouragement in numerous instances for their schemes from men who ought to be beyond deception. The Fontaine locomotive was a case in point."

This is very well put, and we have had occasion to make the same criticism frequently. The *Scientific American* lauded the Fontaine locomotive to the skies, as being the greatest improvement ever made in the locomotive, when it had no means of knowing anything whatever about the matter. It was incapable of judging the engine upon its merits, and it has not yet found time to announce its error. A mere failure of judgment, or want of mechanical sagacity and experience, are not grounds for criticism, because all men are not engineers or mechanists, but it is safe for the average man to hedge a little, in sporting parlance, when inventions are put forward to create industrial revolutions.

GLAD OF IT.

All honest men will rejoice in the defeat of the Morrison tariff bill, which, if it had been carried through, would have precipitated free trade upon this country. What with the agitation of this thing and the vicious attacks on rights of property in patents, this has been a dull spring for all who depend upon manufactures; that embraces practically the entire community, for manufacturers are at the foundation of our very existence. We do not intend to argue for or against, in this question of tariff. There is no need of it. Workingmen, and the community at large, know how it should be from instinct; argument is unnecessary to them. Purblind and muddle-headed free-traders are beyond it.

We said that this has been a dull spring, for the uncertainties attaching to the issues at stake have made every one cautious. Now that the weight is removed, let us all go to work and make up for lost time.

"How I Served my Apprenticeship" has come to an end with this issue, which we, in common with many others (judging by our correspondence) will regret. Mr. Slocum has told us, issue by issue, many useful things, and has shown everyday operations in a machine shop in a homely but forcible manner.

The series has been of value to all who are in the business it treated of.

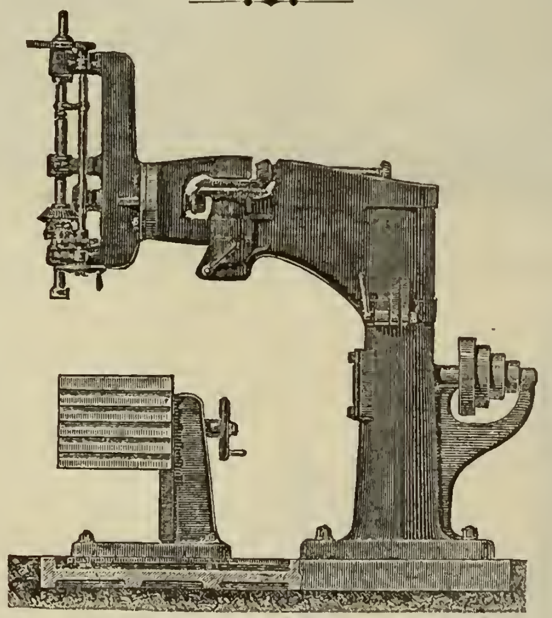
Our readers will hear again of Mr. Slocum, for he is now engaged in writing another serial article for The Mechanical Engineer which will be of interest to older readers, inasmuch as it treats of modern methods of locomotive work, and railway repair shops. This will be commenced some time during the next volume and will be announced more positively later on.

So-called cheap houses for mechanics are anything but cheap. Very few can afford to pay $1,800 to $2,500 for houses, and they do not want to spend a great deal of money in peaked roofs and gables. There is a demand for plain and simple house-plans, costing from $800 to $1,200, which it would pay to have filled.

In the new Washington Market now building in this city, the individual refrigerators of the butchers' stalls are all kept at a low temperature by mechanical means; artificial refrigeration in fact, instead of by free ice. This is laid on in pipes like gas or water, from a "factory" of cold air in the vicinity. It is asserted, with reasonable probability, that this will be the popular method of refrigeration in future for families. In the case of the marketmen the cost is said to be one-fourth that of ice.

A correspondent in Salem, Ohio, thinks The Mechanical Engineer does not come often enough. Perhaps if he sat at this desk he would think it came pretty often. He also says that technical papers as a rule fight very shy of the steam fire-engine, having but little to say about them. His remark is correct; there is a good deal to be said about steam fire-engines, and we wish those who have had experience with them would tell what they know.

Mr. W. P. Davis, of the North Bloomfield Foundry and Mach. Tool Works, N. Y. writes that he has recently shipped five of his new upright drilling machines, which were recently illustrated in The Mechanical Engineer.



A PECULIAR DRILLING MACHINE.

Our engraving illustrates a French drilling machine which has one marked peculiarity, at least, and that is the jointing of the horizontal arm. By means of this it is possible to do some kinds of work without moving the radial arm itself, but it will occur to some, as it did to us, that this device is gained at the expense of rigidity in the arm. Introducing a joint, as shown, is a weakness from the spring which is necessarily entailed thereby. As a rule, radial drills do not need any encouragement in this direction, when the spindle is at the end of the arm and large drills are in use.

In the case of Joseph S. Mundy against the Lidgerwood Manufacturing Co., in the United States Circuit Court in New York, the Court has decided that the re-issued patent No. 9,289, dated July 13, 1880, and issued to Joseph S. Mundy for an improvement in friction drums for pile-drivers and hoisting machines, is valid in law as to the fourth claim thereof; that Joseph S. Mundy was the first and original inventor and discoverer of the invention described in the fourth claim in said patent and the exclusive owner; that the Lidgerwood Manufacturing Co. has infringed by making and selling friction drums substantially as described in the patent. The decree enjoins the defendant from continuing to sell friction drums, or from otherwise infringing the patent, and refers to a master the question of the amount of damages sustained by the previous infringements.—*Railroad Gazette.*

WHAT PAPERS ARE THESE?

Some of the Eastern trade papers must be run on the principle of salvation free for all. There are five or six I could name that come to the waste baskets of nearly all the manufacturers in St. Louis every week in the year without the slightest intimation that there is any expense attached to running a newspaper. The publishers may think they can slip up on the blind side of an advertisement by keeping it up and taking the pains to mark those items referring to the receiver of the paper, but I think not. I think it is a thankless and profitless piece of enterprise. Papers that are not paid for are seldom opened, and if opened, seldom read.—*Age of Steel.*

This man is wise in his generation. He ought to write a pamphlet to L. Lum Smith, of Philadelphia, who has pestered us with his blatherskite sheet—with a penny stamp on it—for about three years last past. It is never opened, however. We wish some one would deal hardly with him.

The *American Miller* says:

> The Mechanical Engineer fails to appreciate the "mild and genial satire," which two of its milling contemporaries lately employed on a third. But Bro. Watson does not know the subject of the satire, perhaps. It requires a rasp to make an impression on the hard, cold cheek of some people, and the subject in question has a cheek of precisely that nature.

"Harder than the nether mill-stone." We regret to learn this. We have always admired the pleasant feeling which seems to exist among our milling contemporaries. It contrasts so strongly with that "war to the knife" atmosphere which pervades our own calling. Somehow, we don't know why, mechanical papers do not move in an atmosphere of sweetness and light, but they seem like Saul—"breathing forth threatenings and slaughter." We would it were otherwise, but we have given up, long since, trying to remodel the world.

Respecting setting globe-valves some discussion has been recently published by us. On this point a contemporary, the *Industrial World*, says:

"We have found in large establishments where an enormous number of valves were in use, that some of them were placed one end to the steam and others the opposite way. In not a few cases we have found them all placed so that the steam entered against the under side of the valve, so that when the valves were closed the pressure of steam was constantly against the valve, tending to force it open and causing it to leak. The proper way is to allow the steam to enter in such a manner as to press down the valve, which, when closed, the pressure of steam helps to hold down. It is urged as an objection that it is hard on the valve to open it against the pressure of steam, but this has no force except while the valve is closed, for the instant it is opened ever so little the pressure is alike on both sides, or as much more on the under side as the area of the valve-stem on the upper side. Thus there is no force nor reason in any argument for placing the under side of the valve to the steam entrance.

"One of the outrages on consumers is the placing inferior and imperfectly made steam valves on the market. There ought to be a penalty in such cases."

The consumer has no need to buy such goods; he buys them on account of their cheapness.

[Eds. M. E.

J. F. A. Cullinan, Secretary of Nat. Assoc. Stationary Engineers No. 3, of Rochester, N. Y., requests us to state that his Association is in no way connected with, or related to, the Brotherhood of Mechanical Engineers, of Rochester, N. Y., which is, he asserts, a separate organization of engineers outside the National Association.

David Summers, of Struthers, Ohio, says in the *Iron Trade Review:* "I have rolled sheet-iron 14,000 to the inch. The iron was of no use, but was made merely to see how thin it could be rolled. By applying a match, it would burn like paper."

The *Iron Bay Company* of Marquette, Mich., sends us a very handsomely illustrated catalogue of their various machines, boilers, etc. Its value is greatly enhanced by the clearness of the engravings.

A curious new process which will doubtless be used for decorative purposes has recently been invented abroad. It is called metalizing wood, or giving wood the appearance of metal. As described in *Les Mondes* the process is this: The wood is steeped in a bath of caustic alkali for two or three days, according to its degree of permeability, at a temperature between 164° and 197° F. It is then placed in a second bath of hydrosulphate of calcium, to which is added, after 24 or 36 hours, a concentrated solution of sulphur. After 48 hours the wood is immersed in a third bath, of acetate of lead, at a temperature between 95° and 122° F., where it remains from 30 to 50 hours. After a complete drying, the wood is susceptible of a very fine polish, especially if its surface is rubbed with a piece of lead, tin, or zinc, and finished with a burnisher of glass. It then looks like a metallic mirror, and is completely sheltered from all the deteriorating effects of moisture.

◆

A Board of Trade report has been issued on the explosion of a vertical steam boiler at Norfolk. The boiler was reduced to from 0·094 in. to 0·125 in. in thickness, and burst at some pressure between 40 lb. to 50 lb. In his evidence the foreman said: "I did not know whether it was fit for that pressure or not. About six or seven months ago I held the safety-valve down by hand, and raised the pressure to 70 lb. by gauge. After that I was satisfied that the boiler was safe."

This foreman would probably look for a gas escape with a lighted candle, put himself on ice to see if it were strong enough to carry considerable weight, and put a match on a keg of gunpowder to see whether it was wet or dry.—*London Engineer.*

ONE OF THE POOREST.

This item appears in a contemporary:

> "Castor oil is a good lubricator for machinery, by reason of its great adhesiveness and elasticity. On this account it is also comparatively cheap; cheaper in fact, than many of the lubricators, axle greases, etc., offered for sale, which are often, for the sake of increased weight and volume, adulterated with worthless and even deleterious substances."

The best, and only reliable test for lubricating oils, as to their comparative value, is had in machines constructed for the purpose, and supervised in operation by trained and careful observers. Under such conditions castor oil is shown to be one of the poorest of lubricators. In the words of one experimenter, "it ran the belt off of the tester."

The master mechanic of the Indiana, Bloomington and Western Railroad, finds that the Consolidated engines on the Peoria division average 28 loaded cars 17 miles with one ton of coal, while the Mogul engines average a haul of 20 cars $19\frac{1}{2}$ miles on one ton of coal. On the Middle divisions the Consolidated engines haul 35 cars $20\frac{1}{2}$ miles with one ton of coal, and on this division the passenger engines average 47 miles to each ton of coal consumed.—*Mining Herald.*

◆

Papers which are anxious to become "organs" of associations, or trades, have only to look at the avowed representatives of labor-unions or similar societies, to see what they amount to. The idea of many who aspire to become organs is that every man in the association will subscribe and forward the interests of the publisher, but, if we may judge from the trade-sheets in question, a very lukewarm interest is taken in them.

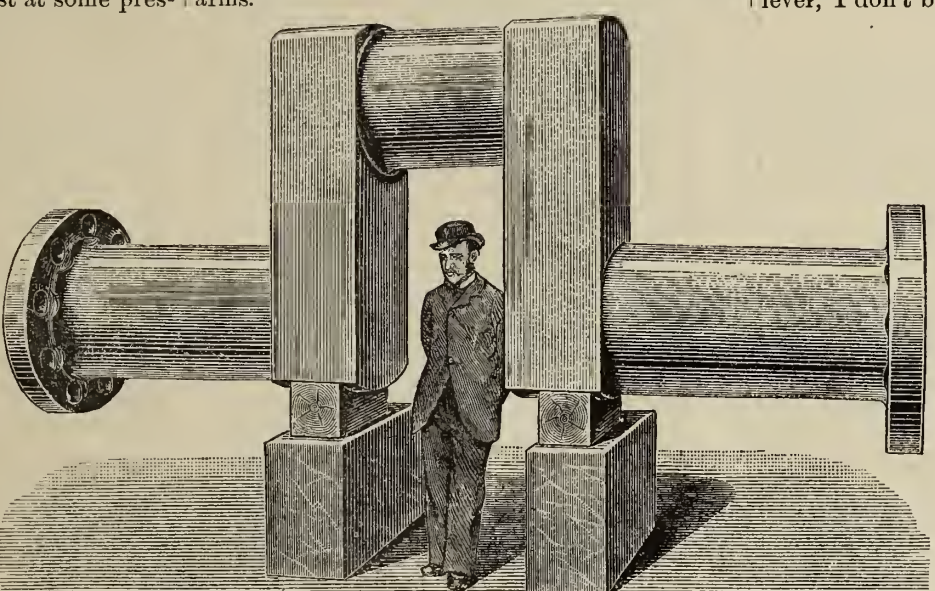
◆

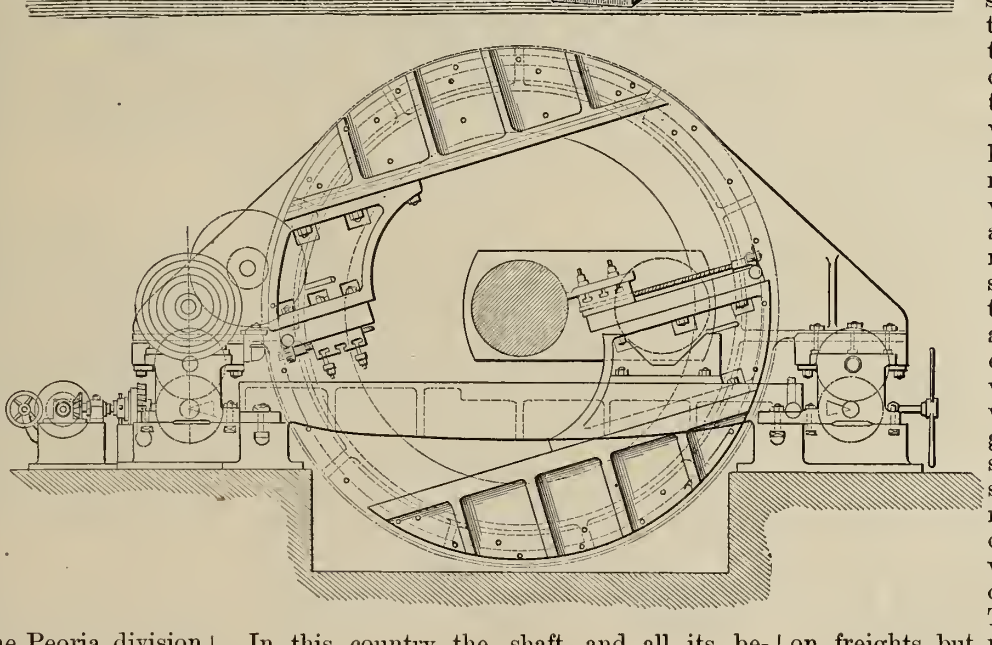
The new head of the *Industrial World* is an improvement on the old one.

MARINE ENGINE CRANKS.

A better idea of the immense proportions of large modern marine engines is given by the engraving herewith than by pages of detail. As may be seen, it represents a solid forged crank of wrought-iron; the forged weight of it was 24 long tons, 11 cwt.; the finished weight is 15 tons, 8 cwt. We do not know the proportions of the gentleman between the crank-arms, but if he is of the usual stature he represents a scale of $\frac{1}{4}$th of an inch to the foot, which is quite impossible as regards the crank. Measured on the same scale this would make the crank 4′ 6″ between centers, or 9′ stroke. Few modern screw-engines have nine feet stroke. It is noticeable that this crank has no fillet at the shoulder in the main bearing, but is cut square in the corners; there is plenty of fillet in the corner on the coupling, however, and one is tempted to ask if it is good upon one side why not on the other?

This is an English forging, and method of constructing cranks; they are not so made in this country. Ours are all built up, the arms are forged separately and shrunk on, and the pin is also a separate forging shrunk in to the arms.





In this country the shaft and all its belongings are rough-turned to size (except where the parts are to be shrunk together), and after this latter process are swung on their own centers in a lathe and finished completely. This gives a crank-shaft which is absolutely in line all over. In England in one shop a machine like that here illustrated is used, which, by the mechanic and engineer, is readily understood. The tools are carried on angle-plates which in turn are fastened to a revolving ring set in a frame. This ring is driven by the gearing shown.

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Charles F. Ritchel, of Bridgeport, who tried to invent a flying machine, will get $100,000 to perfect the invention with from the estate of Maxwell, a millionaire brewer at Milwaukee, who left $500,000 for experiments in aerial navigation, one-fifth of it being specified as for Ritchel's machine. Ritchel will begin experiments on a large scale.—*N. Y. Sun.*

Since we published a letter in our issue of May 3d, criticising this paper unfavorably, we have been literally overwhelmed with friendly communications from all parts of the country. We naturally wish to publish them, but we do not think all of them are intended for publication, judging from the technical epithets bestowed upon the unfortunate critic. These might not come amiss in the open air, but in the columns of our paper they would be rather overpowering. The writers of the communications will please accept this acknowledgment, in gross, of their good will, with the assurance that we shall endeavor to continue to deserve it.

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WHAT RUNNING A LOCOMOTIVE MEANS.

"Lots of chaps think that it would be fun to run an engine," said the driver, as he stuck his head and a long-necked oil-can in under his machine, "but if the most of 'em would try it they wouldn't like it quite so well. 'Taint everybody can run a locomotive, either. A nervous man has no business in a cab; no more has a careless one, or a stupid cuss. To run an engine a man must feel his responsibility and keep his head level; I don't believe half the people know what it is to run an engine. A locomotive has to stand wear and tear and weather that'd knock a stationary engine into smithereens. And no matter what emergency rises—freezing of pipes, or starting of flues, a loosening of packing, or heating of journals—we've got to know just what to do, and do it right quick, too; then when we're running there's the time-cards, and pretty often a new one; and the train orders—they are a life and death and reputation to us, and to read 'em correct and live up to 'em gives us no end of anxiety. Bet I've read a train order over a dozen times an hour. I am always so afraid of making a mistake or forgetting. You know the consequences of even a little mistake, sometimes. Then there's the signals to watch, the conductor's gong overhead, steam to keep up, time to make, whistle-posts and crossings to look out for, bad spots in the road to be careful on, and along with all this there's the track ahead of ye which your eyes mustn't leave for more'n five seconds. There's the brakes, too—one is always worrying about them. I don't s'pose everybody knows, either, that we have to be mighty careful when we come to the top of a grade. You see in going up she labors hard, and so soon as she begins to descend she makes a rush, and there's the danger of breaking your train when the rear cars are still dragging on the up-grade. This danger is especially great on freights, but no good engineer fails to shut off some of his steam when his engine reaches a summit. It isn't every one that can run a locomotive.—*Chicago Herald.*

◆

The adoption of air-brakes has been attended with very considerable increase of expense for repairs. The air-pump alone is a detail which requires constant care and attention to maintain its efficiency, while the greater force applied to the wheels, as well as the swifter action of the brake, tells in the repair account.

◆

"What's in a name?" Steel nails, so called, are now being put upon the market, but inasmuch as no one can tell them from iron by the appearance, and the iron nails answered every purpose, it needs Sam Weller's microscope—"forty million magnifying power"—to find out the value of them.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(THIRTY-THIRD SESSION.)

Philadelphia Meeting, September 3–10, 1884.

Editors MECHANICAL ENGINEER :

You are doubtless aware that an effort is being made to place the new Mechanical Section (D) of the A. A. A. S. on a footing that we shall not be ashamed of when the members of the British Association, and other distinguished gentlemen, visit us at Philadelphia next September. To this end a circular is just issued, a copy of which I mail to you with the request that you will favor us by inserting it in your valuable paper.

J. BURKITT WEBB,
Professor of Applied Mathematics, and Theoretical Mechanics,
Secretary, Section D.
Sibley College of Mechanic Arts, Ithaca, N. Y.

The circular is given in substance herewith. We are not able to publish it *verbatim*.

(CIRCULAR.)

ITHACA, NEW YORK, March, 1884.

In accordance with a resolution adopted at the Minneapolis Meeting of the Section of Mechanical Science (D) of the American Association for the Advancement of Science, I am requested to extend to you a cordial and earnest invitation to attend the Philadelphia Meeting of the Association, to join the Association (if not already a member), and to take an active part in the proceedings of the Section.

The British Association will meet next year in Montreal, immediately before the date of assembling of the American Association, and arrangements will be made to bring its members to Philadelphia on September 3. The presence of the British Association at Philadelphia will lend much additional interest and importance to the meeting of the American Association. The opportunity is thus also offered to make this meeting an occasion for bringing together a larger number of gentlemen interested in the subjects falling under the consideration of this section than have ever been or are likely for some time to come to be again brought together in this country. It is hoped and expected that the meeting will prove to be one of singular interest, as well as importance, and worthy alike of the occasion and of the opportunity. Its success will gratify, not only the members of the Association, but every one who is interested in the promotion of the industrial interests of the country and the welfare of the people who are so largely dependent upon those interests. You are urged to make arrangements to attend this meeting, and to interest others in insuring a full attendance and a list of valuable papers for the Section.

The Section, the sessions of which you are invited to attend, is especially devoted to the advancement of all the sciences most directly applicable in the arts, and in the departments of engineering, civil and military, mining, mechanical, and electrical, and in architecture. It is hoped and fully expected that the several great technical societies of the country, as well as the local societies of engineers, will take active part in the promotion of the plan here indicated, and in the inauguration of a series of convocations of all the departments of engineering, and kindred organizations, at the meetings of this Section of the American Association. Members of every related profession will be heartily welcome.

Members (actual or prospective) who intend presenting papers to be read before this section, can obtain the proper blanks, from the Secretary, on which to offer the titles and abstracts of their papers for the consideration of the proper committee. Papers are usually printed in the Proceedings by abstract, and such abstract, ready for printing, must be presented to the Standing Committee and approved by them before the paper can be admitted to reading. It is requested that titles and abstracts be sent to the Secretary of the Section as early as possible, before the meeting, accompanied by a statement of what models, apparatus, drawings, etc., will accompany the paper, or, in case the abstract is not ready, a brief outline of the paper can be sent and the abstract furnished at any time before the reading. In addition to the abstract upon the regular blank, five copies of the same should be furnished for the use of reporters and secretaries, and special efforts will be made to secure the immediate publication of abstracts or papers in current periodicals for which they are suited. A list of papers received before Aug. 10 will be mailed to each member of the Section who sends his address to the Secretary as below.

If it is desired to place articles, models, or apparatus on exhibition, a list, and a statement of the space required, should be sent to the Secretary at an early date. If bulky, the Secretary will have the option of giving smaller exhibits the preference. Papers and exhibits void of scientific value are not desired, and everything of an advertising character will be rejected. The Secretary will forward to members, and to those desiring them, the circulars of societies proposing to join in the welcome extended to such members of the allied professions as may desire to take part in the Philadelphia Meeting of the American Association for Advancement of Science.

R. H. THURSTON,
Vice President and Chairman of the Section.
Stevens Institute of Technology, Hoboken, N. J.

J. BURKITT WEBB, *Secretary,*
Cornell University, Ithaca, N. Y.

A FRIENDLY REMONSTRANCE.

Editors MECHANICAL ENGINEER:

It was with a curious mixture of feelings that I read the first letter in "*Letters to the Editor*," in your issue of the 3d inst., from a correspondent whose name you do not give. With you, I think this person "has an offset in him," and one that is very evidently pointing in the wrong direction, as he will most likely find to his cost some day, should he continue to follow the course his letter seems to indicate, providing he *is* an engineer or fireman. If he is a machinist I think his reason for criticism a very poor one indeed. After over twenty-two years experience as an engineer, giving the closest attention to my profession, I feel justified in denying this man's statement that, "there is very little to be learned about boilers for engineers." In my opinion, it is a part of the profession that will never be entirely mastered, and I believe to-day, that to run a boiler, or boilers, safely and satisfactorily to all concerned, it requires every whit as much ability, judgment, or what you may call it, as it does to be a first-class engineer. Not that I wish to be understood as saying, that any first-class engineer is not a capable man with a boiler, but I do think that no man who is not a first-class fireman, or would make one, could make a first-class engineer. Of the two, I believe the fireman's position is the one requiring the best judgment and skill; or would, except that boilers are too often overlooked by the engineer, so that some one must learn what he can about them. When our friend has learned all there is to be learned about boilers, if he will let me know where he is to be found I will try and make some arrangement, so that he will impart some of his learning to me. I feel there is a great deal for me yet to learn about this much abused servant of man, although I sometimes flatter myself I have learned quite a bit about boilers and engines. At some future time I will try and give some illustrations of my ideas, or what a predicament this know-all idea will sometimes get a man into. I have always been much interested in the articles in your paper concerning boilers, and I doubt if there are two sound thinking readers of it, who would say there has been any too much said about them.

I cannot but think that this gentleman referred to, misspoke himself when he said "he never saw anything about machines and tools in THE MECHANICAL ENGINEER such as he reads in other papers." I have certainly seen many illustrations and descriptions of both tools and machines, and have often noticed that such machines possessed merit of their own, while we often see in what are alleged to be technical papers, illustrations and flattering puffs of machines and tools that are never heard of again. I, for one, am thankful that THE MECHANICAL ENGINEER has so closely pursued the course promised at the start, and has not become a mere advertising sheet in the interests of those whose patronage it is seeking to secure. The prosperity enjoyed by it is, I believe, the best proof that this is the best policy.

Again: our friend seems to be badly taken with Mr. Moulton, or perhaps, rather "*The Professor in the Machine-Shop.*" Well, I suppose we might expect that, but for myself, I have often wished I could take Mr. Moulton by the hand and tell him personally how much I enjoy reading his letters, and I try not to read much that I cannot get good from. I believe I share the feelings of a large majority of your readers, and sincerely hope Mr. Moulton will favor us with his letters for a long time to come.

The writer of the letter referred to cannot, certainly, read very carefully if he does not see that every issue is replete with just such things as every young engineer ought to know, if he intends to ever be qualified for such a responsible position. He must know one thing; and that is that no paper can possibly instruct him in every detail of his particular engine; for that, he must be willing to exert himself a little. This critical young man is taking just the right kind of medicine, and if he continues to read THE MECHANICAL ENGINEER, my word for it, he will find his indisposition cured in time.

I too do not care a great deal about English engineers, but I do care about what English engineers are doing, and have no doubt but that we might learn some valuable things from them. At the same time, I can say with our friend, "this country is good enough for me."

It cannot be your expectation to please everybody, but my vote will always be to *not* make THE MECHANICAL ENGINEER a mere advertising sheet, or trade-catalogue. I would not suggest any improvement, but, at least, let us see what a paper for the working engineer and machinist will do. I believe it will be appreciated, for certainly there are few enough of such papers.

Kingston, Ill. L. P. HARVEY.

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"LEARNING A TRADE."

Editors MECHANICAL ENGINEER :

I often hear persons say: "I think I would have made a good mechanic, for I have a turn that way."

Yes, but, if they have only a smattering of education you will find them having little desire for a trade. I know it is the misfortune of some boys not to have had the privilege of going to school while they were young; perhaps they were left fatherless and had a mother to support, therefore they go early to trades and sometimes make the very best workmen. To the boy who has wasted his time at school, and the one that did not have the privilege, I have this to say: If he has felt his deficiency, and has a desire to learn, I don't think it will take him long to find a way. Various things present themselves to the workman or apprentice. Problems of all kinds, both plain and simple, are encountered daily. Now, without some learning you will find it hard work to understand some things pertaining to the trade.

I was one of the boys that waste their time at school, and my experience has prompted me to write these words of warning to my fellow-workmen and apprentices.

I never realized, or felt the need of mathematics until I had responsibilities thrown upon me. And let me tell young men to "improve every hour," study hard after work to enlighten your mind, so that you may become a first-class workman and master of your business. I have seen boys at trades who seemed to me to care very little whether they learned them or not, and others so that they could run a machine, drill, bore out, plane, and turn iron, had achieved the height of their ambition. They felt that to serve five years at the trade was all that was requisite to be a first-class workman. Not so, my boy; you should know, if you run a lathe, what wheels to put on to cut a certain number of threads to the inch, independent of the index. You must know how to make tools for certain kinds of work, and to speed the lathe or machine for various metals and diameters; with also an eye for designing work, having a view to neatness, adaptability and a good job. There are other matters pertaining to the trade, such as how to line an engine, to get the lengths of various parts of it, throw of eccentric with and without rocker arm, travel of valve, size of cylinder and stroke for a certain horse-power, size of ports suitable for a given cylinder, and also the steam-pipe for the same. After completing the engine you must know how to set the valve and how to get the speed desired, size of pulleys, etc.

Learning a trade is only a phrase expressing an occupation, and the amount of information acquired during his probation should incite every young man to learn more, to comprehend the principles attaching, and the reasons why certain operations are performed.

Virginia. R. J. S.

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HOW SHOULD STEAM-PIPES BE CONNECTED.

Editors MECHANICAL ENGINEER:

I notice a letter in your issue of May 17th, signed "*Eccentric*," commenting on a letter of mine in the issue of April 5th, asking for information about setting a cut-off valve. I object to the expressions "smart Alec" and intimation that I "know it all," in "*Eccentric's*" letter. Surely, if "I knew it all" I would not subscribe to THE MECHANICAL ENGINEER; but I do, for I find it an educator that aims, and faithfully accomplishes its effort, to instruct me and my fellow-engineers in our respective callings. I do not see that my letter, which *Eccentric* criticises, savors of pedantry. His advice to let the eccentric alone virtually implies that it matters not where this detail is on the shaft!

In reply to his request for dimensions of the engine, I here append them, but it is quite immaterial, as regards the question I asked, whether the engine is 20, or 50 h. p. The cylinder is 8½ inches diameter, and 12″ stroke, with independent cut-off on back of main valve, and governor; speed 130 revolutions per minute, steam-pressure 70 lbs. by gauge; cut-off at 7″ of the stroke.

Last year I asked in this paper for the best method of connecting feed-pipes and check-valves to boilers. In return I received a great deal of information, and feel encouraged to ask another question, to wit: How to connect steam-pipes to batteries of boilers so as to allow for expansion; also the location of stop-valves, so that any one boiler may be shut off in case of accident or for repairs. Also, how should safety-valves be attached, and where? Many who are on the lowest round of the ladder, like myself, would be glad of information on these points.

Mass. WALTER BURDEKIN.

[We hope correspondents will not allow their communications to become tinged with personalities. All such are out of place anywhere, especially in print. Let us confine ourselves to the communication of facts, and omit probable motives, or criticisms on modes of expression.—EDS.]

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THE FOREMAN CURSES HIM.

Editors MECHANICAL ENGINEER:

I noticed in the issue of May 3d of your paper a letter entitled "*One of the Other Kind*," in which the writer says Mr. Moulton's articles are the worst kind of silliness. I wish you to tell Mr. Moulton to keep on writing silliness of that kind. I have received more encouragement from reading his articles than from anything I have yet read; he puts everything so plainly that an apprentice can understand what he says.

I am an apprentice under instructions, and with a pretty hard foreman, who curses a fellow so much sometimes that I get discouraged and do not know what to do; but, somehow or other, Mr. Moulton's articles give me new energy and help me to get along. I am also greatly interested in other parts of your paper.

UNDER INSTRUCTIONS.

[Mr. Moulton was in our office when this letter arrived, and has made his own comments.—EDS.]

Now, this is what I call pretty tough: that a boy learning his trade should be abused by one "clothed in brief authority." Our young friend has fallen on hard lines, and no mistake; but I hope that he will remember that it cannot always be so. He must be patient, try and give no cause for fault-finding, and do the best he can, *for his own sake*, never forgetting that he is working for himself. If I were him I would not complain to the proprietor, or anyone. I would try and bear the trouble as well as I could. No disgrace attaches to him for being cursed—it falls on him who curses. Let him learn all he can, and carry out his agreement to the very letter. When his time is up he will be free to seek a better place.

MOULTON.

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GROSS LIBEL ON THE BLUE PRINT.

Editors MECHANICAL ENGINEER :

I notice in the last issue of THE MECHANICAL ENGINEER a gross libel on blue prints. How is it that so impartial a journal should come to be so unfriendly to the unoffending blue print? You say they are unreliable, as they are not "fac-similes of the original." Now I must beg to differ from you on this point, as they are the truest kind of fac-similes it is possible to make; that is if they are properly made, and under certain conditions may be measured from with the utmost certainty.

If made in a pressure-frame the only alteration is due to the shrinkage of the paper in drying, after having been washed, and if dried between blotting-paper under slight pressure are equal all over, so that if any one dimension is known a scale may easily be constructed that will measure correctly any part of them. As for the lines throwing a "shadow," that is practically of no account, even if it does occur, which I doubt.

I am using them, and measuring from them every day, and find them as correct as any drawing I ever saw.

Yours, etc., Walter W. Scott.

[We have had occasion to trace a great many blue print drawings on the prints themselves, and the paragraph relating to their unreliability to measure from was based upon that experience. We have found that straight lines are not straight, but thick and thin in the same line. Also circles are not round, but ovate, etc. We have called the attention of expert draughtsmen to this point and they agreed with us; we did not suppose there could be any question of fact. If our correspondent will call at this office we will show him what we refer to. Perhaps others will favor us with their views.—Eds.]

HIS CANDID OPINION.

Editors Mechanical Engineer:

In your last issue I see that the individual who spoke his mind about boilers is getting attended to, and some advised him not to read The Mechanical Engineer if he did not like its contents. For my part I also think there is too much about boilers, for engineers never care about boilers if they don't leak, and they make steam. I know good mechanics, and there is not one out of fifty of them who ever go near the boiler; much less in it. They leave all that to the inspector, and take what he says. I believe I would write a little more about engines; it would be far better to leave boilers to boilermen, for they never ask how the engine is, or what this engine or that is good for. In the future please write more about engines, and tell us how to get at them and take them apart

I wish you would tell some of those gentlemen who wrote in your last issue, to mind their own business, if they are engineers; if they are boiler-builders let us know. If they are engineers they can learn for the next 100 years, "and abuse somebody who is right." (?)

Chicago, Ills. A Reader.

[Comment is unnecessary.—Eds.]

HARDENING LOCOMOTIVE PARTS.

Editors Mechanical Engineer:

Are you not a little off, in your issue of May 17th, in saying that locomotive parts are not hardened, "neither in the bushes nor in the bolts"? I think it safe to say that nearly all shops harden these details; also the bush in valve-stem rod, also all the link gear and parts generally under wear.

The object of inquiring the best way to lap these parts out after hardening was to draw forth the latest methods of so doing, and I hope that this will be the case yet. Some of your many readers must have had experience in this line, which they may be willing to communicate to others.

Louisville, Ky. "Old Kentuck."

[We were in the wrong, and frankly acknowledge it. Our correspondent will accept our thanks for his prompt correction. At the same time, to show how genuine our confession is, we have made inquiries at railroad shops—since writing the paragraph stating that parts were not hardened *in our experience*—and find that they are hardened. We hope those who are at work on such details as our correspondent mentions will oblige us with the information.—Eds.]

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS, U. S. A.

Editors Mechanical Engineer:

The annual election of officers for the Subordinate Associations of Stationary Engineers, for the term ending June 30, '85, will take place at the last regular meeting in June, '84. The installation of officers will take place on the first regular meeting in July. The election of delegates to the National Convention (unless already elected) should take place upon the same evening of and immediately after the installation of officers. The Secretaries of Associations will at once, after election, send a full list of the names of the officers elected to the National Secretary, with their quarterly report for the year ending June 30th, also "per capita" tax. Secretaries should not fail to make these reports, as they are necessary to enable the National Secretary to post up his books for the year ending June 30, '84.

J. G. Beckerleg, President N. A. S. E.

ANOTHER REMONSTRANCE.

Editors Mechanical Engineer:

I was surprised to see a letter in your issue of May 3d, from a young man who found fault with you because you published so much about boilers, and, to use his expression, "a lot of things that nobody cared anything about." For one, I think the articles on boilers just what is wanted by every engineer. I am only a machinist myself, but I have found that whatever I can learn outside of my own trade never comes amiss. I got a job once, when I would not otherwise, because I knew how to put a soft patch on a boiler. It happened in this way: I wanted a job at my trade, but the shop where I applied did not need any more help at the time, but did want a boiler-maker for a few days. I asked the boss what they wanted done and he showed me, and I was able to make a good job of it; after that I got a place in the shop.

Messrs. Editors, all I have to say is, print all you like about boilers, you can't give too much about them.

Belmont, N. Y. E. B. M.

MR. "GREASER'S" VIEWS.

Editors Mechanical Engineer:

Having been a subscriber from the start, nearly, I must say I am well satisfied with the paper. Of course there are things in it I don't care for, but these, like boys at school, I skip. I like Moulton's writings, and was sorry when I thought we were going to lose him. I am an engineer of thirty years experience, and ought to know what a good paper for the trade is. The articles on boilers are very useful in some parts of the country, but do not specially apply here, as ours are all cylinder boilers, set in batteries of twenty and thirty each, in some places. The man who wrote in your issue, May 3d, that he did not want to know anything about boilers, must be a curious engineer.

Shenandoah, Pa. Greaser.

A SURGICAL OPERATION SUGGESTED.

Editors Mechanical Engineer:

I notice, in your issue of May 3d, a communication from a very innocent young man; the letter is entitled "*One of the other Kind,*" and in it he expresses a desire to see less about steam boilers in The Mechanical Engineer. I differ with him. The boiler holds the first place in my opinion and the engine the second, but there is only one way to make this clear to your critic. Let him get a butcher to saw a piece off the top of his head, and examine the interior. If found vacant let the butcher introduce a teaspoonful of calf's brains. I think it would be an improvement.

San Francisco, Cal. John Mailer.

SCIENCE AND THE SHOP.

Practical men are too often inclined to look upon scientists as mere theorists, whom it is dangerous to follow, as though they were false teachers or mere visionaries. Perhaps there is a foundation for this belief. Many professing to be scientific teachers have shown themselves to be totally unfitted for their work. Lacking a proper education, or failing in making a proper application of the facts at their command, they have proven indeed "blind leaders of the blind." But these are not true scientists, and they should no more be mentioned as representatives of the schools of science than should the merest amateur painters be mentioned as fit representatives of the schools of art of which a Rembrandt or a Story were worthy and illustrious disciples. × × × × ×

The machinist, in attempting to dress a certain casting, finds that his tools grow rapidly dull or easily break. He at once seeks the cause. Before him is the effect—broken or dulled tools. To find the remedy he must know the cause. Does he look for this alone in his shop? He may not find it there. Another casting upon which he works may not produce a like result. What does he do? He goes to the foundryman and ascertains, if possible, how the casting was made, and of what it is composed. Finding that it has too tough a skin, he will, if desirable, have his foundryman make a change either in his methods or in the materials of which the casting is composed. To ascertain how to properly order this change, the aid of the metallurgist must be sought, and the hand of practice must be assisted by the hand of science.

× × × × × × ×

What are the stepping-stones to progress in the mechanic arts? Certainly not mere practice. Intelligent study and observation lead to higher results. The mechanic or artisan who would rise must study causes as well as results; must learn principles as well as methods; must look beneath as well as upon the surface of his work. The mechanic who scoffs at science, who abhors study, who seeks only for present accomplishments, who thinks that all there is in work consists of turning out the job before him, and who cares not to ascertain how that work may be improved, or better substituted, will always lag in the race of progress. He may cling tenaciously to his rule of thumb methods, but he will see his brighter and more studious companions rise above him. J. S. Salisbury.

SECOND ANNUAL REPORT OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

We publish herewith the second annual report of the above body, as far as heard from, to date.

The numbers "26," etc., indicate the members in each body.

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Rome, N. Y., No. 4, 10. Chas. Tracy.
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Omaha, Neb., No. 1, 13. A. A. Thomson, Herald Office.
Canton, Ohio, No. 1, 15. Jesse F. King, 2 Hane st.
Cincinnati, Ohio, No. 2, 148. G. G. Minor, Room 9, Esplanade Building.
Toledo, Ohio, No. 3. (No report.) C. W. Parsons, care Maclean & Sprague.
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Worcester, Mass., No. 4, 36. F. D. Wheeler, 23 Hermon st.
Loyal, Mass., No. 5, 23. H. F. Howard, Box 880, Beverley, Mass.
Troy, Mass., No. 6, 31. Robt. Place, 3 Alden st., Flint-Village, Mass.
New Bedford, Mass., No. 7, 11. Chas. H. Cutter, care New Bedford Mfg. Co.

As the annual election of officers takes place at the last meeting in June next, I would request the secretaries to send me their list of officers and report *immediately* after the election.

A. M. DAVY,
Sec'y Nat'l Assoc. Stationary Engineers.

According to the *Age of Steel*, the result of a test for evaporation in tubular boilers was but 6·35 per pound of coal—from and at 212°. The test was made by skilled and trained observers, and was, no doubt, the best that could be obtained, but it is a low duty and leaves open to conjecture what the same boilers would have done under every-day conditions.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

THICK AND THIN BOILER PLATES.

We made some allusion to this subject on page 118, No. nine, current volume, and asked the question point-blank, whether the economy or evaporation was affected by the thickness of the fire surfaces.

In reply, two correspondents have favored us with their views on the subject, which we have read attentively. One of the correspondents is a well-known boiler-maker in a neighboring city, and the other is an engineer of very wide experience. Both of these gentlemen entertain the view that the thickness of the fire-sheet does affect the evaporative capacity of steam boilers, though how they arrive at it, other than by quoting precedents and examples, is not shown. Our correspondents also touched upon the other side of this question—the comparative durability of boilers with widely different thickness of fire-sheets, and upon this they accord, to wit: that the life of boilers is materially shortened by extremely thick plates.

As we stated in our previous reference to the subject, we do not include this in our consideration. What has appeared remarkable to us is that a steam boiler with flues $\frac{5}{8}$ths of an inch thick is able to evaporate as much water as one with tubes $\frac{1}{8}$th of an inch thick. This is a fact to be seen of all men, and as such, the observation of M. Peclet, who we believe is a French observer and experimenter, seems to be rather puzzling. This gentleman deduces from broad grounds and general bases the proposition that:

> "Under ordinary circumstances the quantity of heat which a metal plate has the power of transmitting is far greater than it is called upon to transmit. × × × × Again, since no more heat can be transmitted through a plate from one side than can be taken from it by the recipient on the other side, the transmitting power of any given surface must be absolutely dependent upon the absorbing power of that recipient, whether it be water, steam or air."

There need be no question as to the truth of these positions. The inquiry which does arise naturally, is: What bearing have they upon the relative value of thick and thin fire-sheets and surfaces, as regards the evaporation of any given boiler? To us they do not seem to have any, for it is known by all men that the evaporation of water in steam boilers is practically the same all over the world, and as we look at it, inquiry should be made into the capacity of water as a conductor of heat—recipient rather.

Baldly stated, the facts are these: A vessel with walls five-eighths of an inch thick will evaporate as much water as one with walls an eighth of an inch thick. Query? will water receive any more than a certain quantity of heat in a given time? That is what we wish to know, and in our opinion it is the point to be solved.

As to set experiments, we do not see what is to be gained by them, other than to establish facts already known. Experiments are in progress more or less, continually, with steam boilers everywhere. Many of these are conducted by persons capable of recording what they see correctly, but in none of them does it appear that any more than the usual quantity of water has been turned into steam. Experiments to apply to boiler evaporation must be made under the usual conditions, and should be made on steam boilers in every-day work. Every new steam boiler tested by competent men is, therefore, an experiment, but none of them establish or add anything to well known facts—always as regards the quantity of water evaporated per pound of coal.

Respecting the quotation from Bro. Le Van, that very thin boilers cannot be calked, and very thick ones have not the same margin, or factor of safety as those of medium thickness, this comment may be presented:

Thick and thin are purely comparative terms, and are too vague and general to be used in this special connection. Thin boiler plates, by which we mean $\frac{3}{16}$th plates, are in use and can be calked; so can $\frac{1}{8}$th plates if necessary, but no one builds boilers out of plates $\frac{1}{8}$th thick. The weakness of thick plates, by which we mean 1″ and upward, lies in the joints of them, and is unquestionably a correct assumption; but inasmuch as a large factor of safety exists in the boiler as a structure, and no one has ever been burst through its unaided working pressure, it is hard to see what particular bearing it has on the question we put. This, as we have said, concerned only the evaporation.

It has been asserted that circulation is a prime factor in rapid evaporation, and it is true that it is an agent, at least, but it is also true that boilers with sweeping circulations, those wherein the water is actually kept flowing in a continuous thin stream, or injected directly upon hot surfaces, are but little, if any, more rapid evaporators than those which depend upon their own currents for circulation.

We have reduced the consumption of steam from forty pounds per horse-power in an average engine, to under twenty in the best engines, but we have made no advance whatever in reducing the cost of this steam as regards the evaporation per pound of coal. We have reduced it in one way, by improved furnaces and better combustion, but per pound of coal burned we evaporate no more water to-day than we did thirty years ago. Why?

◆

RESPECTING THE PROPORTIONS OF COMPOUND ENGINES.

I trust, in the interest of good engineering, that no *practical engineer* will receive as his guide in designing, the statements set forth by a correspondent, "*Compound Engine*," in your issue of May 3, '84.

To accept them, would be in opposition to the experience we have had with compound engines, on several steamers in regular service out of this port.

I may assert, that to waste the power of the steam as this writer advises, is, fortunately, not the practice of to-day, which is far ahead of the ideas he advances.

A few years ago a prominent American engineer published the results of his experiments, proving to his satisfaction that no economy was had by using steam expansively in the cylinder of a steam-engine.

Later experiments by another engineer satisfied him, that expanding to four volumes was the limit to which it could be carried economically or usefully.

Others have quite lately proved by experimental tests, that expansion might be carried to six volumes, and be "commercially valuable" in an economical sense, taking into account interest and depreciation.

In the meanwhile, English engineers are using a much greater ratio of expansion, increasing it with each new vessel, so that these experimenting gentlemen are away in the rear with regard to actual practice and experience at the present time.

Our present practical engineering experience —that which I am writing of—has shown, that with a properly arranged engine, the steam can be usefully expanded down to six pounds above a perfect vacuum, and the economy is *realized*, as known and shown by the fuel used; therefore the range of expansion as stated by me is correct.

The use of a large receiver in a compound engine, has been proved a valuable addition in several instances. It is a necessity for the best development of power in any compound engine. A receiver was placed over two years ago on an engine whose cranks were set 180° apart; the steam originally passing directly by short passages from the high-pressure cylinder upon the piston of the other cylinder; the result is that more power and economy is had. The size of the receiver was also increased from time to time, until about six capacities of the high-pressure cylinder were reached, and only want of room prevented further enlargements. Each increase was an advantage, showing that receivers should be from eight to ten times the capacity of the high-pressure cylinder, and that a nearly constant back-pressure on the smaller piston is an advantage.

If an engine is properly arranged, there need be no loss from free expansion; this is proved by actual practice.

The power developed from each cylinder, making their sizes to accord with the rule of proportion quoted by me, will be found to give excellent average results, and nearly equalizes the pressures on the crank-pins, which is desirable.

It is entirely safe to assert, that if an engine is properly proportioned, arranged and constructed, it will give out nearly all the force of the steam used, in harmony with the theoretical gain of power due to using it expansively.

Engineers are now considering a change in the kind of boilers to be used, instead of the prevailing Scotch type.

Those having perfect water circulation and great strength, such as the water-tube sectional construction will give, enabling a pressure of 200 pounds and higher to be safely carried with less weight and less space in the vessel, with a better evaporative economy, seem to be looked upon favorably.

I should be sorry to have a theory prevail among your practical readers, by which the splendid results to be had, from using this pressure, would be lost through badly designed engines. Miers Coryell.

TALKS ON THE STEAM ENGINE.

Professor W. D. Marks' series on this topic will close for the season with this issue, but will be resumed when cooler weather sets in; say early in the fall. It is the design of the writer and the publishers to cover the steam engine in this series, giving rules and data for calculating each part in accordance with the best modern practice. We believe that these papers have been of great service to our readers; they have certainly been interesting, and we shall be glad to renew them.

ROT.

This is a portion of a speech on Free Trade—(Morrison's patent horizontal reduction process)—by Frank Hurd:

> "Oh, if I could burn into the brain of the manufacturers of America one sentence," he burst forth, it would be this: 'Turn from this constant introspection to the nations of the world.' Down with walls. Out to the sea. There are 2,000,000,000 people who want to buy what you make. Rise up to the truth of the great thought that these immense peoples can be supplied by you with all the instruments of husbandry and the tools of artisanship. But they will not take your goods unless you take theirs. Let your tariff disappear, and then, O manufacturers! your attention will be diverted from home markets to generous rivalries in foreign trade, in which a wealth will come to you of which you do not dream to-day." [Applause.]

Oh, if we could burn into the brain of Frank Hurd some sense, it would be to say: Out with your pocket-book; there are in your vicinity some thousands of people poorer than you. They want all you have got, and more too. Rise to the truth of the great thought that if you give it all away you won't have much left, but whatever it is it will be more than you deserve. Let your compunctions disappear, and then, O Frank Hurd, your attention will be diverted from efforts to impoverish your countrymen, and you will have an opportunity to see for yourself where you would have landed them.

EARLY COMPOUND ENGINES, AND OTHER THINGS.

(Continued from last issue.)

BY NORMAN W. WHEELER.

The engine for the *Octavia* was constructed in this wise:—The surface-condenser was a long square box, lying upon the keelson. Upon the top of the after end of the condenser was secured the main bearing. At the sides of the condenser-case, and about midway of the height, broad flanges or bed plates projected horizontally, and upon these flanges stood the cylinders, circulating pumps and air-pumps. The initial cylinders—18″×18″—stood inboard, close to the condenser. The expansion cylinders—36″×18″—stood outboard of the initial cylinders, each cylinder of a pair coming under the end of a working beam, and the pistons connected thereto by rods and links. The beams were supported from the bed plates by bearings carried on columns, and braced directly to the condenser and to the *main bearing:* Each beam was extended inboard to carry a connecting-rod pin, which had 27 in. stroke, and the pin was placed in the beam above the horizontal line, so that the connecting rod center-lines joined upon one crank-pin and were 90 degrees from each other: This made a modification of the Oliver Evans engine, which was called a "grasshopper engine" when it was applied to some locomotives with vertical boilers, built long ago in Baltimore. The beam-center shafts were continued forward, and carried short beams for the air, circulating, and feed-pumps, a complete set upon each side. The diameters of the cylinders were so great, relatively to the lengths of the beams, that the cylinders of a pair came close together, and very short intermediate pipes were needed. One innovation was ventured upon; viz: each cylinder was provided with a complete valve and chest, instead of one valve being made to serve both cylinders of a pair, although both sets of valves were operated by the same link-motion. This was to enable us to set the valves by trial for each cylinder, so as to get the best results; for the proper setting of the valves of a compound engine was then involved in a little more doubt than it is now. The link-motion was of the ordinary kind, and an independent cut-off gear of great range was fitted. The valves were piston-valves, according to D. P. Davis' design, and worked well, but were rather difficult to adjust, allowance having to be made for expansion of the parts by heat.

It will be seen that we had a double, compound, grasshopper beam-engine, with initial cylinders 18″ diameter and 18″ stroke, and expansion cylinders steam jacketed 36″ diameter and 18″ stroke. The relative movements of the pistons being similar to those of the old Oregon, or "modern" tandem engine, except that the movements of each pair of pistons were opposite, by reason of the intervention of the beam. It will also be seen that we had a wide range for experiment in valve-setting, for by changing the distances between the valve-heads we could greatly vary the lap, both inside and outside, and by shifting the eccentrics we could vary the lead almost indefinitely. This would have been of small import had the vessel been a commercial steamer, for we all know that in that kind of a vessel the counting-room influences lead to the putting in of freight almost as soon as the main parts of the machinery are hoisted in, so that, so far as experimental adjustments are concerned—"as the tree falleth, so must it lie."

The boilers were of the common flue and return tubular type, except that combustion chambers were introduced, and the furnace tops were "camel backed"—like a Ross Winans eight-wheel locomotive. They were of such proportions that we had only to call upon them for a vaporization of one pound per minute per 16 square feet of submerged heating surface, and a rate of combustion of ten lbs. per hour per square foot of grate surface.

We got steam early in the spring of 1865, and for some days busied ourselves with the question of the best set of valves. We talked very little about the matter in public, because we were not certain ourselves as to the outcome, and all avenues for argument with us were closed by the public engineering sentiment, led by the three-quarter-stroke men, who said that a man who would get up a "high-low-pressure engine" in the expectation of securing economy, was a fool *per se.*

We attended quietly to business nevertheless and tried her with several adjustments affecting the steam distribution. Records of each experiment and the resulting performance would be invaluable now, but we were not alive to the importance of such records then, and depended too much upon memory, and such records as we did make have been lost. But we started with the valves set as for a common engine and found that the surge at the centers was troublesome. The final distribution was, as I remember it, about as follows: The steam-lead for the initial cylinder was almost *nil:* the exhaust-lead was about 30 degrees of a revolution, but the intermediate steam did not escape, being caught in the expansion steam-chest, and the pressure was merely reduced by the filling of the intermediate spaces. The exhaust of the expansion cylinder was early—about 22 degrees of a revolution, and the inside lap was minus, so that for a time a vacuum existed on both sides of the piston; the outside lap was such that intermediate steam was taken upon the expansion piston about 5 degrees of revolution *late;* hence that piston had vacuum upon both sides when the engine passed the center.

We felt our way to this adjustment, being governed in our proceedings by the shock arising from the shifting of steam at the centers, and the nearness to each other of the initial exhaust line, and the expansion steam-line on the indicator cards. We got those lines within an average of three pounds of each other at last; we could account for one-and-a-half pounds difference by taking into account the idle expansion in the intermediate spaces, but the other pound-and-a-half we attributed to leakage past the valves and pistons—but we were greatly puzzled by the fact that these lines approached each other near the end of the stroke, until a notion of the true inwardness of cylinder condensation began to dawn upon us, when we discarded the leakage idea, and found ourselves unable to believe *all* that the indicator told us. The fact that we could get better performance by paying strict attention to drainage—especially of the intermediate spaces—and "wasting" the hot water, went far to enlighten us on the then dormant questions of cylinder-condensation and re-vaporization.

I will not say now what was the performance of the *Octavia's* engines, as I have not the documents and cards to prove it, but will say that I have not known it to be excelled, and that Mr. Kennard told me that he had repeatedly weighed out 300 lbs. of coal per hour for 14 or 15 hours at a stretch, and kept the bunker doors all locked between the weighings, and that the average of performance was eleven knots per hour with that consumption, with no aid or retardation from wind or tide; this while the hull was displacing 450 tons.

But a life of pleasure for the *Octavia* was doomed to be of short duration. With the end of the war came financial troubles to railroads and railroad men, and Mr. Kennard abandoned his American enterprises, after long years of litigation, during which the *Octavia* swung at her anchor—for nine years—in Glen Cove, off his country seat. She was under the British flag, and could not be used in commerce on our coast. Finally, the vessel was sold to somebody for some sort of foreign service.

When she was to be fitted again for sea it was found that her boilers were corroded away, and also the stern-shaft, etc. It was amusing to hear the discussions among some people who were thought to be skilled in engineering about the best way to get rid of the compound principle and use the expansion cylinders as low-pressure engines! At last she was fitted out so secretly that I knew nothing of it, and next heard of her as a blockade-runner for the Cuban insurgents—giving the Spanish navy a good deal of trouble. The newspapers had it at one time that she had been caught and burned; but she appeared in New York harbor a few months after, when I first saw her second boilers, which looked much too small for the engine; otherwise she looked fully capable of having shown her heels to the whole Spanish navy for a term of three years, without having been overhauled—but then the Spanish navy of that period might have resembled ours of the present period, for all I know.

A wire rope over six miles long and one and a fourth inches thick is being manufactured at the Hazard Works of Wilkes-Barre, for the Third Avenue Passenger railway in New York city under the traction system.

TALKS ABOUT THE STEAM-ENGINE.—No. XVI.

BY PROF. WM. D. MARKS, UNIVERSITY OF PENNSYLVANIA.

I will discuss the method of proportioning a wrought-iron crank of nearly uniform strength.

Lay down the radius of the crank C D, Fig. 1, bisect this in B, and lay off a distance A D equal to B D.

Assume the thickness of web in inches, recollecting that a crank should overhang as little as possible.

Multiply the total initial pressure on the piston-head in pounds by the length of the crank between centers in inches.

Divide this product by the product of 1666, *multiplied by the thickness of the web in inches.*

Extract the square root of the quotient and the result will be the width of the crank face G K at the middle point B.

Lay this down and draw the lines A C and A K.

Draw the hubs as already directed.

Should the result not give satisfaction as to appearance, change the assumed thickness of web; repeat the process.

For a steel-crank the rule is the same, save that we multiply the thickness of the web in inches by 3000 *instead of* 1666.

In the following example: Let the boiler pressure be 40 lbs. per square inch.

Let the diameter of steam cylinder be 32 inches.

Let the length of crank be 24 inches.

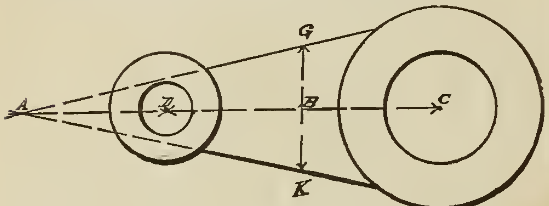
Assume the thickness of crank-web to be 7 inches and that it is made of hammered iron.

The total initial pressure on piston, as already deduced, is 32,170 lbs.

```
        32,170               1666
            24                  7
      --------             ------
        128680              11662
        64340
      --------
11662)772080      (66 20(8·13
       69972       64
      --------    -------
        72360     161)220
        69972          161
      --------        -------
         23880   · 2623)5950
         23324
      --------
          5560
```

The square root of 66·2 is 8·13 inches.

This is the width of face *G K*, Fig. 1.



It would, perhaps, have made a better looking crank to have assumed the thickness of web to be 5 or 6 inches. For a steel crank with web 5 inches thick, we would have.

```
15·000)772·080    (51·47(7·17
         75         49
       ------     -------
         22     141)247
         15          141
       ------       -------
          70    1427)10600
          60          9989
       ------        -----
          100
```

The square root of 51·47 is 7·17 inches.

This equals *G K*.

The thickness of metal around pin and shaft can be one-quarter less than for wrought-iron.

The rules given above relate only to the strength of a single overhanging crank.

If, however, we have a two-cylinder engine with cranks at right angles, the cylinders having equal power, we can calculate the after bent-crank by assuming it to have about $1\frac{1}{2}$ *times the initial stress of the forward piston-head.*

If the cylinders have unequal power we must assume the after crank to have about three-fourths of the sum of the stresses on both piston-heads.

This will give about the proper dimensions, provided the engines are accurately made and put together. If this condition is not fulfilled the strains will be greater, but how much greater is a matter of guess-work, and as one person is as competent to guess as another, I will not offer any suggestion, save to be liberal when dealing with marine-engine builders.

× × × × × ×

In every case a key is used to fasten the crank to the crank-shaft. The sides of the key and of the key-way must be perfectly parallel. If there is any taper to the key it should be on top. The best position for the key, if only one is used, is between the hub and eye, as there it weakens the crank the least.

If we have one key we are tolerably sure, with care, to make a good fit—but then the key must be a big one.

If we use two keys the combined weight of the two need only be about one-half of a single key of equal safety.

Keys for shafts are almost always too large, probably because they rarely fit except where they can be seen. The rule for the width of wrought-iron keys and key-ways is:

Multiply the total initial pressure on the piston-head in pounds, by the length of stroke in inches.

Divide this product, by the produtc of the length of the key in inches, and the diameter of the crank-shaft in inches multiplied by 5000.

The result is the width of the key in inches.

For steel keys the rule is the same, save that 6750 *is substituted for* 5000.

If, now, we place the condition that the key shall be divided in thickness equally between the shaft and hub, and, further, that a straight line drawn through the bottom of the key-way, on the end of the shaft, shall extend a distance equal to the width of the key before reaching the surface of the shaft, we have the following rule:

Square the width of the key in inches. Multiply this by 4. *Divide this product by the diameter of the shaft in inches, and reserve the result.*

Multiply this result by $2\frac{1}{2}$ *times the square of the breadth of the key, and divide it by the square of the diameter of the shaft.*

Add these two results together and their sum will be the thickness of the key in inches.

As an example:

Let the diameter of the steam cylinder be 32 inches;

Let the initial pressure be 40 lbs. per square inch;

Let the length of the key be 12 inches;

Let the diameter of shaft be 10 inches;

Length of stroke, 36 inches.

For a wrought-iron key the total initial pressure is 32,170 lbs.

```
                        32170
                           36
                       -------
     12                193020
     10                 9651
   -----              ----------
    120               6)11·58 120
    5000               -----
  --------              1·93 inches for the width
   600000                    of key.
```

For a steel key we would have $\frac{3}{4}$ of 1·93, or about $1\frac{1}{2}$ inches.

We can take the key as two inches in the first case.

The thickness of this key should be calculated as follows:

```
    2             4
    2            2½      1.60
  -----         -----     .16
    4            10      -----
    4            1.6     1.76 the thickness of key.
  -----         -----
  10)16         100)16
  -----         -----
  1.6 for a first  .16
      result.
```

The wrought-iron key must be $1\frac{3}{4}$ inches thick. A steel key, if used with a wrought-iron shaft, should be of about the same thickness, which will give it rather more hold on the shaft than the wrought-iron key of equal strength.

The use of two or more keys is attended with practical difficulties as to perfect fitting, which prevents such an attempt, save where the metal would be too much weakened by one large key and we have no means of thickening it. When cranks are shrunk on, a key-way does much to weaken the grip of the metal closest to the surface of the shaft: but I do not see how this can be helped.

THE END.

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THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LVI.

A correspondent in your last issue asks me to say something about pattern-storage, with a view, perhaps, of eliciting some points of value on that subject. If I were to record my inward thought at the time I read his letter, it would be to say, "he won't get much, I fancy;" for of all the unpromising, disheartening details to deal with in machine-shop management, this is the worst. The old problem, how to eat one's cake and keep it, is akin to this, and I have never been in a pattern store-room that it did not give me a melancholy feeling. The amount of money stored up in them is something appalling. I went up in a country pattern-loft the other day—a little shop that has about forty men employed the year round—and it is a fact that the pattern storage room was bigger than the machine shop. The proprietor was with me, and seeing me glance around said:

"Guess how much these cost us, Moulton?"

"I can't guess," said I. "I can't see half of them, for one thing, nor do I know how long they have been made, or what you pay your men, but as a snap estimate I will call it $25,000."

"You ain't so far out of the way. We made an actual inventory some time since, and there are locked up here $30,000."

"And how many of the patterns are in use?"

"Well, about one-third, I should say."

"And the other two-thirds?"

"We are going to make a bonfire of them some time."

"Why not now?"

"We hate to, for one thing; for another, we can't use the room where they lie for anything else; and for another reason, just so soon as we put a match to some of those old fellows over there, that would be the time a man would come from the Sandwich Islands for a casting from it."

"And how do you find patterns when you want them?"

"Easy enough; I go where the pattern is, and carry it away with me."

"That's all right," said I; "you have been here so long that you know where they live; but suppose you were to be taken sick and somebody else wanted a pattern, what would he do if you couldn't tell him?"

"If he was smart," said my friend, "he would set right to work and make a new one, for he could get that done sooner than he could find the old one. After he had the new one made, the one he wanted would fall off the shelf into his hand; that is about the way the thing works generally."

All this does not help your correspondent to any system as to keeping patterns, and perhaps if I tell him how they were kept in a large shop where I worked once, it may be of interest.

This concern had a three or four story brick building, about 100×25 feet, devoted to patterns alone. Each floor was divided into stalls by uprights, and on these were shelves at various intervals. Two aisles ran up and down each story, and the stalls were 26 in number on each story. From the uprights a sign projected with a big letter of the alphabet on each. The shelves were numbered from the top down, 1, 2, 3, etc., in each stall; that's all, so far as the loft itself was concerned. The key to the whereabouts of any pattern in the building lay in the Pattern-book, which was a bulky volume like a city directory. Everything that a pattern was ever made for in these works was in that book. Suppose a man wanted a pattern for a 3″ globe valve! He turned to globe-valves in the directory—found the size, and read after it—4 .. A . 6, by which he knew the pattern was in the fourth story, stall A, shelf 6. If he wanted a washer-pattern he did the same, and he always found the pattern where it was designated in the book. The reason why he found it was this: There was a man attached to the pattern-loft who came into the world for that especial thing. I am convinced that Fox had no other object in being; if he had he never gave any signs of it outwardly. Whoever took a pattern out of that building was held to a rigid accountability for it, from the time it went out until it came back. Fox never suffered anyone to get a pattern himself; he would ask what was wanted and go directly to it. He used to say he could find any given pattern in the dark, and some of the aisles were so gloomy and dim, after coming in out of the light, that it was literally groping in the dark for a stranger to find one. Fox would go directly to any given pattern. So long as you did not cross the threshold you could never know if Fox was on the place; you might call until you were black in the face, and he would not make a sign, but make one step on the floor inside, and he would appear, leisurely, from behind some projection and ask you what you wanted. If you asked him why he didn't answer you, he would say he was reading and didn't hear you.

But I will let up on this gossip.

I don't know any better way than this to keep patterns. Of course, it involves the employment of a pattern keeper, not to find the patterns merely, but to find other men in brains; wait on them, and make them bring things back when they got done with them. It also involves system and careful attention.

There is nothing to prevent a foreman of a foundry, in the absence of a system, from sending a core-boy back with a pattern, nothing to prevent said boy from putting that pattern back on the first shelf he came to, instead of going upstairs into the fourth story perhaps; there was nothing to prevent this except Fox; he prevented it because he was on the watch. He did what he was paid to do, and if, for any reason, he had to go away he simply locked every one out until he came back. This is the value of system; the price of it is eternal vigilance. It costs money, and sometimes persons who see no farther than the surface of things object to it, and say it is no good, forgetting that this very system is nothing more than an assurance that the money locked up in the patterns shall be available (as far as the use of them is concerned) when it is wanted.

It is not one pattern but many. It is not the time lost in hunting for the pattern alone that has to be considered, but every interest involved by waiting for it. Just as when the shop-engine stops ten minutes by the clock, just as many more times ten minutes as there are men waiting on its motion, by the pocket. Or if this is rather muddled, I mean to say that if there are 100 men in the shop and the engine stops ten minutes the concern has lost one and three-quarter days' work. So it is with that lost pattern; the same principle is involved, and where there are many patterns a man to look after them is essential.

I can see how convenient it would be for those in charge of departments to look after the patterns belonging to their work, but unless the said patterns are isolated and kept by themselves, I do not see what is to prevent any one and every one from having access to them, which, practically, gives them to the shop-world at large.

Keeping one lot of patterns in one place, and another lot in another, does, as my friend "*Machinist*" says in his communication, expose some to loss by fire, but saves risking all of them. Now if the work was small and the patterns few in number there would be no difficulty about the plan, and it would be excellent, but as a system for general adoption I don't think it would work.

I will take the opportunity to say here, at the risk of offending some, that I think a great deal more time and money is spent upon patterns than is warranted under the circumstances. Most of us have seen pulley-patterns and similar work, say cylinder-heads for steam engines, as elaborately made as a piece of art-work. Where patterns are to be used frequently, and are always in stock, they cannot be too well made, but then they should be of metal, for no wooden pattern, however well made, can stand the racket of ramming and damp sand forever.

Also, I should have said previously, that the patterns were marked with the place they belonged to; "4 A 6," so that in the event of Fox not living forever (as he seemed inclined to), his successor could go right on with the system.

The sequel should be appended. Long since that immense building full of patterns was destroyed. Every one of them was burned up. I saw the value of them stated at the time, and it was given as $450,000, and this was when pattern-makers got $2 per day, and lumber was cheap.

◆

HOW I SERVED MY APPRENTICESHIP.

NUMBER XII.

BY GEORGE SLOCUM.

I had now put in about nine months on a lathe; this included the time put in on old '76, although I worked some, off and on, with Pat. McVey, the man who ran the frame-slotter. This was a double-header, and when it came to chawing up iron, she was awful.

"Say, Jones," said I to him one day, "Windy Jim was giving me a story to-day, about a man out in Terre-Haute inventing perpetual motion and selling the patent right for a million dollars. Is there anything in it?"

"Why of course. It must be true if Windy says it is. See here, bub! the less attention you pay to Windy Jim's cock-and-bull stories, the more stock folks will take in what you say. You were asking me about the horse-power of a locomotive the other day; have you figured on it yet?"

"Yes, some," said I.

"Well, give us the proceeds of the work," said Jones.

"Well, I took an engine with 5 ft. drivers and 17" by 24" cylinders, and I allowed a mean pressure of 50 lbs. per square inch."

"All right; go ahead."

"I find the area of piston to be 227 square inches, and the total pressure on piston to be 227 times 50, or 11,350 lbs. I allow 35 miles per hour for speed of train. I find that 5 times 3·1416 gives me 15·71 ft., the circumference of my drivers. The drivers make 196 revolutions per minute, and the speed of piston is 784 ft. per minute; the speed of train is 3,080 ft. per minute. Now I multiply 11,350 by 784, and get 8,898,400, which I divide by 33,000 and get as a result 269·65; this multiplied by 2 gives me 539·30 horse-power."

"The answer is right, but it seems to me you've got more data there than are necessary. To find the power of a locomotive, is to find the greatest capacity for pulling trains. Now you've figured out the approximate or nominal horse-power; you would have to take more pains and take many things into consideration before you could get the actual power. In the first place to get the nominal power of any engine you find the total load moved and the distance through which it is moved in one minute, then multiply both together and divide the result by 33,000 to get the nominal horse-power; that's all there is to it."

"Well, here's something I want to ask you about. The piston-speed of this engine running 35 miles an hour is 784 ft.; piston speed is a very important factor in computing the horse-power, you say? Now, when this engine begins to climb a grade of 50 ft. to the mile it's going to run slower (with same pressure of steam, mind), and consequently its piston-speed will be less; of course its horse-power ought to be less. How's that?"

"That's as clear as mud. You didn't figure out what that engine could do climbing grades or running down hill, you figured on its capacity taking a certain string of facts to base your calculation on. Now suppose that after that engine had pitched over the top of that grade, the engineer should let her rip, ain't it safe to presume that she would dash down that grade at the rate of 70 miles an hour, supposing the same grade as before? wouldn't that double her piston speed, and according to that, she would rate over 1,000 horse power. You must remember that when that engine was climbing that grade—supposing it a mile long—she was moving herself and train in two directions—forward 1 mile, and upward 50 feet."

"I didn't think of that," said I.

"No, I guess not. When a farmer starts 10 miles to town with a load of produce, he doesn't pile on every pound his team can haul on a dead level, does he? He'd be in a nice fix when he struck the foot of a hill. Well, no more do they hitch on all the cars that an engine can haul on a dead level, if they have any hills on the road," said Jones.

"Jones, is the throw of eccentric always equal to the travel of valve?"

"No, it is not. There is an engine over there that has a 5 inch throw of eccentric and 4 inch travel of valve. The most of engines have 'em both alike, but this engine hasn't. Come over here. You see this upper rocker arm; it is $9\frac{3}{8}$ inches from center to center, and this lower one is $7\frac{1}{2}$ inches from center to center. Now to get the travel from the throw, we say by proportion as $9\frac{3}{8}$ is to $7\frac{1}{2}$ so is 5 to 4. If we want the throw from the travel, we put it this way, $7\frac{1}{2}: 9\frac{3}{8} :: 4:5$."

"What is the throw of an eccentric?"

"It is twice the amount that the center of the shaft is out of center with the eccentric itself. If it is 5 inch throw, it's out of center $2\frac{1}{2}$ inches, and so on. Its throw is equal to the distance it will move the valve one way in a straight line, when both rocker arms are of the same length. Two throws are made while the crank makes one complete revolution, and the piston makes two strokes, and while the valve moves from end to end of its travel."

"What should the throw of an eccentric be?"

"Whatever is required to move the valve far enough to give a full port-opening, and a little farther when a link is used, or else in cutting off very short there would be scarcely any port-opening for steam to pass in."

"Well, give me an example."

"All right. That engine over there has an eccentric of 5 inches throw and 5 inch travel of valve. Her steam-ports are $1\frac{1}{4}''$ wide, and she has 1 inch outside lap on valve. Now the throw of her eccentric is equal to twice the width of steam ports; that's $2\frac{1}{2}$ inches, twice the lap; that makes $4\frac{1}{2}$ inches, and twice what the valve travels past a full steam-port opening, which is twice $\frac{1}{4}$ of inch, total 5 inches."

"How about the lead? You didn't put that in."

"This has nothing to do with the lead. You give a valve lead by moving the eccentric on the axle, regardless of its throw; whether 5 inches or 10 inches."

"I heard two gang-bosses arguing the other day. One said that changing the eccentric around from one point to another on the axle would alter the travel of the valve. Is that so?" said I.

"No. As long as you do not change the throw of the eccentric, you may put the belly of it up or down, back or front, or anywhere on the axle, and it won't alter the valve's travel. But they are not slung on that way, of course; there is a certain position for the eccentric on an axle, which is the right one, any other, of course, must be a wrong one."

I had now been in the shop some 3 months over 3 years, but having lost some time through sickness and laying off to visit folks at my old village home I thought I wouldn't say anything until that time was made up. Up to this time I had got along first rate. I was still studying under Tom Lovelace, and had got as far as equations of the first degree in algebra, and besides, was pretty well up in Davies' Legendre. I stepped up to the foreman one day, and said: "Mr. Blank, I guess my time is out, ain't it?"

"Well, I'm sure I don't know. How long have you been here?" said he.

"About 3 years and 3 months," said I.

"Why, is it possible! Seems only a short time since you came into the shop a raw country-boy; now you're a full-fledged machinist."

"What job are you on now?" I told him.

"Well, when you get that job done report to Jenkins over in the repair-gang. In the meantime I'll see him and explain. I'll start you in at journeyman's wages from the first of this month."

"All right, sir."

I tripped off lightly, feeling big at being called a journeyman, and put the job I had in the lathe through on fast time, so as to get over on the repair side as soon as possible. I realized now that, although a "jour.," I was yet in reality an apprentice, so far as a knowledge of the trade was concerned, and I determined to pursue my old course of asking questions of any one that I thought likely to be able to answer them. I knew, because I had seen, that false pride kept a good many of the men and a few of the boys from asking for information of others, concerning matters they were entirely ignorant of, or at best had but confused ideas of; preferring to remain in ignorance rather than to expose it. I had also, by this time, learned considerable of the theory of the trade, and realized how easily a great many seemingly mysterious and difficult things could be explained when exposed to the light of mathematics. And now I have told you how I served my apprenticeship.

THE END.

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A NOTABLE MACHINIST.

Not many persons outside of his immediate vicinity are aware of the many ingenious devices of an American inventor and machinist—Seth Wilmarth by name. Mr. Wilmarth is well known in the Eastern States, but outside of them the present generation have scarcely heard his name. Mr. Wilmarth is what may be called an old-timer, for he has had nearly sixty years experience as a machinist. There were no technical schools in existence when he started as an apprentice, and but few (or none at all) text-books. Mr. Wilmarth's success has been achieved by his own perseverance and genius, and though now seventy-four years of age he is still hale and hearty.

Mr. Wilmarth's inventions are too numerous to be detailed here, but we may mention one which will interest most of our readers, and that is the large planer in the Charlestown Navy Yard at Boston. This tool was built in 1866-69, and is the largest one in the world. English engineers boast of having the heaviest and most ingenious machine-tools, but in no other part of the globe than this is there a planer of so wide a range of capacity, or so enormous in weight. The details appended we find in the Boston *Globe*:

Its total weight is 300 tons, extreme length 55 feet, width 31 feet, height 29 feet. It will plane a piece of metal eighteen feet square and forty-five feet long. It will also plane at right angles or vertically. It will plane a piece weighing 200 tons if required at any given angle, and is capable of boring, turning, slotting or splining to a depth of four feet and at any taper indicated. The lightest class of work is accomplished with great rapidity and accuracy. Among other specialties it will bore, turn and cut gear-wheels of any required size up to forty feet in diameter. It will bore and spline propellers of any size and weight for the largest steamships.

The propelling screw of this remarkable machine is also used as a feed-screw. While the cross-screw is the propelling power, the main driving-screw is the feed-screw, one helping the other; and while the feed-screw is the propelling power the cross screw is the feeding-screw. Again, while the two screws propel the cross-bar up and down, the driving-screw or the cross driving-screw is used for the feed. This cross-bar can be fed up or down to plane a block on an angle so as to make one edge thinner or thicker, as may be preferred. The planer is so arranged that it will bore a hole from the smallest size to four or five feet in diameter, and at any angle. There is no necessity for guesswork. A block may be splined or faced without being moved on the plating, and it will turn, bore and spline any size of wheel without change of position. Finally it is competent to plane, bore, turn, or cut the teeth of large gears, either bevel, miter or spur.

This machine cost the government about $75,000, but Mr. Wilmarth has received no remuneration for his invention, for the reason that the size and cost of the planer are such that it is not used in private establishments.

For three years Mr. Wilmarth has been endeavoring to get a petition for remuneration before Congress, and it now begins to look as though he would succeed, since his claims are now under the consideration of the naval committee.

"I have taken out as many as twenty patents during my life," said Mr. Wilmarth, "and have made as many more inventions that other people have patented. In 1871 I sold to the government my hydraulic lift for use on monitors for $50,000. If it had been managed right I should have received twice that sum; but we must live and learn, you know. I was sixty years, all told, in a machine shop, and I can hardly say which I consider my most valuable invention. The planer was the last tool I made for the government, and I am in hopes that I will be allowed something for it. I have many little contrivances that if I was thirty years younger would be heard of. But an old tinker like me can't expect to do much more, though I am just as much interested in mechanics as I ever was.' "

COMPOUND ENGINES.

(*Concluded from page 124.*)

Experiment and theory both show clearly that in order to use steam economically in an engine, it must be allowed to expand in the cylinder. Precisely what ratio of expansion it is most economical to adopt for any special case may not be so well settled; but this much seems to be clearly established: that such ratios of expansion as are known to be economical cannot be used without serious inconvenience in engines which, as is the case with those of the marine type, are not provided with fly-wheels. This is because the pressure on the crank-pin of an engine in which steam is used with a high ratio of expansion, varies so much that the frame and other parts of the engine are unduly strained. The effect of a fly-wheel in preventing serious injury to an engine subjected to varying strains, and the effect of these strains when they are transmitted directly to the machine, can be most simply illustrated by experiment. The following test was made by the writer: A vertical steam engine, with plain slide-valve admitting steam for the full stroke, was used to drive a train of wire rolls in a steel mill. The speed of the engine was controlled by a centrifugal governor which acted on a throttle-valve, and on the engine shaft there was an enormous fly-wheel, 23 ft. in diameter and weighing 27.5 gross tons. The maximum power of this engine—436 horse-power—was exerted when 8 simultaneous passes were made in the rolls (6 in the wire rolls and 2 in the roughing rolls), and this power was instantly reduced to 36 horse-power when the rolls were running idle. Under these circumstances, there was no perceptible change in the speed of revolution of the engine, and it had been used in work of this kind for a number of years, at a very slight expense for repairs. In the same mill, connected to another train of rolls where the work was not so hard was an automatic cut-off engine, of much greater power than the vertical engine, but with a very light fly-wheel,—and after this engine had come to a stop several times, when two simultaneous passes were made in the rolls, the fly-wheel was taken off and a heavier one was substituted, which change put an end to the trouble.

A striking example of the effect of expansion in an engine which had no fly-wheel, is contained in Chief-Engineer J. W. King's "Report on European Ships of War, etc.," Washington, 1877, as follows:

"The most expensive and notable attempt to realize the benefits of the compound system by the simple engine at sea was made two years ago by the proprietors of the Allen Line of steamers. This company made the comparative test on a large scale. Two ships were built, the one fitted with compound engines, and the other with simple expansive engines. The boilers were identically alike, made from the same drawings, having the same grate and heating surface, and the same pressure of steam was used in each vessel.

"I have not at command all the details of these ships, but I received from the designer of the machinery the following particulars:

	Name of ship, Polynesia.	Name of ship, Circassian.
Length, feet............	400	360
Breadth, "	42	40
Draught of water, feet...	25.5	23
Kind of engines........	Compound.	Non-Comp'nd.
Number of cylinders....	4	2
Diameters, inches.......	43 and 86¾	62
Stroke, feet............	4	4
Number of boilers......	10	10
Number of furnaces.....	20	20
Pressure of steam, lbs...	60	60

"The expansion valves were fitted in the simple engines to work the steam, when desired, to the same degree of expansion as in the compound engines. The workmanship and materials were equally good, and the parts equally strong in each set of engines. The two ships were put on the line between Liverpool and Quebec, Canada, and, as was anticipated, the results as to economy of fuel were not materially different, about two pounds of good Welsh coal per indicated horse-power per hour being expended in each ship. This satisfactory result, however, soon found an offset in the shape of unexpected difficulties with the simple engine, consequent upon the serious shocks resulting from the rapidly varying pressures on the crank-pins. So serious were these, that not only the crank-shaft, but also the stationary parts of the engines, began at an early day to show signs of weakness, and in a short time gave out altogether. The superintending engineer of the company was the designer of the machinery, and it was only after his skill and efforts failed to keep the ship running that he reluctantly decided to remove the engines and to substitute compound engines in their stead. The engines substituted had a pair of vertical inverted cylinders, with a diameter for the high pressure of 55 inches, and for the low pressure of 92 inches.

"The performance of the Polynesia was satisfactory from the first, the voyages never having been interrupted; and the performance of the Circassian has also been satisfactory since the substitution in her of the compound engines for the simple ones."

It frequently happens that a wasteful single-cylinder steam engine can be made much more economical by changing it to a compound engine. The principal reason for the economy that results from such a change seems to be the suppression of a large part of the cylinder condensation. The cylinder of an engine is exposed, during each stroke, to the extremes of temperature due to the entering steam and the exhaust. Now, if the steam is used in a double-cylinder engine, the extremes of temperature in the small cylinder are inconsiderable, and in consequence the condensation in this cylinder is usually slight in amount, and the extremes of temperature in the large cylinder are also less than they would be if the small cylinder were removed.

* * *

These two lines reveal a condition of things in England, as regards steam launches, which we deplore. We quote from a foreign contemporary:

> "The steam launch proceeded on its course, accompanied by the usual curses of boating and fishing men."

Why should steam launches be cursed?

CREDULOUS CAPITALISTS.

The astonishing revelations made by a recent heavy failure in this city lead us to wonder whether we live in a material world or one peopled with shadows. A young man from nowhere marries a rich man's daughter, and shortly after embarks in financial transactions which, judging from the evidence published in daily papers, had no substantial basis. Upon the foundation of personal representations and assertions, he led experienced men, some of them financiers of long standing, to believe that he could pay them interest for their investments with him at the rate of five per cent. per month—sixty per cent. per annum—and he found a sufficient number to do business with for some years. The end was, of course, certain, sooner or later, and when it came, it was found that $3,000,000 barely covered the liabilities. These are the facts as made public; what commentary is necessary? None. A mere review of the testimony given is sufficient. We quote from the *Sun:*

Captain Spicer said he had sunk through Grant & Ward close to $275,000, after deducting $50,000 received from them as profits. Mr. Purrington asked Capt. Spicer these questions:

Q.—How long had you known Mr. Ward? A.—About two years.

Q.—You are a director in the Marine Bank? A.—I have been for about two months.

Q.—How did you come to know Mr. Ward? A.—Mr. Fish introduced me to him.

Q.—All the accounts concerning the contracts were in Mr. Ward's handwriting, were they not? A.—Yes.

Q.—Did you not do all your business with Mr. Ward? A.—When I went to the office to transact business they always referred me to Mr. Ward.

Q.—Were the contracts mixed up with each other or were they isolated? A.—Each one stood on its own merits.

Q.—They were in almost all instances renewed? A.—Yes.

"Captain Spicer," said Mr. Bangs, "do you think that you have been deceived?"

"I think that I have been sold," said the Captain, laughing heartily.

"And resold, and rehypothecated, and run up the spout," said Mr. Bangs. "But who do you think has defrauded you?"

"Some one, evidently," said Captain Spicer, laughing again.

By Mr. Green—Capt. Spicer, did you examine the statements given to you by Ward & Grant? A.—I never examined the figures.

Q.—There are serious inaccuracies in them. Now, if you had examined them and seen the errors on Nov. 22, would it not have opened your eyes a little? A.—I should have sent the statement back to be corrected.

Q.—You are a business man? A.—If a man sends me an account I turn it over to the bookkeeper.

Q.—Did you turn this one over to him? A.—No.

Q.—You made no effort to ascertain its correctness? A.—None except adding up the figures.

Q.—You never thought it worth while to examine into the particulars of the transaction? A.—No.

By Mr. Bangs—Do you know of your own knowledge that the bonds that Ward & Grant said were bought on your account were ever bought? A.—No.

Q.—Did you ever receive such a note as stock brokers usually give in such transactions? A.—No.

Q.—For all you know you may never have become either a debtor or a creditor? A.—No.

Credulity, it appears, is not confined to the unsophisticated.

* * *

Macaroni is supposed to be the staple food of Italian workers, but Consul Welsh reports that it is in reality accessible only to the rich. He says that the food of workingmen throughout Italy is polenta, or Indian meal mush. A cup of bad coffee in the early morning serves till noon, when a meal of beans cooked in olive oil or hog's grease, or polenta, boiled or fried, is eaten, with a small allowance of wine; dinner is taken in the evening when work is finished, and is of very much the same nature as the noonday meal, with the exception that some salted fish or pork is added, with cabbage or other greens. Fresh meat is but seldom eaten, even by the skilled mechanic. Vegetables and fruit, however, are at times so plentiful as to be accessible to the poorest.

* * *

A guard-rod runs across the frame under the ends of the eccentric-rods on the locomotives of the Philadelphia and Reading R. R. This is to prevent the ends of the rods from dropping on the road-bed if a pin works out of the links.

* * *

Native porters in India are called wheelbarrow stipendiaries.

FOUNDRY PRACTICE AS ALLIED TO PATTERN MAKING.

BY JOSEPH P. MULLIN.

THE LOCOMOTIVE CYLINDER.

Fig. 81 is a horizontal section of a Locomotive Cylinder, showing the steam inlet, port, exhaust, and other details. Fig. 82 is an end elevation, with the cylinder-head removed. The figure also shows part of the saddle-flange, which extends across the engine, and is bolted to the smoke-box, while a section of the main frame, to which the side-flange of the cylinder is bolted, is shown at *A*. The steam-inlet, exhaust and steam-ports are clearly shown in both the figures. The exhaust is, of course, to be made of larger dimensions, so as to carry away the greater volume of expended steam, after it has driven the piston; and as shown in the end view, the steam-port extends through nearly a third of the circumference of the cylinder.

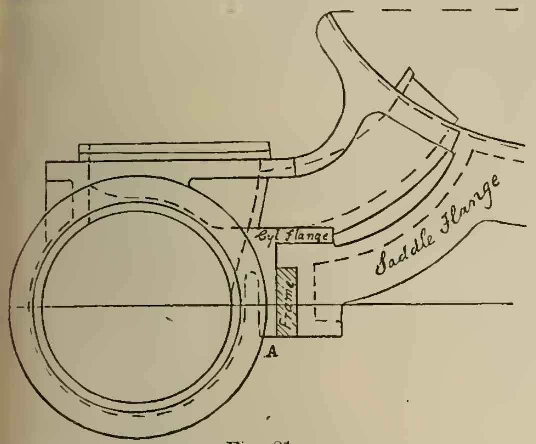

Fig. 81.

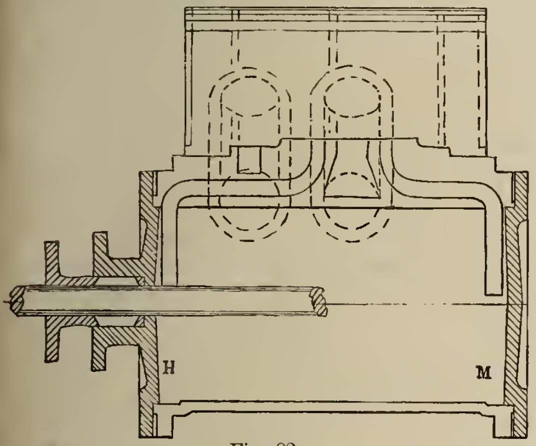

Fig. 82.

The front and back covers are shown at *H. M.*, fig. 81, and are slightly concave, in order to conform to the shape of the piston, and reduce the clearance.

PATTERN MAKING.

Figs. 83, 84 and 85 are three views of the pattern, and Fig. 86 represents the core-box for the extension, or saddle of the cylinder. The pieces *L. T.*—which must be made of the size and form of the outside of the wall of metal required around the steam inlet and exhaust cores —should be made loose, and held in place with dowel-pins or screws. It is not necessary to give any illustrations of the other core-boxes required, as the pattern-makers can see all the different shapes and curves on the general drawing, figures 81 and 82, and can also see the cores set in the mould, at figures 87 and 88, so that each individual can use his own judgment with regard to the best way to make the boxes, and be guided in his operations by different circumstances and the facilities at hand, such as lumber, wood-working, machinery, etc. Fig. 83 is a front elevation of the pattern of the cylinder. The prints for the steam-inlet, ports and exhaust cores are shown at *B. L.* and *D.* The pattern is made to part through the center of the body of the cylinder, as shown by the dotted line *O. N.* The flange *A* is made loose at the dotted line *R*, Fig. 85, and sits in a rabbet, as shown at *N*, Fig. 84. Fig. 85 is a plan of the pattern showing the valve-seat and the bottom of the steam-chest, and also the chipping strips on the face of the saddle. Fig. 84 is an end elevation of the pattern, and the correspondence of the letters with those of Fig. 85, will show the reader the different projections of the same parts—thus: *L* is the joint for the end of the exhaust-core. Having given the above description of the pattern and how to make it, we will leave the pattern-making, for the present, and turn our attention to an important part of this subject, viz.:

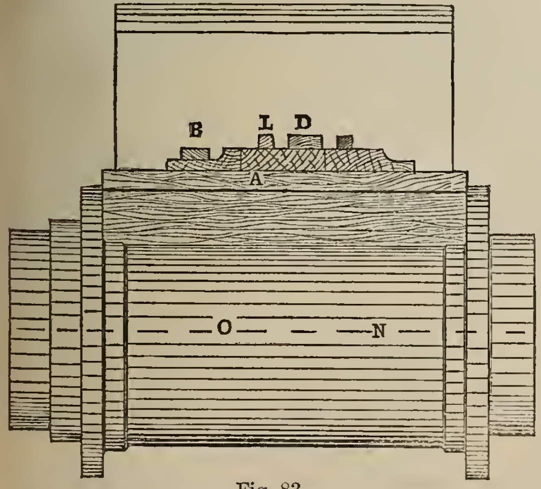

Fig. 83.

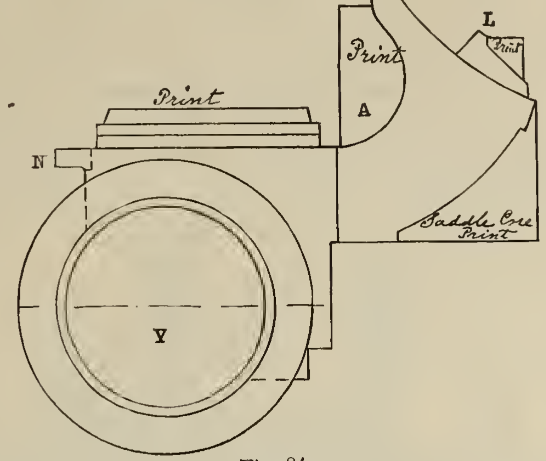

Fig. 84.

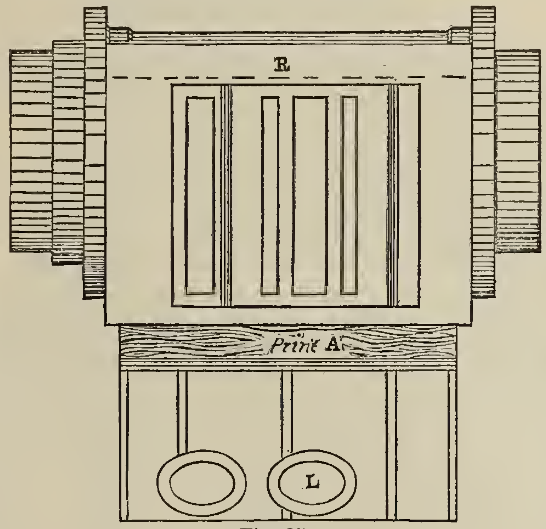

Fig. 85.

MOULDING.

Fig. 87 is a sectional end view of the mold, showing the shape of the flask and all the cores when they are set in their proper positions.

Fig. 88 is a plan of the mould, with the cope lifted off, and the steam-inlet, exhaust and steam-port cores set in place.

As will be seen by Fig. 87, the flask is made with a jog, or step, corresponding in shape to an end view of the surface of the pattern, with the section *Y*, Fig. 84, lifted off.

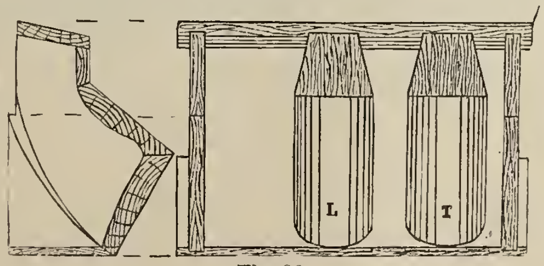

Fig. 86.

When the large section of the pattern has been set in the position shown in Fig. 87, and the mould filled in and rammed up to *K*, the parting may be made level with the edge of the flask. The small section of the pattern is then set in place, and the cope flask put on. The feed-gate and riser-pins set in the position shown in the figure, and the mould filled in and rammed up level with the top of the flask. We now lift off the cope, draw the pattern, finish the mould, and put it in the oven to dry.

The manner of setting the cores is shown in Figures 87 and 88, and is as follows:

We first set the core marked *A*, Fig. 87, and then the steam-inlet, and exhaust and port-cores, as shown at Fig. 88. All these cores must be held in position by strong wires run down through the bottom and made fast on the outside of the mould, and the outer ends of the port-cores must be supported by chaplets.

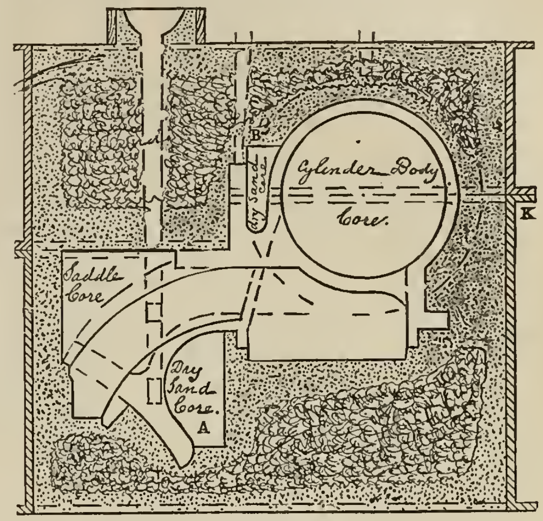

Fig. 87.

The point of the saddle-core shown at Fig. 87, is supported by chaplets set firmly upon the dry sand cores, marked *A*, in the same figure, and the large end is tied to the cope. The core for cutting out the metal between the side-flange, and the body of the cylinder, is also tied to the cope, as shown at *B.*

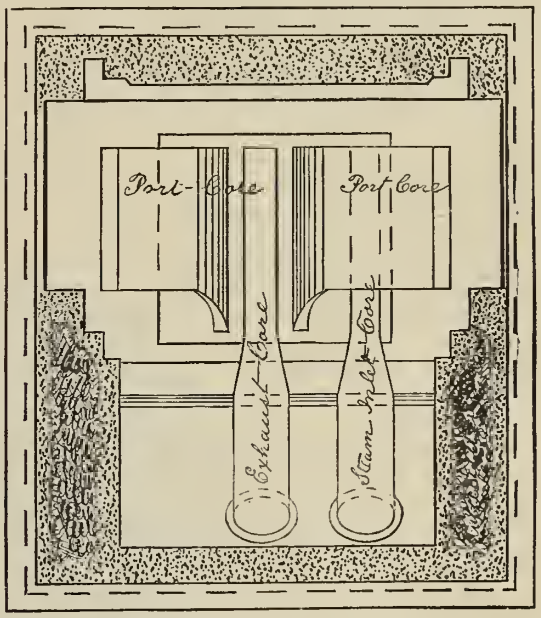

Fig. 88.

We may now set the cylinder body core, close the mould, and prepare to cast the cylinder.

◆

A FINE MACHINE-TOOL.

At the Pratt & Whitney Company's Works, in this city, is probably one of the finest specimens of machine-tools ever built. It is intended for the dressing and finishing of large valves—an improvement on the globe valve—patented by the Pratt & Cady Company, of Hartford, who have recently built a large manufactory on the corner of Cushman and Sigourney streets. This machine will finish valves direct from the foundry, of from six inches to twenty-four inches aperture. It is a combination of screw-cutting lathe, tapping-machine, chucking-machine, milling-machine and planer, and is entirely under the control of one man. One of its novelties is that reverse motions are obtained without change of belts, all of the actuating parts being started and stopped either by means of friction-clutches or the movement of gears on fixed studs attached to levered frames. Every change is made without shock, and instantly. The platen of the machine which receives the work is a large chuck on a vertical spindle, traversing on V-ways, and the work, when once fixed on this, can be manipulated without change.—*Hartford* (*Conn.*) *Post.*

HOW WORKINGMEN AND WOMEN LIVE IN SCOTLAND.

From careful inquiry it has been ascertained that the average wages of the working people in Dundee are for skilled artisans $6.87 per week of 54 hours' work, in the case of iron workers, and 51 hours for tradesmen connected with house building. Laborers get $4.75 per week for 57 hours. There are workmen that make more money weekly; for instance, iron shipbuilders, some of whom at piece work are paid from $11 to $15, and several others, such as boiler makers, who have about $8.50. The earnings stated, however, as the average are considered very near the mark. In the linen works women in the spinning-mill departments make about $2.50, and in the weaving factories $3.50 of wages per week for 56 hours' labor. These working people on the whole are but poorly provided for in the way of house accommodation. There are in Dundee 8,620 houses of only one room each, in which there is a population of 23,670, and 16,187 houses of two rooms, into which are crowded 74,374 men, women and children. If to these be added the three-roomed houses with the people living in them, it shows that 118,000 of the 140,000 inhabitants of this community live in houses of one to three rooms. The rent per year for a house of three rooms, including all taxes and conveniences, is $77.50, and for one of two rooms $48. These houses are engaged for the year and rents are payable half-yearly. Rents for single roomed houses are from 60 to 75 cents per week, payable weekly. Many of these single-roomed habitations are wretched in the extreme, containing little furniture, and occasionally are without even a bed. In some, five or six human beings are sheltered, with nothing to lie on but the floor, covering themselves, when they have the opportunity, with jute burlaps, which they take in to make into hand-sewed bags. The sanitary authorities of this town do a great deal to cleanse and purify the entrances to, and vicinity of, these vile dens, so that they may be kept healthy, but without success, as they prove to be prolific sources of all sorts of contagion.

Although habits which are not commendable characterize a portion of the working classes of Dundee, yet it is satisfactory to have to report that there is a large section of them prudent, economical and thrifty, who manage to save money, as shown by the figures of the Dundee Savings Bank.

Boys and girls under fourteen years of age are engaged in the mills as half-timers, getting 60 cents per week for 28 hours' work and education for two hours daily in the school connected with the mills. Those above that age are eligible for full-timers, and can make average wages. Thus, the joint earnings of a family enable them to live pretty comfortably, and be well clothed. Indeed, it is noticeable that these respectable working people are nicely and warmly clad. Many of the factory girls overstep this medium and are expensively and fashionably dressed on Sundays or holidays. There are ample facilities for education and self-improvement in Dundee. Schools ably conducted are numerous and provided with everything appertaining to the imparting of instruction in all branches of knowledge. Still a large number of the rising generation are growing up in ignorance and crime, through not attending these institutions for elementary learning. The invariable excuse of delinquents is that they are so poor that they do not have the wherewithal to pay the 7 to 12 cents per week demand for teacher's fees, or are unable to furnish their children with clothes to properly appear in school.

The price for a good, well-made, ordinary suit of tweed clothes usually worn by workmen when dressed, is $17. Coats can be bought for say $9; waist-coats, $3.50; trousers, $4.50; and strong boots for $4. The cost of the necessaries of life for fairly superior qualities is for a four-pound loaf of wheat bread 14 cents. In cents, the value of the pound of butter is 30, of sugar 7, tea 75, coffee 40, ham 24, oatmeal $3\frac{3}{4}$, American flour 4, European flour, $3\frac{1}{4}$; fresh beef, home fed, 24; American fresh beef, 16; mutton, home fed, 20; rice, 4; cheese, American and European, 14; codfish, salted, 5; potatoes, 1; pork, salted, 12; American canned meat or beef, 19; milk, per pint, 4; and eggs, per dozen, 26. The food of the working classes is simple and homely, consisting of, it is understood, for breakfast, porridge made with half a pound of oatmeal and half a pint of milk, or tea, or coffee, and bread and butter, with perhaps either an egg, a bit of bacon, or a herring.

Dinner is frequently Scotch broth, cooked with cabbage, other vegetables and beef; from 4 to 6 ounces of the latter is what falls to the share of the heads of a family. Supper, tea or coffee, with bread and butter, sometimes accompanied with a little delicacy. Mill and factory girls who do not reside at home, but in lodgings or rooms, are compelled to live more plainly, their wages being insufficient to pay rent, clothe themselves, and procure to the full extent the kind of fare specified. Animal food is therefore more rarely on their tables.—*Willard B. Wells, U. S. Consul.*

TRADE TOPICS FROM EVERYWHERE.

The Ball Engine Company, Erie, Pa., contemplate greatly increasing their capital stock and enlarging their operations.

The Jersey City Electric Light Company are contemplating putting in new boilers and engine, and otherwise reorganizing their plant.

The Hartmann Steel Company, at Beaver Falls, Pa., has begun to manufacture wire nails of iron, steel, brass and copper, both plain and barbed. —*Mech. News.*

Zug & Co., of Pittsburg, are still making semi-steel nails, the plates being rolled from a "pile" formed of steel rail crop ends and muck bar.—*Pittsburg Chronicle Telegraph.*

The H. B. Smith Company, Westfield Mass., are having additional buildings put up, to increase their facilities and number of workmen to turn out steam-heating apparatus.

Clark, Raffen & Co., Chicago, will soon erect a foundry 100 feet square. It will contain two 30-ton cupolas, and they will run in connection with this a 50 by 75 feet five-story machine shop.

Richards & Clarke, Omaha, manufacturers of architectual iron and machinery, and engine builders, are erecting a new foundry building and a new boiler shop, and will put in some new machinery.

The Union Brass Manufacturing Company are putting up a building 28 by 52 feet in size, on Ohio street, Chicago, to be used for the manufacture of Orme's patent locomotive, marine, relief and lock-up safety valves.

The American Railway Construction Company, of Chicago, has undertaken to build 85 miles of the Indiana Pacific Railroad, which is to run from North Judson to Auburn, Ind. The work is to be completed in two years.—*N. W. Lumberman.*

The mill of the Upham Manufacturing Company, of Marshfield, Minn., lately destroyed by fire, will be rebuilt. The new mill will have a larger capacity than the one burned, and will in every respect be superior to it. The mill will cost $30,000.—*N. W. Lumberman.*

The Sioux City Foundry and Machine Works, Ia., have recently been organized into a stock company and the capital increased to $100,000. They employ 50 men. The works are undergoing change; over $6,000 has been invested in additional new machinery.

Another shingle mill is to be erected at Chippewa Lake, Mich. The Chippewa Lumber Company's mill at that point is cutting 120,000 feet of lumber a day. Doyle & Co. are shipping 20 car loads of logs a day over the Detroit, Lansing and Northern Road to F. E. Bradley & Co., Saginaw City.—*N. W. Lumberman.*

The works of the Pullman Car Company, at Pullman, Ill., are full of orders for cars, but at low prices. An order for 1,000 freight cars for the Cincinnati, New Orleans and Texas Pacific Railroad has just been filled. The new freight car shops have a capacity of 30 finished cars a day, and are already turning out 20 cars a day, though the shops are scarcely in running order.

John E. Wootten, patentee of the Wootten Dirt-Burning Locomotive, has sold his rights in the patent for a sum said to be $200,000. The purchase was made by an association of railroad capitalists, who have formed a company, of which Mr. Ezra Bowen is president. It is understood that Mr. Wootten will be represented in the company to the extent of about $75,000 in its stock.—*Iron Age.*

Ground is being broken for a four story and basement factory, 36 by 218 feet, for Knisely & Miller, at Chicago. A wing, 40 by 75 feet, will also be added to their present works. The company are placing several thousand dollars' worth of new machinery in their works, including a 150 horse-power engine and a battery of two boilers. The improvements above mentioned are expected to be completed about the 20th of May.—*Age of Steel.*

William Baragwanath, of the Pacific Boiler Works, will erect, about the 1st of June, a one-story and basement factory building, 50 by 175 feet in extent. This structure will have a truss roof and be very substantial throughout. An engine and boiler and about $10,000 worth of improved machinery, punches, shears, rolls, etc., will be put in, and it is intended to have everything in running order by the last of July.—*Unknown Source.*

The I. P. Morris Company, of Philadelphia, are building a huge winding drum for the Calumet & Hecla Mining Company, to be used in hoisting cars from the mine. The drum is 20 feet in diameter, the wheel 24 feet, and the total weight of the machine when completed, about 100,000 pounds; there are 8 feet 4 inches winding surface and the total breadth of the drum is 10 feet. The apparatus is said to be the largest hoisting drum ever constructed.—*Iron Age.*

C. P. Willard & Co. have removed to their new factory at 280 to 284 Michigan street, Chicago. This building is seven stories high, 80 by 80 feet in size, and is arranged with every convenience. The machine shop occupies some 7,000 square feet and has received a complete equipment, including a new 50-inch chucking lathe and a 4-foot planer. This firm are adding a full line of boat engines to their list of small engines.—*Manufacturer and Builder.*

The Albany Steam Trap Company, Albany, N. Y., are engaged in fitting up the three-story brick factory building, 78 and 80 Church street, in that city, for the purpose of manufacturing and placing on the market several styles of steam valves, with renewable seat, the invention of James H. Blessing, of that company. So far the valve has been received with much favor. Special tools have been, and are being, provided for the purpose of making all parts of the valves interchangeable, and reducing the cost of manufacture to the lowest limit. In time the building will probably be utilized by the company for the manufacture of its steam traps also. The shops, including foundry, are about 60 feet wide by 70 feet deep.

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GANZ'S ELECTRIC GENERATOR.

The enormous electric generator shown at the Vienna Exhibition has now been permanently erected at the Central Station at the Hungarian States Railway at Buda-Pesth. It is to be employed to supply current for 70 arc and 600 incandescence lamps, and will form part of one of the most important and interesting installations in Austria. The machine itself and the inverted compound engine by which it is driven are herewith illustrated, the two being combined on one bed-plate, and the moving part of the generator forming the fly-wheel of the engine.

The currents are alternating, and therefore the field magnets need to be separately excited. Consequently the machine consists of two separate parts, viz., an alternate current generator and an exciting dynamo, both mounted concentrically on the same shaft. The armature of the main generator is composed of a wire drum, on the inside of which there are mounted 36 induction coils, in the manner adopted by Messrs. Ganz & Co., and which is shown in the accompanying view. These are wound with wire of 3·8 mm. (·150 in.) diameter. The 36 field magnets rotating inside the armature coils form a fly-wheel 8 ft. 2½ in. in diameter and 18 in. wide. The fixed magnets are wound with wire ·138 in. in diameter.

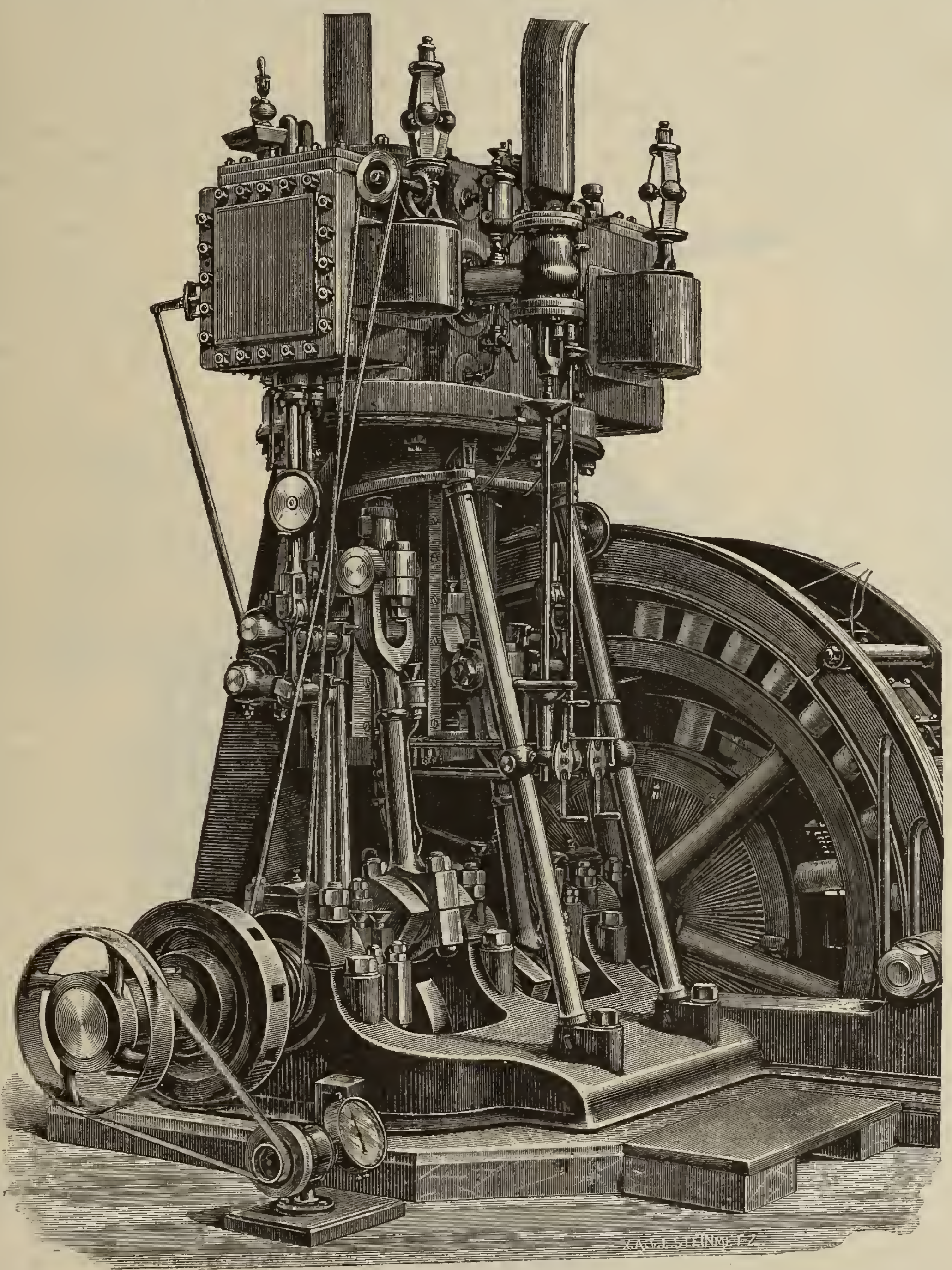
The exciting machine is a six-poled Gramme ring of 3 ft. 11 in. mean diameter, revolving within 12 pairs of field magnets. The ring is wound with wire ·98 in. in diameter, and the magnets with wire ·138 in. in diameter. The commutator is 11·8 in. in diameter, and consists of 180 sectors.

A noticeable feature of this machine is that the whole of the fixed parts—that is, the induction coils of the alternate current machine and the field magnets of the dynamo, are removable sideways to such an extent that a man may enter for the purpose of making repairs, though it is scarcely likely that this provision will be needed. To this end the fixed parts are mounted upon two stout horizontal bars, along which they can be drawn by two screws geared together and to a hand-wheel. By the aid of this arrangement one man can perform the work of removing the drum in a few minutes.

The following are the electrical measurements in connection with this machine:

Resistance of 36 induction coils in parallel circuit	0·0039 ohms.
Resistance of 1200 lamps and leads	0·038 "
" field magnets of alternate current machine	0·44 "
Resistance of Gramme ring	0·165 "
" field magnets of dynamo	0·24 "
Number of revolutions	180 per min.
Difference of potential at terminals of alternate current machine	57·6 volts.
Difference of potential at terminals of exciter	36·4 "
Current in alternate current machine	1516 ampères.
Current in dynamo	88·8 "
Watts of alternate current	96,297 "
" exciting current	6,663
" in lamp circuit	87,330
Electrical efficiency	85 per cent.

The weight of the machine is about 15 tons. It was designed and constructed in the short space of three and a half months, and during the time of the Exhibition was employed without any interruption to feed 900 Swan lamps of 20 candle power each, in the theater, and about 300 others at the makers' stands.—*Engineering.*



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THE MODERN high speed steamship is, in fact, a yacht devoted to commerce. A vessel in which space is sacrificed to speed, and to attain which no expense is spared. The *Oregon*, to make her average speed of a little less than 18 knots an hour, consumes 337 tons of coal a day. The *Aurania*, with an average speed of 16.6 knots, burns 240 tons of coal a day, or 97 tons less. The *Servia* does about as well. It is a question whether it pays to burn 100 tons of coal extra a day to gain a little over one knot an hour. It seems that it does not, judging from the fact that the Cunard Company have paid no dividends for some time past, and that one of the leading English steamship owners has failed. High speed looks very fine on paper, except when we come to count the cost of it; then it looks very bad on paper.

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IN THE MANUFACTURE of the Westinghouse automatic brake no callipers are used in sizing the various parts of pumps, triple valves, locks, couplings, etc. Sets of special tools, each ground to the proper shape, are used in turret lathes, and when the fresh ground tools are started a trial on a standard coupling or other article being machined enables the latheman to test the accuracy of his tools, and a micrometer scale in connection with his slide-rest feed-screw gives him the exact amount of feed necessary. It is evident that, this point once properly determined, the cutting tools will turn out accurate and interchangeable work every time, unless the tools become blunt or loose in the tool-holder. Neither can occur without detection. Piece-work offers no inducement to work with tools which cannot cut perfectly, and any slackness about tool-holder or rest should be instantly detected. Each piece of work is stamped by each man handling it, and thus a finished coupling or other part has several small marks upon it which enable the various men who molded, turned, bored or milled it to be identified.—*Railroad Gazette.*

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THE CAPTAIN of the schooner George Sherman, which was so roughly handled by the gale in Saginaw Bay, reports that the only thing that saved the schooner in the heavy seas was the use of oil. They first tried kerosene, but it was too light.

On trying linseed oil it worked like a charm on the waves, and caused them to break quite gently against the vessel as she drifted in a helpless condition.—*Marine Record.*

CURIOUS BEHAVIOR of English steel plates, so called. An English engineer said at a late session of the *Iron and Steel Institute,* that a point which he would like to see cleared up by some of the steel makers present was the cause of failures that took place some time ago, when material in which chemical analysis showed nothing abnormal, which would bend double when the edges were carefully planed and prepared, broke like glass when the edges were rough, or when holes were punched in the material. There was another point which he would like some explanation of. It is as to the effect of successive heating upon steel; and the point was that where we have a difficult plate to fit, such as the oxter plates at the stern, and it cannot be got to the shape in one heating, the plate has to be put in the furnace again and reheated; and although it may have worked exceedingly well in the first heating, it is much more difficult to work it in the second heating, and if it has to get a third heating the material gets almost entirely spoilt and unworkable.

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ROTTEN AIR-BRAKE HOSE.

The possibilities of accidents with automatic air-brakes are greatly increased by the use of inferior hose. Under stress this bursts sometimes, with the result that the brakes go on directly, and bring the train up all standing. This happened to one we were on recently, and, being in the cab, we said to the engineer:—"If there was a train behind us now, with short headway, there would be trouble." He shook his head, with compressed lips and said:—"This is the third time within a few weeks that thing has happened, and it's all on account of rotten hose."

There should be no economy practiced in this direction.

THE CONSUMPTION OF FUEL IN LOCOMOTIVES.

BY M. GEORGES MARIE, ENG'R PARIS AND LYONS RAILWAY.

During the past twenty years a great advance has been made in regard to economy of fuel in steam engines. In marine engines remarkable results have followed from the general use of compound cylinders and surface condensers; for whereas their consumption was formerly from 3½ lb. to 4½ lb. per indicated horse-power per hour, it has now been reduced to about 2 lb., and sometimes even less. Equally good results are obtained with Corliss engines. This progress in economy of fuel has led to the endeavor to effect a corresponding reduction in locomotives. But, before the ordinary build of locomotives so long in vogue is abandoned, their exact consumption ought to be ascertained. Generally it is measured in pounds per mile; but that mode is not a convenient one for comparison, because it takes no account of gradients, weight of train, speed, and train resistance, all of which are so variable that the bare statement of consumption per mile is of scarcely any value. The only proper way of reckoning the consumption, so as to admit of comparison under different circumstances, is in pounds per horse-power per hour.

There is a general impression that locomotives consume as much as from 4½ to 5½ lb. of fuel per horse-power per hour. With a view to dispel this very prevalent error, the author can quote experiments made by him during the last few years, which show an average consumption in good locomotives of 3·35 lb., when the horse-power is measured by the work done at the circumference of the driving-wheels, and of 2·91 lb. when it is measured by indicator diagrams; the fuel being of good quality and the firing done with care. Comparing this with the marine engine consumption of 2 lb. per indicated horse-power, it is seen that locomotives are much more economical than is usually supposed, considering that they work non-condensing while marine engines enjoy the great advantage of condensation. The author's first experiments on this subject, made in 1877 on the line between Rive-de-Gier and St. Etienne, gave a consumption of 2·90 lb. to 3·24 lb. per indicated horse-power per hour; other experiments confirming this consumption were also made on a longer length on the Nîmes and Clermont line. These results, which were widely criticised, led M. Hirsch, Professor of Steam and Engineering at the Ecole des Ponts et Chausseés, to request that the experiments might be repeated in his presence. Fresh trials, which may be considered official, were accordingly made with him on 18th, 20th, and 21st of July, 1882, on the Mont Cenis line, with the ordinary trains. The average consumption was again found to be 2·90 lb. per indicated horse-power per hour. In these experiments neither indicator nor dynamometer of any kind was used, such delicate instruments being liable to give rise to errors. Indicators especially occasion considerable errors through the oscillations of the piston-rod and spring, and in general give accurate results only from stationary engines working at slow speeds.—*The Engineer.*

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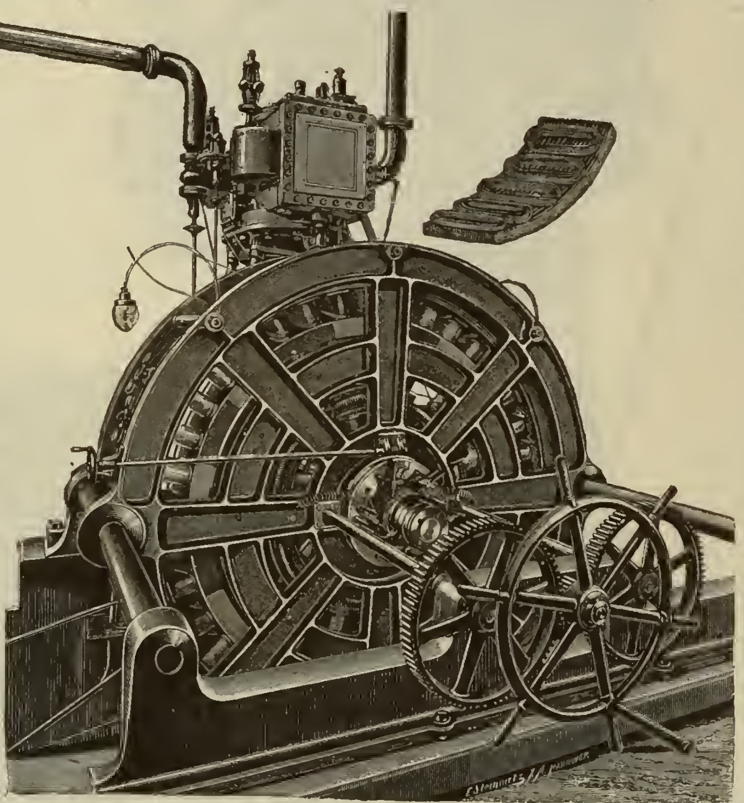
ALUMINIUM BY A NEW PROCESS.

A notable discovery, and one likely to work vast changes in metallic articles of many kinds, has been recently made by a Philadelphian, Colonel William Frishmuth. Hitherto aluminium has been made by the use of sodium as a reagent—sodium itself being very expensive. The process of Colonel Frishmuth uses the vapors of sodium. His work as a chemist was beset with difficulties and hindrances for a long time in getting furnaces of the proper construction, until, after three attempts he succeeded in building one to meet the necessities of the work. The aluminous minerals, bauxite and corundum, are first calcined by chemical processes to obtain the alumina. These processes prepare it for the retorts in which it is placed and exposed to a high heat so as to vaporize it. The vapors of the alumina, as they ascend, meet the vapors of sodium from the sodium retorts; the sodium vapors extract the oxygen from the alumina, and metallic aluminium is thereby produced in very small globules, not visible in the cool slag, to the unaided eye. Next, the aluminium in form as above stated combined with its fluxes, is put into crucibles and remelted at high heat, whereby the aluminium is concentrated in large globules. After this it is poured out in rough ingots like pig iron. When hard, it is pounded up, washed, and put into shape of marketable aluminium.

He is able to produce from 50 to 60 oz. daily. A company has been formed for the manufacture, and the production need only be limited in quantity by the number of furnaces and the demand for it. The article, as produced by the new process, is pronounced by professional chemists as being finer than any in the world, and free from iron.

Commercially, the discovery will effect a reduction in price when a number of furnaces are once started, from the present $16 to $20 per lb. to $5 per lb., or possibly less. Even at present orders are being taken at $8, with scarcely any facilities for making it. The uses of aluminium can only be suggested; expensiveness has hitherto hindered them. It alloys readily with copper, making a beautiful bronze, always retaining color; it alloys with tin, zinc, silver, gold, iron and steel. It does not alloy with lead or quicksilver. Some copper tubes that were shown made with a 10 per cent. alloy of aluminium were very bright, almost golden in color; a specimen of iron alloyed with it took on the color of burnished steel. Colonel Frishmuth uses a dynamo electric machine, and by accident almost he has found a method of applying the aluminium by electricity, and has taken out two patents therefor. We were shown several specimens of this application whereby the aluminium was deposited on the copper in the form of crystallization. This, too, has manifold uses for decorative and useful articles. Elated with these successes, Colonel Frishmuth is engaged in seeking a solder for aluminium. This, the French Academy esteemed of such importance, twenty years ago, that they offered a prize of 250,000f. for its invention.—*Philadelphia Evening Star.*



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USERS OF THE LEAD BATH for heating for hardening make frequent mistakes in allowing something besides lead to form a portion of the bath, and also in allowing the bath to fall below its proper temperature. Only pure lead should be used to obtain the full heat for hardening good tool steel. A mixture of lead and tin—a melted mass composed of pewter, type-metal, and soft solder—is not a lead bath. The melting and heat-holding qualities of metals are not alike. In clean, pure lead, good cast steel can be heated to its proper intensity to obtain a good hardening, and then be drawn to color in sand or blazed in oil. But the lead must be kept at a limpid, fluid heat, hot enough to make its covering of charcoal powder glow, else the steel will not receive sufficient heat to harden.

FLUES ON TOP OF BOILERS.

We are sorry to see that relics of barbarism still exist in the form of flues running over the tops of boiler shells. One would naturally suppose, that when the number of boilers that have been ruined, and the still greater number that have been seriously injured by this form of setting, is taken into account, no one would think of setting new boilers in this manner. Yet it is done every day, and by intelligent and experienced men, too. The argument used in its favor, that the passage of the hot gases over the steam space superheats the steam, and thereby renders it more economical, is a plausible one, and doubtless leads many steam-users to adopt this form of setting, but if the circumstances are carefully examined, the argument will be seen to be fallacious. It will be impossible to superheat steam when it is in intimate contact with such a large surface and body of water as it is in the case of a tubular boiler. Moreover, it will be difficult for any one who has in mind the poor conductivity of *ashes*, to see (when looking into one of these flues after it has been running a few months) how superheating of the steam *can* occur. Our experience with this form of setting (and it is a somewhat extensive one) points to this: So long as the brickwork at the sides of the boiler is perfectly intact, so as to *compel* all the gases of combustion to pass through the tubes before they reach the top of the boiler, and the water is good, the influence of the flue is *nil*, because if the boiler is properly proportioned, the temperature in the flue cannot much exceed that of the steam in the boiler; and if the boiler is badly proportioned, the deposit of ashes which soon collects on top of the shell protects it, in a great measure, and this very protection is sufficient to prevent any superheating of the steam. But as soon as the side walls begin to heave, as they almost always do, and crowd away from the boiler shell, *then* the fire takes a short cut up past the side of the boiler into the flue, the draft is sufficient to carry away the ashes at the points where the openings are, and the exposed portion of the shell gets "scorched." Sometimes, when the feed-water is very acid, the over-heating, while hardly violent enough to burn the plates, is just sufficient to bake all scum on the surface of the water on to the shell above the water-line, beneath which coating corrosion goes on with surprising rapidity. We have seen boilers set in this way, with a coating several inches thick above the water-line, after they had run only a year, beneath which the plates were eaten nearly half-way through, while other boilers in the same room had been running under the same circumstances, with the single exception that the flue did *not* pass back over the shell, for upwards of fifteen years, and only showed very slight traces of this action. This seems to us to be conclusive evidence of the injurious action of this form of setting, aside from the liability, at any time, of the side walls becoming so badly disarranged that actual overheating and fracture therefrom may occur.—*The Locomotive.*

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A NEW SERIES.

We shall continue the articles begun in this issue on Optical Illusions, by Egbert P. Watson, Jr., for some time to come. Mr. Watson, Jr., is skilled in the art of making things seem to be what they are not, and in the course of these articles will explain a great many of the tricks performed upon the stage by illusionists—so called. For summer this matter has special value, for during hot weather, mankind—as a rule—do not love abstruse problems.

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MECHANICS CAN WRITE.

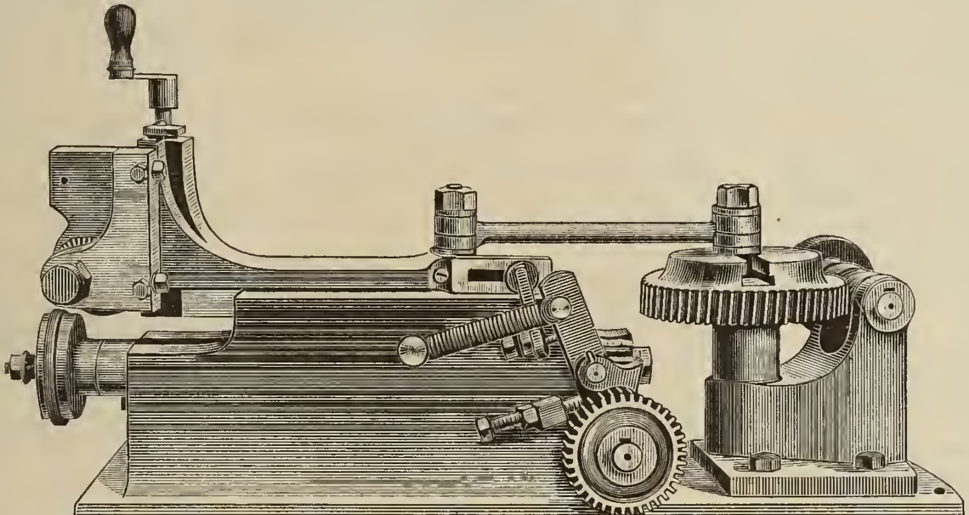
A correspondent, who is a good mechanic and also an editor, says of one of our serial articles just concluded:

"I have been much interested in "*How I Served my Apprenticeship*," although the style is not mine. Start Mr. Slocum on again.

"I have found it very difficult to get a thorough mechanic to put his experiences on paper; of all persons they are the slowest to write their ideas; they seem to have little ambition to 'rush into print.'"

AN ENGLISH AUTOMATIC GEAR-CUTTER.

The machine herewith illustrated is a self-acting gear-cutter; the blank moves the requisite distance for pitch automatically, and thus a number of machines can be run by one attendant. The blank to be cut is mounted upon a horizontal mandrel, which is caused to revolve through the requisite angle for each fresh tooth to be cut, by means of gearing driven from the pawl-wheel, visible on the side of the machine, which is turned one, two, or more teeth at each stroke of the tool-slide as required, the number taken at each stroke of the pawl being fixed by the amount of motion given to the pawl-lever, and which can be nicely regulated by a screw adjustment. The tool-slide is worked by the usual slotted disc and connecting-rod, as used in the ordinary shaping-machine, the disc being driven by worm and wheel from the belt-pulley. The working-tool is a milling-cutter, the upper part of which is just visible in the engraving, and it is driven by a belt from overhead driving gear. The tool-holder is adjustable for height by the handle above, and the cutter moves to and fro across the face of the blank by the action of the slotted disc, the cutter revolving at the same time. We have seen specimens of the work done by this machine, which are very excellent. It may be used to cut a variety of diameters and widths of blanks, and it is altogether a very handy and compact tool. It is much used by sewing-machine makers.—*The Mechanical World.*



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THE DIFFUSIVE AND PENETRATIVE POWER of petroleum is well known, but it is seldom that so marked an instance of it occurs as the one here quoted from the Hartford *Courant.* A well near a house was eighty feet deep, for the greater part through sandstone; it was almost surrounded by a solid wall of stone. Soon after using it a taste of kerosene was noticed, and investigation showed that a barrel of this oil in the cellar of the house, many feet distant, had leaked out. In order to get into the well it had to soak through the thick stone foundations of the cellar wall, then through the ground for several feet, and at last make its way through the sandstone walls of the well.

The well was pumped out and scrubbed, and several bags of powdered charcoal placed at the bottom. But when the water came it still had the taste of oil. Another thorough cleaning followed, and the well was then left to itself until recently, when the water was put to use, and it is now sweet and wholesome.

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TO THE ASSOCIATIONS OF STATIONARY ENGINEERS.

I have lately sent out blank credentials for delegates and alternates to the 3rd annual meeting of the National Association of Stationary Engineers, which takes place in Baltimore, on Sept. 2nd. Through an error they are printed for the election to take place on the last meeting in June. As the elections for delegates are held on the first meeting in July, the proper officer of the several associations will please alter the dates to suit the above statement.

Another thing I would like to call special attention to: Sec. 2 of Art. 6, page 19 of the Constitution, relative to the election of officers. I am informed that several associations pay no attention to that section, but elect officers in any and all months. It is hoped that on the last meeting in this month all our associations will conform, and elect officers for the coming year. Also, that they will all send in their reports at once, with the per capita tax for the year. Some associations have not yet reported for the year. They will, on the last meeting in this month, owe the N. A. fifteen cents for each member on their books. Respectfully submitted,

Detroit, Mich. A. M. DAVY, *Sec'y.*

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TREMENDOUS CHARGES OF POWDER are now fired in English heavy ordnance. No less than 450 pounds is the heaviest fired in the 80 ton gun.

SURCHARGED WATER.

Surcharged water plays a great part with theoretical boiler exploders. These theorists say that boilers standing still for a long time under pressure become surcharged with steam. The water is permeated and saturated with it, so to speak, so that as soon as the equilibrium is disturbed, either by opening the throttle or otherwise, a great volume of steam is disengaged at once, with disastrous effect.

In connection with this, it is curious that the efficiency of the Lamm fireless locomotive depends upon this very principle of surcharged water. A locomotive, in all respects like any other, except that it has no fire-box, is filled with water, and steam of high pressure is forced into it until it is thoroughly saturated with it. In this condition the engine is used as any other is. No great volume of steam is disengaged upon the starting of it, and no difference from any other boiler is perceptible in its behavior. According to those who hold the view that surcharged water is a cause of explosions, the Lamm fireless locomotive is a dangerous contrivance. These locomotives are now in use in France, where they have been working for many years.

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IT IS SAID TO BE a well-known fact that if the barrels of a double gun are laid with their axes parallel, the charges will cross each other at a certain distance from the muzzle. This has never been satisfactorily accounted for, but an English experimenter thinks that it is due to a change of form, owing to the sudden explosion of the charge the barrels are bowed in, and some experiments he tried seem to substantiate his views.

PRIVATE CHUCKLE ALL TO OURSELVES.—Various enterprising contemporaries are circulating an item extensively about cotton-seed hulls, and a use they are applied to in railroad work. This causes us to smile at the immense amount of gratuitous advertising the company which owns the patent is getting. The smile itself is omitted —for want of space.

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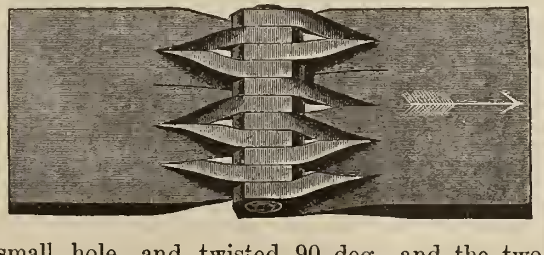
NOVEL BELT-FASTENER.

The engraving shows a novel English belt-fastening recently introduced abroad. We quote from *Engineering:* Each end of the strap is divided into a series of fingers about $\frac{1}{4}$ in. or $\frac{3}{8}$ in. wide, one end having an odd and the other an even number. Each division is pierced with a small hole, and twisted 90 deg., and the two series having been placed together, as shown in the sketch, a pin is put right through the whole, and secured by riveting its end over a washer. It is claimed for this fastening that it is stronger than any other in the market, and this is borne out by experiments. When tried against well-known belt-fasteners, the average of four tests gave a breaking strain of 644 lb. in a belt $1\frac{1}{2}$ in. wide, while the next best failed at 588 lb., and the weakest at 394 lb.



INSUFFICIENT POWER.

Many a mill-builder carries out a principle of false economy when he places the boilers and engine in his establishment. A weak man cannot lift a heavy weight; a small horse cannot pull a heavy load; yet there are men, and plenty of them, who seem to think that a small engine is capable of driving heavy machinery. Too often salesman do much to induce men to believe this. Knowing the disposition of the majority to build as cheaply as possible, these salesmen argue that a small engine will do the work satisfactorily. "I want to cut from 40,000 to 50,000 feet of lumber a day," says the lumber manufacturer. "Oh, well," says the salesman, "this engine will do it." Probably it will do it. With easy feed the saw is driven through the log in a manner that cannot be complained off. But by and by there comes a time when there is a big order to fill, or something of that kind. The time has come to push things, but it is discovered, when it is too late, that there is no pusher.

An engine should be of sufficient power to drive the mill to its maximum capacity, and that easily. An overworked engine complains as loudly as an overworked man. It speaks plainly for relief at every stroke. Overwork prostrates it. A consultation is held and it is decided that the engine must go. It is set one side, and then the manufacturer of it hears that his engine that was put in at such and such a place has been replaced. It wouldn't do the work: consequently it must be a poor engine. Other manufacturers make capital out of it, and infer that the engine must be poor, when it is probable that the engine was first-class in every respect. It was simply worked beyond its strength, and the manufacturers of it are not to blame. The result is damaging to the maker of the engine and to the man who purchased it.

It is impossible for a man who builds a mill to know beforehand how hard it will be necessary to drive it. If the price of lumber jumps up suddenly, he will feel like putting on all the steam and feed possible. It may be found desirable to attach a planer, or some other machinery, and it will be necessary to have enough power to run it, in connection with the saw. To increase the capacity of a mill is an almost every-day occurrence, and, oftener than otherwise, such a change necessitates a new engine or boiler.

We have heard thousands of complaints from mill and factory men because they did not have enough power, but not one because of too much. It is safe to say that no mill man ever found fault because his engine was too large. If it is larger than he really requires, he is pleased rather than otherwise. He not only has the satisfaction of seeing his machinery running easily and at uniform speed, but he knows that in case of an increased demand for the product of his mill, he will be able to meet it promptly without additional expense.

Reserve power is always desirable, at times highly profitable, and the extra cost of an engine and boiler capable of producing such power is one of the best investments a mill man can make. —*Northwestern Lumberman.*

[The above applies to lumber manufacturers with force, but not to all others. An engine too large is a source of greater loss than one too small, where fuel has to be bought.—EDS.]

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GEORGE H. CORLISS, Providence, R. I., has received a patent on an engine cross-head with adjustable gibs. The cross-head tapers on the line of the guides and the gibs are made to fit this taper. By turning an adjusting screw the gib is drawn on the cross-head, increasing the vertical diameter, and so taking up any lost motion.—*Am. Machinist.*

This seems curious, from the fact that it is an old device. The New York Safety Steam Power Company have used it for years on their engines.

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"THEY ALSO SERVE who only stand and wait," says the poet; but if this is intended to include the average "sojer" in shops, his services can be dispensed with.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

FLAT CAST-IRON BOILER-HEADS AT THE FRANKLIN INSTITUTE.

Editors Mechanical Engineer:

The Franklin Institute of the State of Pennsylvania, for the promotion of Mechanic Arts, has impressed the idea upon me that it has taken a stand to promote steam-boiler explosions, for whenever the prevention of such explosions is broached at that Institution, some of its eminent members are always ready to pervert that subject.

Lately, the subject of strength of flat cast-iron boiler-heads has been taken up and experimented upon by cold-water pressure at the Franklin Institute. Fearing that the specious arguments on flat cast-iron heads may mislead some readers of the journal of the Franklin Institute, I felt constrained to make the following remarks at the meeting in May last:

In regard to the papers and experiments on strength of flat cast iron boiler-heads by Mr. S. Lloyd Wiegand, I beg leave to call the attention of the Institute to the fact that the misstatements of the case have been published in the journal, whilst the truths, which were explained at the February and March meetings, have been suppressed; and thus the Institute furnishes unreliable matter to the public.

The vessel representing a steam boiler experimented upon by Mr. Wiegand was four feet long; $D=36$ inches in diameter of cylindrical shell of wrought iron; $T=\frac{5}{16}$ of an inch thickness of said shell, single riveted and punched holes in the longitudinal seam.

The ultimate strength of such a shell made of the best plate iron, say S,=55,000 pounds tensile strength per square inch, would be as follows:

$$p=\frac{ST}{D}=\frac{55000\times5}{36\times16}=477{\cdot}43 \text{ lbs. per square inch.}$$

Mr. Wiegand said it bore 820 lbs. per square inch.

For drilled holes in the longitudinal seam the ultimate strength would be as follows:

$$p=\frac{4ST}{3D}=\frac{4\times55000\times5}{3\times36\times16}=633 \text{ lbs. per square inch.}$$

It is true, however, that a length of only four feet, riveted to two heads, would be stronger than a regular length of that class of boiler would be; but the shell did not burst, and was not tried to its ultimate strength.

The strain on the iron between the rivets in the longitudinal seam of the shell, with a steam pressure of 820 lbs. to the square inch, and the rivet holes punched, would be,

$$p=\frac{36\times820\times16}{5}=94{,}464 \text{ pounds per square inch,}$$

which is much more than the best boiler iron can stand.

The force pump used for the experiments had a working lever of 30 inches, and plunger lever $6\frac{1}{2}$ inches. The diameter of the plunger was 1 inch, and not $\frac{5}{8}$ths of an inch, as stated by Mr Wiegand. I measured the plunger and levers when the meeting was called to order.

During the experiment, two men worked the pump with considerable ease, having each one hand on the lever, making the average leverage 24′′ to $6\frac{1}{2}$, and the plunger 0·785 of a square inch area.

With this proportion, each pound of pressure on the lever will make 4·65 pounds pressure per square inch in the boiler. The easy positions maintained by the two men when working the pump, made me believe that they did not press more than 40 pounds each on the lever, making 80 pounds; from which must be deducted about 10 pounds for friction in the stuffing-box and motion of the water in the small bent pipe, leaving 70 pounds effective pressure on the lever; and thus: $70\times4{\cdot}65=325{\cdot}5$ pounds, the pressure per square inch in the boiler when the flat cast-iron head burst, instead of 820 pounds, as stated by Mr. Wiegand.

Even if the two men pressed 50 pounds each on the lever, the ultimate strength of the head was still only 418·5 lbs. per square inch, which is only one-half of that stated by Mr. Wiegand.

Mr. Wiegand stated that he adjusted the pressure gauges before the experiments were made, and readjusted them after the experiments.

On page 348, May number of the journal, Mr. Wiegand says, "at 550 lbs. the head cracked so as to make a noise, but showed very little leakage; the cracks being two radiations from the manhole opening, and one some 10 inches around the rim, or flange," after which he raised the pressure to 820 pounds to the square inch before the head burst!!!

Can the Franklin Institute take that in?

Even if the experiments and records of the same had been faithfully made, they would still not have proved the strength of flat cast-iron heads when under steam pressure, because the factor of danger, namely the shrinkage strain, was not included in the cold water pressure.

A practical method of experimenting on strength of flat cast iron boiler heads, would be to build a fire under the boiler and raise steam in it to a pressure of about 100 pounds to the square inch, then let Mr. Wiegand, or any other flat cast-iron head engineer, place himself in front of the boiler with a hose in his hand and throw a stream of cold water on the heated boiler-head. Such an experiment would be similar to the Gaffney boiler explosion.

It is well known that flat cast-iron heads are generally strong enough under ordinary steam pressure when protected from sudden change of temperature.

There are thousands of flat cast-iron heads in use in the State of Pennsylvania, of which the best and oldest ones were made of charcoal iron, which flows more even in the mould when cast, and has less shrinkage strain, than those cast of iron reduced by mineral coal.

When boilers with flat cast-iron head explode, the cause of the accident is generally not credited to the broken head, but to over-pressure, low water, or that the cause of the explosion was a mystery.

No engineer with sound judgment would make a flat cast-iron boiler-head, because, the general construction of it is radically wrong for strength, but a concave head is comparatively safe, and costs less in the end on account of there being less iron in it.

At the February meeting of the Institute I gave a formula for safety strength of flat cast-iron boiler-heads which I have deduced from a German work, as follows:

$$p=\frac{20000\ t^2}{D^2}$$

D=diameter and t=thickness in inches of the flat cast iron head.
p=safety pressure in pounds per square inch, the maximum with which the head should be trusted; particularly when it has a man hole.

German engineers do not make flat cast-iron heads for steam-boilers, but the experiments from which the formula is deduced were made upon cast-iron heads for steam-cylinders.

The dimensions of the flat cast-iron head experimented upon by Mr. Wiegand were, $D=36$ and $t=2$ inches, which should make the safety strength as follows:

$$p=\frac{20000\times2^2}{36^2}=61{\cdot}728 \text{ lbs. per square inch.}$$

Mr. Wiegand perverted this formula and said (page 349, Journal Franklin Institute for May, 1884), that it gave the ultimate strength of his flat cast-iron head "between 25 and 30 pounds to the square inch." At the March meeting Mr. Wiegand made an elaborate explanation of how wrong the above formula was. He made no allusion to shrinkage strain. Mr. Wiegand's experiments, as well as those made by Sidebotham & Powell, with hydrostatic pressure, proved that the flat cast iron head with a manhole in it was the weakest part of the boiler. Sidebotham & Powell's experiment gave the ultimate strength 450 pounds; Wiegand's (he says) gave 820, and the Gaffney boiler-head burst with a steam pressure of about 60 pounds to the square inch, and all the three heads were cast from one and the same pattern. The Gaffney boiler-head burst by a stream of cold water being thrown upon it. With such wide difference of ultimate strength, a formula, without allowance for shrinkage strain, cannot be reliable, but when the cast-iron boiler-head is made concave, then a formula can be relied upon, namely,

$$p=\frac{St}{2R}$$

S=ultimate strength of the cast iron in pounds per square inch.
R=radius of curvature in inches of the concave head.
t=thickness in inches of the head.
p=safety pressure in pounds per square inch in the boiler.

It is supposed that the concave side of the head is acted upon by the steam pressure, that is, the convex side of the head is turned out.

At the January meeting of the Institute, on motion by Mr. Wiegand, the subject of strength of flat cast iron heads was referred to the Committee on Science and the Arts, which appointed a sub-committee for that purpose. The flat cast-iron head committee consists of Mr. S. Lloyd Wiegand, chairman; Dr. Robert E. Rogers; Dr. Chas. M. Cresson; Mr. Washington Jones and others. No report had been received from that sub-committee up to May 26, 1884. John W. Nystrom.

256 So. 10th Street, Philadelphia, Pa.

◆

GLOBE-VALVES, ETC.

Editors Mechanical Engineer:

A year ago I had a little experience with a globe throttle-valve which may be of interest; it furnishes an argument in favor of steam on top of the valve. This valve had the steam pressure on the bottom, and had leaked so for some time that when steam was at working pressure, 95 to 100 pounds, that it was difficult to stop the engine (10′′×18′′) without also using a brake on the fly-wheel, except now and then, when the valve seemed to get turned around in the right position. I suspected that the valve-stem was not perpendicular to the seat, or at least was out of truth in some way, and determined to try an experiment with it. The end of the stem (which fitted loosely in the valve) had a bearing on the valve of $\frac{3}{4}$′′ or $\frac{7}{8}$′′ diameter, and I determined to reduce this to about $\frac{3}{16}$′′. This I did by filing a small cone-shaped piece of steel from the tang of a file, and placing it between the valve and stem, with the point inserted in the center-mark of the stem, so it could not get out of place. It did not leak any afterwards during the summer.

Several months since I made the mistake of stating that a small circular saw would cut easier than a large one at the same rim-speed, on account of the difference of leverage. This blunder made me so ashamed that I resolved not to allow myself a chance of doing so again. My chagrin was modified when I discovered that (according to Roper) an engine could be reversed by placing it on the dead center and moving the eccentric round on the shaft till the valve had the same amount of lead at the other end; that the lead at both ends could be equalized by moving the eccentric on the shaft; that, according to The Mechanical Engineer, when a force is acting upon a body in one direction, and an equal force acts almost instantaneously upon it in the opposite direction, the two forces do not neutralize and destroy the effects of each other; as in the cannon ball question.

The writer of the letter, "*One of the Other Kind,*" has probably discovered that he also can learn something from criticism; but don't be too hard on him; he simply made a mistake, and mistakes we all know are common. Humanity in general is not infallible, neither is the pope, I believe, though, as I am not personally acquainted with the gentleman, perhaps I am not competent to judge of that matter. Two of the young man's critics call him a crank, which is quite a compliment, since a crank is a very useful appendage about an engine. He must be mistaken about not being able to learn anything from "*The Professor-in-the-Machine-Shop*" articles. I don't believe anyone can read them without learning something of value, although he may not be conscious of it if he isn't interested in them. Perhaps if the unfortunate young man would take a few lessons from Mr. Moulton in the art of reading between the lines, The Mechanical Engineer would be of greater value to him. Then, if he would sit down and carefully study the information contained in it, he would undoubtedly come to the conclusion that there are many things in this world worth learning besides "practical instruction how to run engines."

Colorado. F. H. Stevens.

[Our correspondent's definition of the cannon-ball question is his own—not ours. We have not taken the position he mentions. Two forces meeting from opposite directions neutralize each other only when exactly the same in intensity. The anvil hits the hammer as hard as the hammer hits the anvil; but through its lesser inertia the hammer is thrown back—rebounds—which is exactly the cannon-ball case in a nut-shell.—Eds.]

◆

THE FIRST PROTEST.

Editors Mechanical Engineer:

Being a constant reader of your valuable paper (which is, without a doubt, the best of its sort published), I am surprised at the tranquil way the engineers appear to view this matter of taxation and graduation, which the authorities are at present exercising on New York engineers. But as engineers are noted for their coolness, I suppose this is not an exception. As for me, I can't withhold my indignation any longer. I have got to blow off.

In regard to this matter of taxation, it is an outrage to all engineers, and I hope The Mechanical Engineer will be the medium through which engineers will discuss the propriety of assessing individuals two dollars for licenses, which sum is turned over to the police fund. If it is right to tax us so heavily, why make a distinction among engineers? Why are the two dollars which we are taxed turned over to the police fund? Is it because we assist in disabling them any more than any one else? Why are engineers singled out to support this fund more than other trades? I, and I believe the majority, would rather have the two dollars go to some charitable institution than to have one cent of it go to the police. They claim to grade engineers according to their ability; this I deny, for I know of several instances in which men, entirely ignorant of the duties of engineers, receive a first-class certificate, while engineers of 15 to 20 years' experience, and men fit for their calling, receive but a 2d or 3d class. I hope the engineers of this city will make some suggestions in regard to the best method we should employ to abolish this outrage. C. A. D.

New York.

[We have said a few words on this subject on the editorial page.—Eds.]

◆

STEAM ON GLOBE-VALVES.

Editors Mechanical Engineer:

I saw an article quoted in your last paper upon this subject, which said that there was no reason in any argument which advocated putting up globe-valves with steam entering on the under side. I admit that I always put up valves in this way, for I find that they can be packed when steam is on without scalding one, and moreover, the handle does not get so hot. If valves are opened against the pressure the wear is equal on them and the strain on the thread, and consequently the wear, are not so great as when steam enters from the top. Also, if the valve is a composition disc, as many are, it is more likely to break by pressure on top than by the same on the bottom.

New York. A. W. Malmstrom.

◆

FROM PRESIDENT BECKERLEG.

Editors Mechanical Engineer:

It gives me pleasure to state that the Stationary Engineers in the West are rapidly organizing into associations. On May 1st one started at St. Joseph, Mo., with 24 charter members, while the following are forming:

North St. Louis, Mo.; Sedalia, Mo.; Hamilton, Ohio; Grand Rapids, Mich.

Missouri seems determined to be the Banner State, with still another which is in progress at Carterville, Mo. The officers of the National Association are corresponding with several parties asking information.

Chicago, Ill. James G. Beckerleg, *President*,
862 Washington Boulevard.

◆

ATCHISON NUMBER ONE STATIONARY ENGINEERS' ASSOCIATION.

Editors Mechanical Engineer:

I recently visited Atchison and was well received by the brothers of No. 1 Association. They may well be proud of their engine rooms and boiler houses, for they are among the finest in the State. Number 1, Atchison, has now 14 members and is in a flourishing condition. They are all leading men in the business and comprise the best engineers. Brother C. W. Jones showed me many attentions and all the members were anxious to make my visit agreeable, which they certainly did.

Kansas City, Mo. Benj. F. Smith.

◆

SETH WILMARTH.

Editors Mechanical Engineer:

I was glad to see a notice in your last issue of Seth Wilmarth. As foreman of a shop in Boston, in 1850, I did some work for him and frequently visited his shop. That's a good many years ago. I had then been out of my time two years, and was foreman of a shop of 14 men in Harvard place, Boston, opposite the old South Church. While there, I. M. Singer, in the same building, was getting up his sewing machine, and I made for him some of the first cams for throwing the arm of the needle-bar. I'm getting old.

Boston, Mass. J.

TRADE TOPICS FROM EVERYWHERE.

The Troy Fertilizing Co., Troy, Ala., expect to start a bag factory, and desire information as to machinery.

W. A. McFadden, manufacturer and dealer in wood and stone pumps and lumber, Bainbridge, Ind., is putting up a building 60 × 80 feet, two stories, for combined saw and planing mill, and will put in a new boiler.

The Walker Manufacturing Co., Cleveland, O., will soon begin the erection of an addition to their foundry, and will also put in a 14-foot pulley borer, a 60-inch pulley lathe, and a 60-inch pulley borer.—*Trade Review.*

The Lane & Bodley Co., of this city, have recently erected a new building, which they have equipped with new and first-class tools for the manufacture of a high grade automatic cut-off engine.—*Cincinnati Trade List.*

Betts Machine Co., Wilmington, Del., inform us that they are building a new tool shop 120 × 75, and 25 feet high, as an addition, and will put some new large tools into operation. They think business prospects fair.—*Chicago Jour. Commerce.*

Webster & King, silk manufacturers at Glenwood, have decided to build a mill of their own in Easthampton. They have bought three acres of the old Chapman property, and will build a two-story stone and brick mill, 175 × 40 feet.—*Boston Jour. Commerce.*

Contractors in charge of the erection of the West Shore railway shops at Frankfort, N. Y., work on which was suspended last December, have received instructions to resume work and complete the shop, foundry and boiler-house in six weeks. A large force will be put to work this week.

The Innis Manufacturing Co., Oil City, Pa., employ at present 115 hands. In their foundry they are melting about 8 tons of iron per day. They expect soon to add to their foundry to the extent of 25 × 38 feet, and to their machine shop to the extent of 14 × 16 feet, besides another building 40 × 80 feet.

Hore & Osborne, Eustis Planing Mills, Eustis, Fla., will make additions to their mill of two stories, 30 × 30, and an engine room and shed about 20 × 50, and put in one tenoning machine, one shaping machine, one mortising machine, one No. 4 side moulder, one turning lathe and one 12-inch buzz planer.

The Brooks Locomotive Works of Dunkirk, N. Y., have secured the contract to build twenty locomotives for the Ohio & Mississippi. They are to be ten-wheelers with cylinders 19 × 24, and are to weigh about 95,000 pounds each. Delivery is to be made during July, August and September.—*Railway Age.*

Fay & Scott, machinists, have purchased of F. W. Hill the property known as the Copeland mill site, and it is understood that they will build a machine shop and foundry this season. The machine shop is to be built of brick, 40 × 80 feet, and two stories high. Their business is the manufacturing of machinists' tools, such as shaping lathes of different kinds.—*American Manufacturer.*

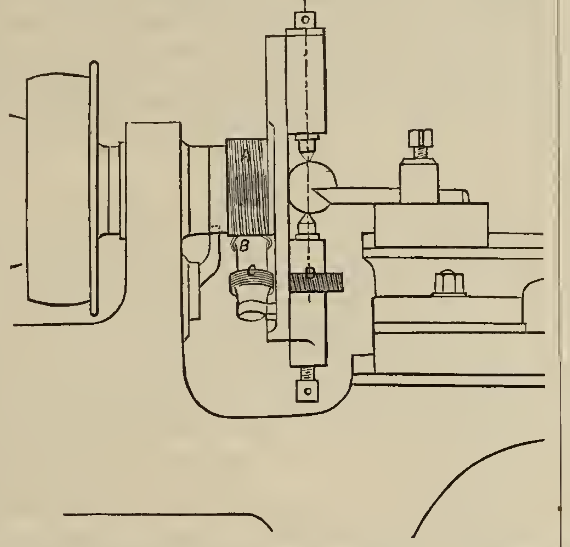
The York Manufacturing Company, Limited, of Portsmouth, manufacturers of steel scrapers, will enlarge their factory by the addition of another story. This has been necessitated partially on account of the increased demand for their goods, and also for the reason that they will shortly enter into the manufacturing of roller and ice skates of new and improved patterns.—*Iron Age.*

J. F. Wollensak, Chicago, is building an addition to his factory, 40 × 100 feet in extent, to make room for new machinery, which will be put in as soon as the building is ready. This addition, which will also relieve the crowded state of his present work, will be five stories high and substantially built of brick. It will be used for the manufacture of locks, keys and light hardware specialties, and will increase his capacity 50 per cent. It will be completed early in June.—*Industrial World.*

NEW CHUCK FOR TURNING BALLS.

The distinguishing feature in this ball-turning machine is that the work revolves in two directions simultaneously. In the case of an ordinary brass ball, the casting is made from a pattern having two small shanks, in which the centers are marked. It is fixed in the machine between two centers carried on a face-plate or chuck, with which they revolve. One of these centers, when the machine is in motion, receives a continuous rotary motion about its axis from a worm-wheel *D*. This is driven by a worm *C* carried on a shaft at the back of the chuck, and driven itself by a worm-wheel *B*, which gears with a screw which rides loosely upon the mandrel, and is kept from rotating by a finger on the head-stock. This center, in its rotation, carries with it the ball, which is thus slowly moved round an axis parallel to the face-plate, at the same time that it revolves about the axis of the mandrel, the result being that the tool cuts upon the ball a scroll, of which each convolution is approximately a circle, and lies in a plane parallel to the line of centers.

When the chuck is set for one size of ball, which may be done in a few minutes, any quantity of that diameter may be turned without further adjustment. A roughing cut for a 2 in. ball may be done in one minute, a finishing cut leaving the ball quite bright in the same time. The two teats are cut off within one-sixteenth of an inch and the ball finished in the usual way. On account of the work being geometrically true the finishing by the ferrule tool is done in one-quarter of the time usually required.



The chuck may be applied to an ordinary lathe or may be combined with a special machine tool. In the latter case everything is arranged in the most handy way for rapid working, and six brass balls of 2 in. in diameter can be turned and finished in an hour. The machine is specially adapted for turning ball-valves for pumps, pulsometers, and the like.—*Engineering.*

The machine above is very curious, and the means by which the end is attained very simple and ingenious. We think, however, that the time mentioned for roughing cuts is rather short.—Eds.

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QUADRUPLE COMPOUND ENGINES. INCREASING EXPANSION.

Three cylinder compound engines are not unusual in England, and, used with very high pressure, are said to be more economical than two cylinder compound engines. Not content with what has been achieved in this direction, English engineers are now building quadruple cylinder compound engines consisting of one high-pressure cylinder and three expansion or low-pressure cylinders. At a recent meeting a Mr. John said that one of the most marked features is the progress now being made with the marine engine, arising from the rapid adoption of very high pressure, and extended expansion beyond the ordinary compound engines. His company is building two sets of engines, one on the triple expansion principle with 150 lb. pressure, and the other with quadruple expansions, or four cylinders, expanding into each other, and using 160 lb. pressure. It is scarcely too much to say that they had a right to expect at least 20 per cent. saving in fuel over the ordinary compound engine. Triple expansion has been adopted by several firms for some time past. To deal with these pressures at all, the introduction of steel in the construction of boilers was an absolute necessity, and he did not think they had come to the end of their improvements in that direction.

There was one other point he wished to mention, viz., the introduction of steel castings into shipbuilding and engine works. Their ordinary and standard practice is to make reversing links, eccentric-rod ends, reversing levers, and link-blocks of cast steel, and these have proved of excellent quality, sound and tough, and have been machined about all over, with an almost entire freedom from air-holes. Recently they had constructed a set of engines with Joy's valve gear, and for this the working parts were made entirely of cast steel, thus avoiding most difficult and expensive forgings.

◆

ON THE BURNING OF IRON AND STEEL.

Iron that has been raised too near its temperature of fusion and slowly cooled, is designated as "burned" or overheated metal. It is both red-short and cold-short, and exhibits a coarse, crystalline structure, and a bright, glistening fracture. Such iron contains oxygen. But this oxygen is not, as is commonly believed, derived from without during the heating, but it was previously contained in the iron itself through the medium of the slag impurities mixed with it. When the iron is raised to the fusing heat, or near it, a chemical reaction takes place which alters the properties of it. The coarsely crystalline quality of iron so treated is not due to the presence of the oxygen. The metal usually contains a notable quantity of phosphorus, which is well known to give a coarse grain accompanied by the quality described as cold-short. The crystallization takes place during the slow cooling while at rest. The greater the proportion of phosphorus present the lower is the temperature to which the iron may be raised without being burned. Pure iron should not take up more than 0·25 per cent. of oxygen in solution. Though this substance does not greatly affect the ductility of the metal when cold, it acts like sulphur on its malleability.

The qualities of steel also undergo change when heated to a high temperature, or when subjected to a lower temperature for too long a time. The richer the steel is in carbon, the lower is the temperature at which the change takes place. Therefore, the harder the steel the more carefully is it to be dealt with in the fire. Such overheated steel becomes coarse-grained and brittle; that is, cold-short. If the temperature be increased, showers of sparks are thrown off, and the steel is said to be "burned." The alteration brought about in this way has generally been attributed to a diminution in the proportion of the carbon constituent, though this assumption is not warranted by the results of analysis. The presence of manganese and silicon is of more weighty consequence. When steel containing these is heated it is not the carbon, but the manganese and silicon that first become oxydized, and there results an important change in the properties of the steel. Later the carbon is oxydized; and while the oxide of carbon escapes those of the manganese and silicon remain behind, and the whole molecular structure of the metal is altered. If the heating be carried still farther the iron will next be oxydized.

A cast-iron furnace door, exposed for several years to the flame of a coal fire, was found to contain 27·8 per cent. of oxygen, in combination with iron, sulphur, nickel, copper, phosphorus and arsenic. The cause of the sparks is not the combustion of the carbon, and the consequent generation of carbonic oxide gas, but the escape of gases imprisoned in the steel. Similar results may be brought about by exposing the steel to a lower temperature for a longer time; the oxidation of the constituents will, in this case, be effected in the order mentioned above, the only difference being in the slower action. Steel altered in this way is well described as "dead." A regeneration of the metal by mechanical treatment is hardly possible, since the original chemical composition cannot be restored by such means.—*Van Nostrand's Magazine.*

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"American Built Up Crank Shafts" will be illustrated in an early issue of this paper.

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Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

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FORTY YEARS AGO.

Forty years ago in the machine-trade, planing machines were the exception; the hammer and chisel were the only reliance for obtaining plane surfaces. In those days men chipped and filed, and removed pounds of iron by hand, where machines now remove ounces only.

Forty years ago castings were made much heavier and rougher than they now are, and were not so sound. Pattern-makers were instructed to allow more stock to finish, and blacksmiths compelled machinists to do work on the lathe and in the vise which should have been done at the forge. Their forgings were rough and covered with scale, and they ran close to the size in places where it was all straight work, and far away from it in others where it was hard work to get the stock off. Forgings, in most cases, were only an approximation to the thing required.

Forty years ago the milling-machine was unknown. The seed, or germ, of it was the "slabber," for milling off hexagon nuts and bolt-heads. These nuts were oftener chipped and filed than any other way; but when a specially nice job was required, they were strung on a mandrel and planed. Then some enterprising genius conceived the idea of a special machine, with serrated cutters (mills in fact), which should slowly grub away the metal to be removed, and this was the beginning of the milling-machine. If it could slab nuts, why not anything else? The idea was there, and it very soon spread to other details and directions.

Forty years ago the lathes in use were poor machines compared to the present tools. The "slide-lathe," as it was called, was confined to straight work and boring; anything that required exact workmanship was done in hand-lathes. No longer ago than 1852, in this city, the threads on the stems of poppet-valves were cut and chased by hand. These threads were possibly 14″ long by $1\frac{3}{4}''$ and 2″ diameter. To this day, in fact, a large machine shop in this city uses hand-lathes very extensively in their business for fitting up small work.

Forty years ago tradition ruled in machine-work, and book lore had no part or lot in designing or constructing. Men followed the plans of their fathers, and any departure or innovation was but slowly adopted. There were no text-books or hand-books, and technical schools were unheard of.

Forty years ago steam worked expansively was the exception; full stroke was the rule everywhere, and steam pushed the piston to the very end of the stroke, the valve only closing in time to open again. Piston speeds were slow, friction was an enormous percentage of the power, and boiler pressures of fifty to sixty pounds were considered high.

Forty years ago the condition of the machine and workingmen was far below what it now is. In forty years the social status and appreciation of craftsmen generally have advanced. Legislation has had no part in this. Men cannot be voted into intelligence, and an ambition to learn the why and wherefore of their callings. Example and individual achievements have raised the mass. Men have emulated the efforts of others who rose from poverty to affluence by hard study. The improvements in machinery have also aided the multitude, and the trades stand higher, are more intelligent, more economical, better citizens in short, than their fathers. Three other great levers have lifted tradesmen out of darkness into light—the free public school, the untrammeled press, and protection for home labor against the encroachments of mere brute force and lower social conditions. These three last named are truly the ramparts of our beloved country, and every man who loves it will do his utmost to uphold and strengthen them.

BUYING SECOND-HAND MACHINERY.

It sometimes happens through the chances of trade that machines which have been used but a short time only, are thrown on the market. If the machines were well made in the first instance, and have been properly cared for, they are practically as good as new, but the purchaser should be careful to ascertain this fact before buying. If he is not capable of judging, he should in all cases obtain the services of a thoroughly experienced man who knows what defects to look for and where to find them. In no case should he undertake to decide himself, or let a low price have any weight. As a rule, the lower the price of second-hand machinery is the poorer it is. Exactly what should be paid for second-hand tools, or engines, is wholly based upon conditions—the need of the seller, for example; the wants of the buyer, and the state of trade. Any tool that has been used for any length of time, say a month, is second-hand, no matter whether it is as good as new or not. It has been in use, and the purchaser takes his chance of its being sold for some fault, or for want of use. It may not be capable of doing what it is made for, and this the buyer is not bound to point out. As an honest man he is morally bound to state exactly the mechanical condition of the machine, but he is not bound to know, or asked to surmise, whether it will suit all the buyer's needs or not. The seller sells and the buyer buys, and each one looks out for himself in the transaction.

As regards specific directions for buying second-hand machinery, these would be superfluous in this article. If addressed to the steam-user he would not know what we alluded to if we pointed out faults liable to be found in second-hand engines, for example, and he would not be able to tell whether a defect was superficial and easily repaired, or whether it was irremediable. It is not necessary for us to instruct engineers, for they know, as a rule, what to look for and where to find it. We may remark, however, that engines sometimes seem to be all right and without fault, but a searching investigation reveals many defects—cracked cylinders and cylinder-heads, for instance, or broken bed-plates. As to this latter it is sometimes impossible to discover faults until the engine is set up and at work.

The least satisfactory second-hand appliance one can purchase is an old boiler. Coal-tar varnish covers a multitude of sins, and it is impossible to judge of the condition of a second-hand boiler unless it is a plain cylinder. Persons who are not engineers think that the natural condition of a steam boiler is to be covered with rivets from end to end. Consequently, there may be patch on patch outside, and the average buyer would not know that these were merely put on because the boiler was worn out, and the plates had given way. The unscrupulous seller would convince him that they were put on to strengthen the boiler.

WHY SHAFTS BREAK SUDDENLY.

It is within the experience of all who follow the news of the day that steam vessels are constantly breaking their shafts. The conditions under which these accidents happen are very singular at times, and seem so utterly opposed to probabilities that it is difficult to account for them on reasonable bases.

For example, the Providence, of the Fall River Line, recently broke her shaft just as she arrived off her pier. The shaft had stood the strain of the trip successfully, but gave way when apparently under very slight strain. Whether this was little or much it was sufficient for the breakage of the shaft, and the cause of it is matter for interesting speculation. Upon this point a member of the Institute of English Mechanical Engineers made some interesting remarks recently, which we quote from *Engineering:*

"In one case a pair of beam engines were working on one shaft, the cranks being set at right angles. The collective indicated horse-power was originally 1,400. The load was reduced to 250 indicated horse-power, and only one engine was kept at work. The main shaft gave way after five months' use. The other engine was then put on to do the work, and shortly after broke down in a similar way. The period of oscillation in the fly-wheel was found to be ·41 seconds, or for a double oscillation, ·82 seconds. The speed of the engine was 32 revolutions a minute. On considering the matter, the speaker came to the conclusion that the failure was due to the torsional strain set up by the vibration of the spur fly-wheel about the shaft, considering the latter as a torsion-spring, and the wheel as a pendulum. Just after passing the center, the wheel, by reason of its inertia, lags behind the position it would have occupied had it been without weight, and the shaft is twisted through a certain angle. This angle will go on increasing until the resilience of the shaft overcomes the inertia of the wheel, and causes it to swing forward and overtake the shaft coming to its natural position with respect to it, and then to swing beyond it, twisting the shaft till the resilience of the latter brings it to rest relatively to itself, and finally causes it to retrograde. Hence there will be oscillations in the shaft causing torsion. These oscillations are caused by the resilience of the shaft, and the force producing them is proportional to the angle through which the shaft is twisted. Therefore the motion is analogous to that of a pendulum vibrating through small angles. Consequently, if the period of the engine be equal or nearly equal to the natural period of vibration of the wheel about the shaft, the amplitude of the vibration and the strain upon the shaft may be increased. In the case of the engine above referred to, the time of a half revolution was ·79 second, and that of a complete oscillation of the wheel, ·82 second, therefore the periods were practically the same. When the engines were coupled the period was ·4 second, and, therefore, every other impulse would be antagonistic to its predecessor, and would tend to destroy the vibration.”

“THROW” AND TRAVEL.

The travel of a valve is, obviously, the entire distance it moves in a straight line without reversing its motion. The travel of a crank is the same, so is that of an eccentric. Sometimes the travel of a crank or an eccentric is called the “throw.” Sometimes, also, the arm or web of the crank is called the throw, thereby confusing many and leading to error.

A correspondent of a contemporary who is discussing this question says:

> “It is customary in naval engine work to call the piece connecting crank-pin and shaft the ‘crank throw.’ We ordinarily speak of the length of a crank, meaning the length from center of shaft to center of pin—not twice that, or the length of stroke. Hence it would seem that, as an eccentric is but an exaggerated form of crank, it would be more logical to term the throw the length of the equivalent crank-arm or the half travel.”

In reply it may be said that it is also customary in some places to call the guide-bars slides; everyone knows what is meant by it, but it is manifestly an incorrect term, for it does not express the function of the detail. The slides do not slide, they guide. Palpably, when we speak of the throw of a crank we mean the distance it moves without reversal, whether that distance be twice its length or not. A rocker-arm is a crank, but it does not travel twice its distance from center to center; it is but a few inches. The writer of the quotation above given stultifies his reasoning, for in the last sentence he gives the correct name—crank-arm—in speaking of its “throw.”

GEARING.

A writer in the *Industrial World* makes this comment upon gears. We have noted the same thing in a previous issue, but it is important enough to repeat:

> “I notice one point in many places where gears are used, that persons in charge do not appear to know that the pitch line means the working line, for I invariably find that wheels are not put to work full in gear at first. Upon inquiry in a large works, I was told that they would be ‘set up’ after they had worked for a time. If this is the general practice I don’t wonder that gearing is not in favor, for a few revolutions would so alter the surfaces of the teeth that the rolling line would be destroyed, and the wheels would then transmit more work to the bearings, thereby increasing friction.”

The fact is, that outside of the best shops, a gear is anything with indentations on the surface. Castings are made from patterns that have been kicked about for years; they are warped out of shape and sprung materially. Moreover, when trains are set up at work, it is not unusual with cast gears to find the draft sides opposed to each other, instead of being, as they should be, on the same side.

There is a thick and thin side to every cast gear, owing to the draft on the pattern, and these, it is obvious, must be identical when gears are meshed together.

The writer we quote argues in favor of supplanting belts by gearing, but he omits to mention the liability of great damage by the breaking of gears. One broken gear may stop a whole works, but no broken belt can do that for any length of time.

One of the large gear-wheels in the Eagle mill, Minneapolis, broke down recently, with the result mentioned above. Between the average gearing and average belting, we believe the advantage would lie with the latter.

DIAMETERS OF SCREW-PROPELLERS.

Of all other elements, the efficiency of screw-propellers seems to be but little affected by relative diameters. That is to say: if a ship has a screw ten feet in diameter, cutting off two feet of it seems to have no injurious result as regards its action. In some cases it has been a positive benefit. A screw steamer was built in England last year to run in shoal water, and its propellers were only 12 (twelve) inches in diameter. The vessel itself was about 100 feet long, but these toy propellers, as they may be called, drove that boat at twelve miles per hour. The screws of torpedo boats are very small in diameter, only 36 inches in some cases, but the boats, as is well known, are the fastest things that float on water.

Navigation on the Great Lakes is attended with difficulties, for some of the lakes are shallow, and vessels which trade in and out of local ports have no more water than they need. In some cases their wheels are one-third the diameter out of water. The efficiency of such a wheel is less than one equal to the portion wholly immersed, for it is not in a position to utilize the power expended on it. It would seem that reducing the diameter so that the wheel would be wholly under water should give greater efficiency in all respects.

AS TO CREDITS.

Inexperienced editors are prone to the error that crediting matter to contemporaries lessens their own status in some mysterious way. Accordingly, they appropriate whatever matter suits them without mentioning the source. There is no moral difference between practices of this kind and those where the offender is lodged in jail when convicted of such offenses, except that appropriating printed matter without credit is a little the meanest, because there is no legal penalty attached to it.

A great improvement is manifest in this matter as compared with a quarter of a century ago. Then all and sundry, without compunction, took what best pleased them; but offenses of this kind are now confined to those who have no moral consciousness, and very little sense. As a matter of course the reader looks at once to see who is the author of a lofty sentiment, a clever paragraph, or a scientific paper. Not finding any signature attached, he is wroth at the editor for concealing the source of his information, and thinks less of him for it. It is a mistake to suppose the average reader is not astute enough to know that technical articles are not written by laymen, or that the wise, witty, or pathetic extract he finds in the *Bungtown Banner* would not be claimed by that sheet if it had paid for it. The average reader knows all this full well.

A VERY PECULIAR ARRANGEMENT.

By methods best known to themselves, local politicians succeeded in having a law passed at the last Legislature whereby engineers of this city and county are taxed two dollars per head for licenses, and the revenue therefrom is applied to the fund for the relief of the widows and orphans of policemen. We fail to see any justice in this. That a license law should be put in force is a matter of congratulation, as regards public safety, where it is honestly carried out, but is this always the case? From time to time we receive reports from our friends that it is not. We have been told that licenses are to be had by paying the price, and that so far as any examination is concerned, to test the fitness of the candidate for the position, the proceedings are farcical.

Moreover, by this new license arrangement engineers are graded according to the work they are in charge of, not by their fitness or attainments. This clause is a practical confession that the examination is superficial, for the position a man holds at the time he is examined has nothing to do with his capacity. The chief engineer of the navy, through the chances of life, may be reduced to the lowest job in the trade, but that would not make him a third or fourth-rate engineer. This new license law rates first-class engineers by the grade of work they happen to be in charge of. The result will be that good men will go elsewhere rather than be degraded by the whims and ignorance of politicians.

The engineers of the city of New York held a meeting a few days ago to protest against the law and its action. We endeavored to obtain minutes of the proceedings, and wrote to one member to get an authentic account, but received no answer to our request.

If any one who knows the facts of the working of this new law will advise us of them, we shall be glad to publish the details.

CORRUGATED FURNACES.

Apropos of the corrugated Scotch-boiler furnaces which are now on sale and, to some extent, in use in this country, does anybody remember the particulars of a corrugated crown-sheet and section of a circular furnace which was kept on exhibition for some years—say about the time of the first cable celebration—on the east side of Broadway, New York, above Bowling Green? The query is whether that was not the same, or very nearly the same, thing as that which is being pushed now.

I do not doubt that the corrugated furnace is a very strong and good one, so far as wear is concerned, but when the sellers lay claim to increased efficiency, because of increased surface exposed, my mind reverts to Ure’s Dictionary, a book which I have had upon my shelves at least thirty-two years.

Dr. Ure says, in effect:

> “If a pan having a corrugated bottom be set in a hot liquid bath, the internal evaporation will be in proportion to the corrugated surface as compared with a pan with a smooth bottom; but if the pan with the corrugated bottom be set over a fire, or in a flue, so that the flame may sweep along the corrugations, it will evaporate no more water than a smooth pan, of like shape and dimensions, placed alongside in the same flue or over the same fire. This curious fact I have verified upon models, with many variations.”—[Page 451,Ed. MDCCCLI.]

Now, if Dr. Ure was right, what becomes of the claim for increased efficiency by reason of increased surface arising from the corrugations?

For all that, the corrugations may be of vast benefit to the furnace, not in the way of absorbing more heat, but in the way of ameliorating the intensity of the heat radiated from the fire and striking the plates, and thus keeping the duty within the absorbing and transmitting capacity of the plate. The boy’s old question, whether more spears of grain will grow upon an acre of side-hill than upon a level acre, would seem to apply here. At any rate, I suppose many more corrugated furnaces will be used when they can be had at more reasonable prices. Endoxus, Jr.

[Bro. Endoxus’s question as to corrugated furnaces of old time must refer to “Dick Montgomery’s” device which he made at the Morgan Iron Works about the time named in the communication above. “Dick” was very enthusiastic over his discovery, and tried very hard to get it into practical use. It was tried, but with no very satisfactory, or noticeable results. One reason was that—as constructed—it was not so good as a straight sheet, for “Dick” had no way of making his tubes seamless. His seam was straight, like any other, and, as a result, bore the whole stress, for the corrugations expanded under heat and pressure and let the straight seam hold it all. There was, as one might say, a long side and a short side on the corrugated flue; long where the corrugations were, and short where the seam did not expand so much as they did.—Eds.]

AN AMERICAN CORRUGATED BOILER-FURNACE.

In our next issue we shall publish an engraving of a “Scotch” boiler with corrugated furnace, which is constructed on a novel plan. It is the boiler of the steamer *Winone*, running on the Kennebec River. This boiler is built of steel and carries 100 lbs. per square inch. Aside from the furnace there are many other peculiarities not found in “Scotch” boilers of this class, and we think the drawings will be found of great value to our marine friends.

We omitted to notice in due course the enterprise of our friends of the *Iron Trade Review*, of Cleveland, in their issue of April 19th. In that they “blossom as the rose,” with a new illuminated cover and several columns of new advertisements. Messrs. Day & Carter, the new proprietors of the paper, are making great improvements in it.

THE PROFESSOR IN THE MACHINE SHOP.

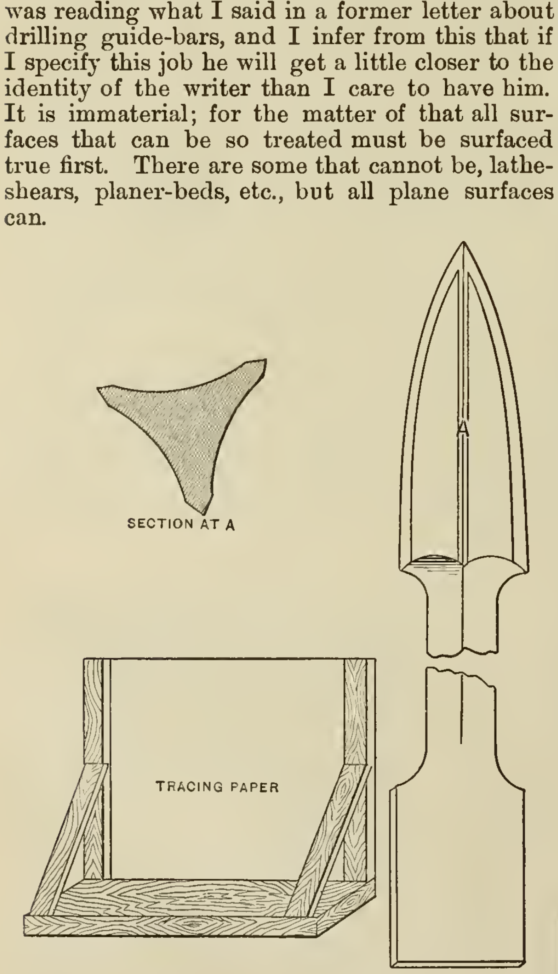
NUMBER LVII.

I was in a machine shop last week, and there I saw a little man sitting on a little stool "chugging" away at a planed surface with an old file fashioned into a scraper. He made me think of something mysterious and "uncanny," for while he looked to be busy and intent upon his job, I could not see that he was doing much that was of advantage to it. He was putting in time, sure enough; no mistake about that, but as for the boss's dividend on it I wouldn't have given ten cents a week. This little man kept "dibbing" away with his little scraper, first here, then there, until it made me fidgety to look at him, and I wished that he was doing that sort of work in our shop, so that Jake Hess would have a chance to tell him what he thought of it.

Withal, our little man was so dreadfully impressed with a sense of his great importance, his personal elevation to so particular a piece of work, that the very back of his head looked conceited and arrogant. As who should say: "I am the most experienced man in the shop. I do this work because no one else is fit to be trusted with it. I have been selected out of fifty others to scrape this face flat, because in me is combined all the knowledge which exists on this subject." And there he sat, confessing in every motion, in the state of his work, and the way he handled his tool, that he did not know the first principles of it.

For example: he was scraping flat surfaces, and endeavoring to true one by the other, when neither had been faced by a surface-plate. It is not necessary to tell a good scraper that this would not answer, but as there are plenty of good workmen who never have scraped a surface, it may not be amiss to say that no truth can result from scraping two plates just as they come from the planer. One or the other must be faced by a surface-plate first, so that there will be truth to start from. It is easy to see why this must be, when we reflect that plates may bear all over and be true in some positions when they are not true if changed about. They wind, perhaps, or are curves of great radius; in short, they are not flat as they come from the planer.

I do not wish to specify more particularly what the job was, for I saw in the office of the works a copy of this paper, and a man reading it. I got behind him casually and saw that he was reading what I said in a former letter about drilling guide-bars, and I infer from this that if I specify this job he will get a little closer to the identity of the writer than I care to have him. It is immaterial; for the matter of that all surfaces that can be so treated must be surfaced true first. There are some that cannot be, lathe-shears, planer-beds, etc., but all plane surfaces can.



Leaving the case above mentioned to its own merits, I will say that in my own experience I have never found a tool for scraping to equal that here shown. I am also bound to add that I have been able to convince only a few persons of its superior utility. I have tried to point out to many that it is better for finishing than a flat scraper, for many reasons. One, to begin with, is that the spot to be scraped is not covered up by the scraper, which is the case where a flat tool is used. Notice a man using a flat scraper: he always carries his head cocked on one side, so as to see under his tool where he is scraping. This, of itself, gives a crick in the neck very soon, and is wearing on the back-bone.

With the three-cornered scraper a man can see exactly where he is cutting, and how much, from first to last. With a flat scraper a man covers too much ground, and when he comes to finishing the surface he cannot lay it flat because it would rub out bearing marks before it cut them out, so he just humors the tool a little and cocks it on one side, with no good result either. Now, if he had a three-cornered tool like the one shown here, he could take the top of a pin's head off if he chose, without disturbing the surface around it. Moreover, this three-cornered scraper has one more cutting edge than the flat one and does not require grinding so often, though this latter is a small item, and is, perhaps, not worth mentioning.

Of course, the reader will not understand me to say that a flat scraper is not useful. I may have given that impression in speaking of the three-cornered scraper. A reference to the engraving shows that I give it place, for one end of the scraper is flat. I would use this end for heavy work where I could not file, but when I came to patches of bearing that were less than half an inch apart, I would use the three-cornered end.

Now, as to another thing, and not a small one either—distinguishing between actual bearing marks of iron on iron, and cross-lights thrown up by scraping marks at various angles. Inability to do this prevents many from getting a surface to nature quickly. In natural light (direct rays) it is not always easy to distinguish bearing marks from scraping, and a man often moves his head from side to side to catch the metallic sheen which determines the bearing marks positively.

Direct light is bad to scrape in—according to my experience—and I would always use a screen like the one shown in the engraving. It is, as may be seen, simply a piece of tracing paper (not cloth) stretched on a frame. The yellowish light sifting through this on the work throws the bearing marks up dead black, and a man never has to look twice to see where they are.

I think any one who is unprejudiced, will find these devices I have mentioned an improvement on methods in general use. The best way to find this out is to try them. I found it out from an old Scotchman. "Eh, mon!" he said to me some thirty odd years ago, when I was plugging away with a twelve-inch bastard file—ground square on the end for a scraper—"ye don't know much. Ye wouldn't be let use sic a thing as that in the old country. Go away you to the tule dresser, and bid him make ye a thing like this, (he chalked out the scraper I have shown before) and ye'll finish that job afore the chaps beyond have one side grubbed aff."

And he spoke the truth.

CYLINDER DIAMETERS OF MARINE COMPOUND ENGINES.

THE LOW-PRESSURE CYLINDER.

The size of the low-pressure cylinder depends upon one thing only, *i. e.*, the total number of expansions desired.

The following table gives the cylinder ratio for any number of total expansions from 12 to 5:

Total number of expansions of steam.	Number of expansions in high-pressure cylinder.	Cylinder ratio.
12	2·72	4·41
11	2·72	4·04
10	2·72	3·67
9	2·72	3·31
8	2·72	2·94
7	2·72	2·57
6	2·72	2·20
5	2·72	1·84

The method of procedure, then, to obtain the size of the cylinders of a compound engine, according to this plan, is as follows:

Find the weight of steam evaporated per unit of time at the maximum boiler pressure. Allow for the fall of pressure between boilers and cylinder, and also for difference between amount furnished by boilers, as per coal consumption, etc., and amount accounted for in the cylinder (*vide* Isherwood's "Experimental Researches in Steam Engineering").

We then have the initial weight, pressure, and, consequently, volume of steam used per stroke in the cylinder. The volume of the cylinder is, therefore, 2·72 times as great. The stroke of the piston being governed by considerations of space, etc., and fixed, the area of the high-pressure piston is at once obtained. The above volume includes the clearance space of ten per centum of the stroke displacement.

Knowing the total number of expansions required, the size of the low-pressure cylinder is obtained from the table here given by finding the cylinder ratio in the third column.

This method is applicable only to engines fitted with an intermediate receiver, in which the pressure can be kept practically constant and equal to the terminal pressure in the high-pressure cylinder. Also, when the ratio of expansion is 2·72 in the high-pressure cylinder, the low-pressure cylinder follows full stroke.

Example.—Find the diameters of cylinders for the *Galena* from the following data: Two compound cylinders; crank at 90°; stroke, 3·5 feet; revolutions per minute, 65; initial absolute pressure of steam in boilers, 95 lbs., and 88 lbs. at cylinder; ratio of expansion, 5·32 [see "Summary"]; it is required to develop 1150 I. H. P., using 20 lbs. of steam per I. H. P. per hour.

Solution.

$$\text{Pounds of steam used per minute} = \frac{20 \times 1150}{60} = 383{\cdot}33.$$

$$\text{Pounds of steam used per stroke} = \frac{383{\cdot}33}{130} = 2{\cdot}95.$$

Volume of one pound of saturated steam of 88 lbs. absolute pressure = 4·9336 cu. feet.

$$\text{Area of high-pressure cylinder} = \frac{2{\cdot}95 \times 4{\cdot}9336 \times 144}{0{\cdot}4044 \times 3{\cdot}5} = 1481{\cdot}2 \text{ sq. ins.}$$

Diameter of high-pressure cylinder = $43\frac{7}{16}$ inches.

$$\text{Ratio of cylinders} = \frac{5{\cdot}32}{2{\cdot}72} = 1.96$$

Area of low-pressure piston = 1·96×1481·2 = 2903·15 sq. inches.

Diameter of low-pressure cylinder = $60\frac{13}{16}$ inches.

Jay M. Whitham, Ass. Eng'r U. S. N.,
Proceedings U. S. Naval Inst.

FOOD VALUES.

Persons who fancy that in order to do a great deal of work it is necessary to eat a great deal of food, have only to look at the pedestrians in walking-matches. The actual foot-pounds of work done in lifting the body and carrying it 600 miles, or 500 miles, in six days far exceeds any labor expended in the same time by craftsmen. It is the most arduous, fatiguing, and irritating task conceivable, and it is all done upon the least possible allowance of food which the trainers deem essential. Food values show their utter insignificance here, for there is no recognized diet for a pedestrian. His individual likes and dislikes are, to some extent, consulted—if our information is correct—but as to "hygienic" methods, or nutritious values, so called, the trainers ignore them.

The facts are, that the human stomach is a capricious and peculiar organ. What one converts into bone, muscle, and tissue, another rebels against, and no tabular statement can be made which represents the value of certain food to the individual.

BOOK NOTICE.

Work-Shop Recipes for Manufacturers, and Scientific Amateurs, by C. G. Warnford Lock, New York: E. & F. N. Spon.

This is a collection of useful recipes and information upon various operations and processes, alphabetically arranged. This work now current is the third series, and the first article treats of alloys. Under this head nearly every conceivable metallic combination known to the arts is described at length, the whole forming valuable reference to those whose interests lie in this direction. Various mixes for brass are given, as well as minute instructions in moulding, etc. Following this are 140 pages on Electricity, and modern applications of it to the arts. In itself this is a most valuable portion of the work and quite worth the price of it. Great space is given to lubricants, and the same careful compilation and crediting of authorities characterizes the treatment of it. We consider this book of great value to our readers, for it enables them to cover in one volume well-digested information upon topics of every day application. The price is $2, and it would be difficult to lay out that sum to better advantage. It can be had of the publishers direct, or will be mailedby us on receipt of the price, $2.

DETACHABLE TOOL POINTS.

BY J. RICHARDS.

Among the many improvements in metal cutting that have been attempted during twenty years past, detachable tool points have a prominent place. The "principle," so to call it, of these devices is applied to a greater or less extent throughout all machines for working metal, wood, stone, and other materials, and its success, to view the matter generally, varies with the stress to be endured by the edges or acting surfaces.

In wood cutting, for example, when the strain is not great, nearly all implements operate with detachable tools, perhaps all do that are propelled by power—augers, knives, chisels and saws, and so forth. The strains are so light, even in the case of what may be called percussive machines, reciprocating mortising machines for example, that detachable tools can be employed, and do not even require an "abutment" at a right angle to the force. Tapered shanks inserted in cylindrical sockets answer for mortising machines, and these have the most severe duty among wood-cutting tools. In working stone, also, detachable tool points are in most cases essential, because of the rapid wear of the acting edges or surfaces.

Apart from the difficulty of holding such points under heavy stress, another condition that has had much to do with their use, is the amount of work and consequent cost of preparing the tool points. The less the cost of preparation, the greater the saving and success.

Taking the crushing of quartz stone for example; in the common stamp mill the dies or wearing parts are ready for use when cast at a foundry, requiring no fitting, and representing no more than the value of the metal and of casting it. In nearly all cases wherever the dies, or other acting surfaces, detachable points they may be called, have required fitting or other preparation that much increased their value, the method has failed. This rule will be found to apply throughout stone-working machinery, especially that for crushing. Cast-iron, worth from 9s. to 12s. a hundredweight, has succeeded, while tempered steel, ground or shaped to particular forms, has failed to fill the required conditions. The matter, as before intimated, seems to depend upon the two conditions of stress and cost of removal, or, as we might say, strain and wear. In metal working the same rule will apply in the case of cleaving tools, or those acting on the principle of a wedge.

There can be no doubt of the superiority of solid tools in so far as their strength and more convenient dimensions are concerned. No "built-up" tool can have the same strength within certain dimensions that a solid one can, but the expense of maintenance is such that solid tools are out of the question in many cases. In planing and turning there is great difficulty in fastening detached points so as to resist the severe strains that have to be endured, and still permit easy removal. There has also been an equal difficulty in avoiding the increased dimensions that detachable points render unavoidable. Still, upon the whole, there has been a constant gain, and much promise of greater success in future.

The principal success in the employment of detachable tool points for metal cutting has been in England, owing in some measure, no doubt, to the method of holding tool-bars in lathes, planing, and other machines. In America it is common even in the largest machines to pass the tool through a mortise in a "tool-post," the depth of the tool being from two to two and a half times the thickness. When the strain falls on the deep section, and when tools are made from solid bars, there is much in favor of the mortised tool post, especially for small machines, but for the larger class of machines it is in every way inferior to the broad clamp, the square tool-bar, and detachable points.

Among the more obvious conditions relating to such tool points may be named: 1. The tool points being made as small as possible, it is desirable that the cutting force should fall lengthwise and not transverse to the tool points; in other words, that the tools work "endwise," their lower angle forming one side of the piece, as in Fig. 84. 2. When so mounted the tools cannot be held by friction alone, or by clamps that grip the parallel sides of the tool, some kind of positive "abutment" being required behind the tool to resist thrust. 3. That both a solid abutment and clamping are required to give rigidity necessary in heavy cutting. 4. That the cutting strain upon the tool should tend to fasten it more firmly in the stock or supporting bar.

For operating on flat surfaces, as in planing and shaping machines, with a clearance angle of 3 deg. to 4 deg., the supporting stocks are necessarily weak at *a*, Fig. 85. This is unavoidable when the grinding face is on the top angle, and demands that the stocks be of the strongest material. The same thing applies in respect to the sides at *e e*, Fig. 86. For turning, the support beyond the tool at *a*, Fig. 87, can be stronger, but the width is as objectionable as in planing, and the best way is to make the stocks of the strongest forged steel. Their first cost will be more, but in their case material should be reduced to its smallest dimensions.

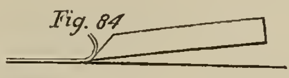


Fig. 84

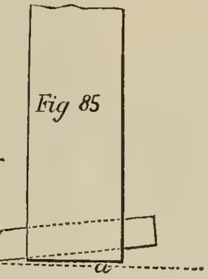


Fig 85

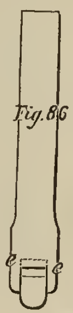


Fig. 86

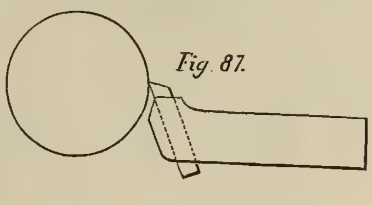


Fig. 87.

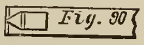


Fig. 90

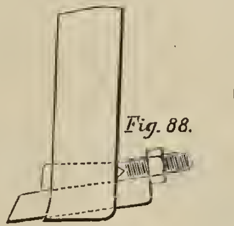


Fig. 88.

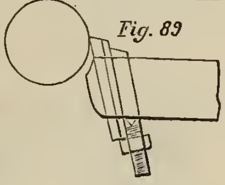


Fig. 89

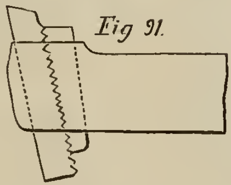


Fig 91.

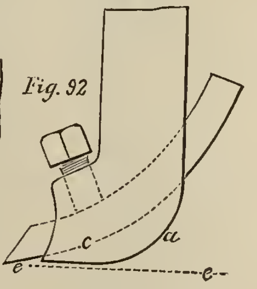


Fig. 92

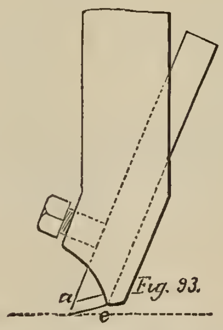


Fig. 93.

Figs. 88 and 89 are drawings of some tools recently designed by the writer for using points of Mushet steel, $\frac{1}{2}$ in. by $\frac{3}{4}$ in., and intended mainly for roughing cuts. The method of fastening shown is perhaps the best one ever invented, and aside from a somewhat clumsy appearance, fills all the required conditions. The tool points need no preparation except cutting from a bar. When inserted they are stopped at the required position; they have an end abutment against the nut at *a*, and are fastened more firmly by the cutting thrust, and can be instantly removed or replaced.

It may also be noticed that points of almost any section can be employed. For cutting screw threads, as shown in Fig. 89, these tools give excellent results. It will not be necessary to refer to the many inventions relating to tool points. Such inventions seem to grow up periodically, especially in America, but without claims that have brought them into use. The serrated cutter and wedge, as shown in Fig. 91, or in other form substantially the same, is most frequent; but such points require too much preparation and are not likely to come into use.*

Taking into account the various conditions in respect to resisting thrust, clearance, the strength of the stocks, and so on, there seems much in favor of bending the tool points to a curved form, as shown in Fig. 92. This would permit a stronger section for the stock at *a*, and the cutting thrust on the line *e e* would fall at an angle of about 10 deg. against the tool seat at *c*, so that the friction caused by the set screw *n* would prevent the tool from slipping under ordinary strains. This arrangement, which is no more than a suggestion, provides, as all the previous cases, for grinding the tool points on their front or cutting side, and the profile of shape extends the whole length on the bottom side.

If, however, the profile is ground on the tool, and there is often an advantage in this, then a stock, as shown in Fig. 93, can be employed, and this after all may become a common arrangement for detachable points.

The change from solid forged tools to those with detachable points will be favored by the present custom of grinding shapes as required, and as workmen may deem most suitable for their purposes.

The adoption of arbitrary shapes for tool points would of course lead to a regular system, and dispense with skill in sharpening tools, but the innovation would at this time be met with considerable opposition from workmen, a circumstance that, whether reasonable or not, must be taken into account. In mounting points as in Fig. 93, the angle at *a* would become the constant one, instead of *c* as in the previous cases, but as both these angles could be modified by grinding, to suit the kind of work being done, and as the tool points would be plain pieces without other preparation, a workman could be supplied with a large number shaped to suit various requirements. The matter seems to resolve itself into the proposition, that to hold detachable points the strain must be transverse to the tool in such a degree as will prevent it from slipping when fastened by some simple clamp. Also, that a fixed angle at the bottom or cutting face does not have enough strength in the stocks between the tool and the piece being planed. The subject offers a field for improvements, and these will no doubt come as attention is directed to the matter.—*Engineering.*

◆

BEARINGS. STEAM JACKETS.

An English engineer says that no single pair of brasses forming a bearing should be subjected to wear on two or more axes at right angles to one another, and all bearings should be adjustable in the direction in which they wear.

The main bearing of a horizontal engine necessarily has to withstand the alternate thrust and pull of the connecting rod horizontally, and at the same time the load of the fly-wheel and crank-shaft vertically, and possibly the resistance of some driving-gear in another direction. This bearing ought, therefore, to be made in four or in three pieces, as is usual in good portable engine practice; but in large engines, for the sake of simplicity, it is frequently made with two brasses, inclined at an angle of 45 deg., which cannot possibly be kept in perfect adjustment.

The cylinder capacity ratios of compound engines were usually from $3\frac{1}{2}$ to 4 to 1; but if steam jackets were not adopted, it was useless to make the low pressure more than three times the size of the high pressure cylinder, as, if larger, the diagrams would be very attenuated, and almost valueless, in consequence of the lodgment of water, especially at the upper end. Details of some experiments show the slow rate at which an unjacketed, low pressure cylinder is warmed. At one hour and a half after starting, water was present in it during steam admission at a temperature of only 150 deg.; at three hours it was 175 deg.; and only after about five hours did it reach 192 deg.

◆

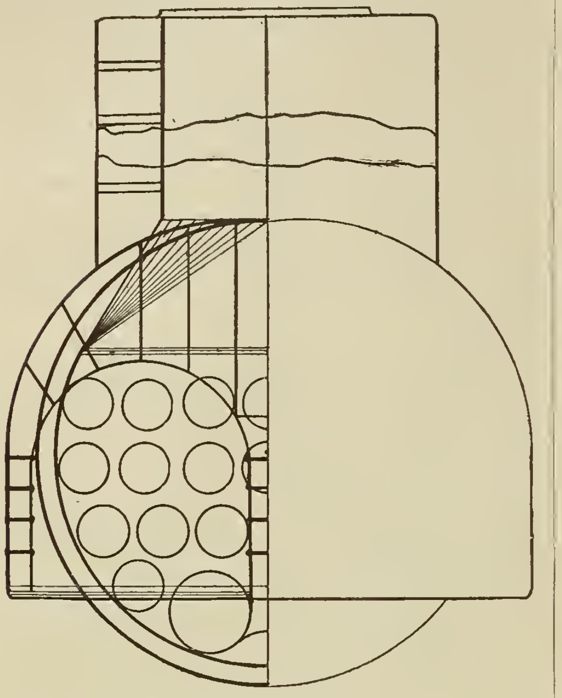
Apropos of the boiler series: a friend at the head of a large boiler works writes us that they are in great favor in his shop; the men have learned more from them than they could from many books on the subject. We hear from various sources of their popularity, and hope those not interested will not begrudge the small space occupied by them.

[* The writer argues against facts and should be better informed. This style of tool is more widely used than any other.—Editors Mechanical Engineer.]

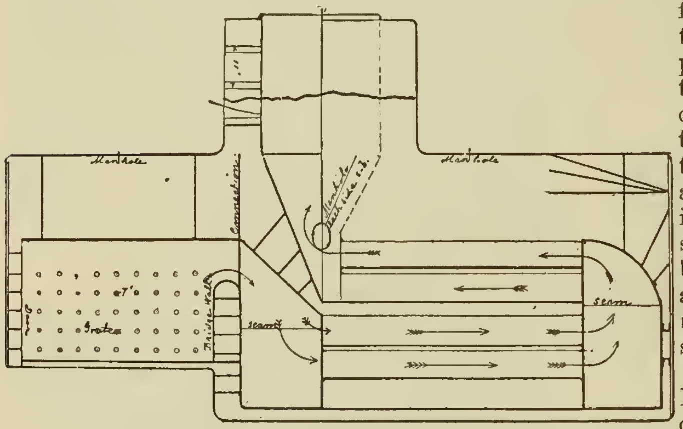
TYPES OF AMERICAN STEAM BOILERS.

NUMBER X.

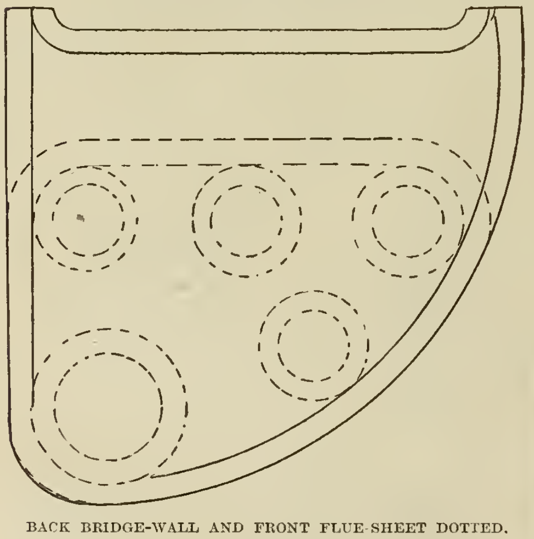
Our diagrams represent a peculiar boiler for low-pressure service. It is of the return flue type and has large combustion chamber behind the bridge-wall. The bottom of this chamber is thirteen inches below the fire-box. The back smoke-box is arched, and the fire-box crowns are semi-circular. The top of bridge-wall is 18″ from the crown-sheet of furnace. In each combustion chamber there are three ten-inch flues and one sixteen-inch flue.



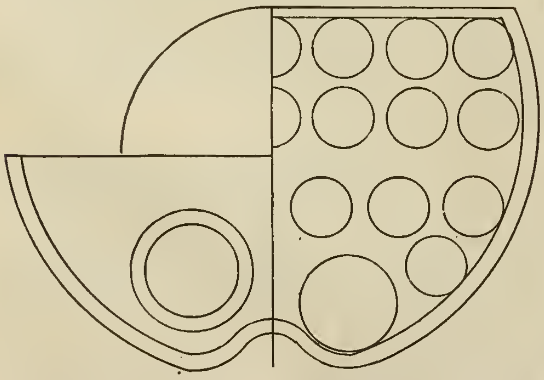
FRONT ELEVATION.



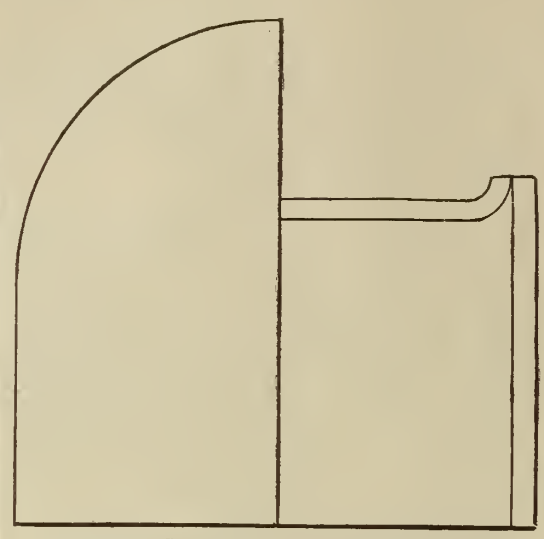
SIDE ELEVATION IN SECTION.



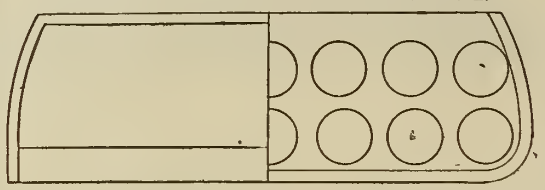
BACK BRIDGE-WALL AND FRONT FLUE-SHEET DOTTED.



HALF BACK SMOKE-BOX HEAD AND HALF OF BACK FLUE-SHEET.



FRONT FIRE-BOX HEAD AND FRONT BRIDGE-WALL.



FRONT HEAD OF FRONT SMOKE-BOX AND FRONT FLUE-SHEET.

We have omitted the sizes of plates and number of them, as not essential to the comprehension of the plan of boiler; unless parties wished to build one exactly similar, the plate-sizes would be of no use.

◆

AN EXTRAORDINARY LOCOMOTIVE BOILER EXPLOSION.

What appears to be an extraordinary boiler explosion is thus reported in the Sedalia, Mo., *Bazoo.* We quote: "After we went on the side track, the fireman opened the furnace door and at the time the steam gauge showed 125 pounds of steam. I left the fireman on the engine and went to the telegraph office for orders. I got no orders. I then went back to the engine. While there I heard an unusual noise which attracted my attention to the gauge and it showed 135 pounds. I noticed the steam coming out of the seams of the boiler-head in the cab. I then said after it had cracked twice, to the fireman: 'Come, let us get off—it is not safe—she's going up.'

We both gathered our clothing and left. I went directly to the telegraph office to report the unsafe condition of the machine, and while I was there the explosion took place.

The flues, bent in all conceivable shapes, were showered over the country. A piece of iron weighing ten or fifteen pounds was driven about one mile and deposited in the public highway. The smoke-stack parted company with the locomotive—part going about 150 yards while the other part went one-quarter of a mile. The concussion killed four canary birds in a cage hung on a portico, which fronted toward the explosion. A piece of boiler-iron weighing, it is estimated, about one and a half tons, was deposited in a corn-field at least four hundred yards north. The explosion sent a flue, about twelve feet long, and weighing probably fifty pounds, on the roof of the church, making a good-sized hole. The pieces of the wrecked engine—those that could be found—were brought to this city on three flat cars. Nothing remains of the engine that can be used, with the exception of the driving-wheels. One driving-wheel axle was broken in two, and another was bent until the wheels stood at an angle of forty-five degrees. The boiler was straightened out and the flue-head did not contain but two or three flues, and these were twisted and turned until they resembled grape-vines.

It seems to us extraordinary—that a boiler properly cared for and in good condition should give warning some minutes before exploding.

◆

A CURIOUS NEW SAW for cutting stone is described in a French contemporary, the *Constructors' Weekly.* It consists of three small square steel wires, twisted like twine, and running over pulleys like a band-saw. The lower side of the band is brought to bear on the stone, and water only is used in connection with the saw.

THE FOSSIL FOREMAN.

Prejudice is not unfrequently fostered by men who have spent many years in one firm. They have moved in contracted areas and viewed the creations of their brains until the importance of them has become so magnified that no outside opinions can receive attention. The prejudiced man fortifies himself with quickly formed opinions, strings together a few stale phrases, and adopts a stereotyped method of working in keeping with his narrow-mindedness. These relics form his stock in trade, and every proposal advanced by others, no matter how practical and worthy of recognition, if out of accord with his antiquated notions, and foreign to his little stock of information, it cannot be entertained. In fact, everything out of harmony with, and antagonistic to, his preconceived notions, must be rejected.

When the work and methods of manipulation are cut and dried by the manager, or chief draughtsman, the prejudiced foreman has no alternative but to obey, and bury his inconsistencies. In such cases the foreman's influence is extremely limited, and his old-fashioned ideas can do little or no harm. But when a foreman who is influenced by prejudice happens to rule supreme, what a stumbling-block he becomes! The longer he reigns the greater will be the difficulty of causing him to move with the times, and throw his inconsistencies to the wind. In choosing a foreman to work harmoniously with others, it is wiser to have one whose mind is unbiased and who will implicitly follow the directions of his superiors, rather than one who has his head crammed with pet notions and unreasonable opinions, which cause him to view all new methods of working with distrust, to the detriment of real progress.—*The Mechanical World.*

◆

SENSIBLE OBSERVATION BY THE *American Machinist.*—"A man has devoted three years of his life, working ten hours a day, to the production of a toy locomotive, with cylinders $\frac{5}{16}$ths″ × $\frac{1}{8}$th inch, with every other part small in proportion. We cannot regard the feat of this mechanic as anything otherwise than wasted industry. The work produced is not so small as numerous daily operations in watchmaking, so it can have no value as a specimen of minute workmanship, and we do not see that anything about the construction of the engine adds a grain to the volume of human knowledge. The feat of making this engine is about equal to that of the maiden lady who devotes the labor of five years to the sewing of a patch-quilt, containing an amazing number of combined fragments. The tendency to produce work of this kind does not emanate from healthy conditions, and we do not desire to see its influence extending into the machinist ranks."

Counting his time worth that of machinists in general, say $2.50 per day, this trifle has cost about $2,250, exclusive of material; the man will be lucky if he gets $150 for it.—EDS. M. E.

◆

SUPPOSE A BILL were introduced to shorten the term of all railroad company charters to five years—a melodious outcry there would be, wouldn't there? But rob the inventor of a patent car-wheel of twelve years profit on his invention, and you find only six men in the House of Representatives to see the iniquity of the proceeding—six out of one hundred and twenty voting. Truly, the age of pure reason has not dawned yet; and there is not so vast a distance between prehistoric man and the dude as the dude's shirt collar would imply.—*Puck.*

◆

AS SHOWING what is possible in the way of steam engine building, where a uniform size is produced and systematic shop practice prevails, we append a record for the past six months, as obtained from an officer of the company: Taking the first week of April, the output was 33 completed engines—in other words, 5½ engines per working day, or one engine every two hours. At this rate the April record will run up to 130 engines. Of course this could not be done in a shop where different sizes are made; nevertheless it is a most excellent record and cannot be surpassed, we think, by any works of like size in the country. The engines in question are all 9×12, 12 H. P., and are designed for oil rigs. Since the beginning of October of last year, the demand for engines has been very brisk in the oil regions.—*Iron Trade Review.*

OPTICAL ILLUSIONS.

BY EGBERT P. WATSON, JR.

The sphinx is simply an illustration of a very old saying, viz.: Things are seldom what they seem. It is an optical illusion. You see and yet you don't see. You think you see the drapery under the legs of the table, but you do not.

"But can we not believe the evidence of our eyes?"

"No, for your eyes deceive."

"But we see the drapery under the table."

"Pardon me, you do not, and if you will wait patiently for a few moments I will explain to you why and how you do not.

The whole stage is draped, sides and back, in a sombre manner to be in keeping with the solemn nature of the illusion, and the trick lies in this and in the table itself.

This is made with a square frame and a round top, and in the center of that top a hole is cut, which is fitted with a trap so arranged as to admit of the head being passed up. The head used is not a mere wax or plaster affair, but real flesh and blood with the body concealed, and in this concealment of the body lies the secret of the trick. The accompanying illustration will give a better idea of this than words can.

In it is a table with only three legs visible. Under this sits the person who represents the sphinx, his head coming up through the trap. In the drawing the body is seen, but when exhibiting—and now we come to the mystery of the sphinx—the spaces between the three visible legs of the table are fitted with mirrors. These being in their places, the table is put exactly in the center of the stage, the leg marked 2 facing the audience. The sides and back of the stage are hung with curtains and the mirrors, being at angles with the sides, reflect the curtains with which those sides are draped. The audience seeing the reflection of the side curtains, imagine that they are looking directly under the table at the back curtains, never for a moment dreaming that they are peering into a looking-glass. Now you see that you didn't see. The performer, when addressing the audience, must be always careful to keep out of the angles of the glass, as otherwise he too would be reflected. This would be liable to betray him.

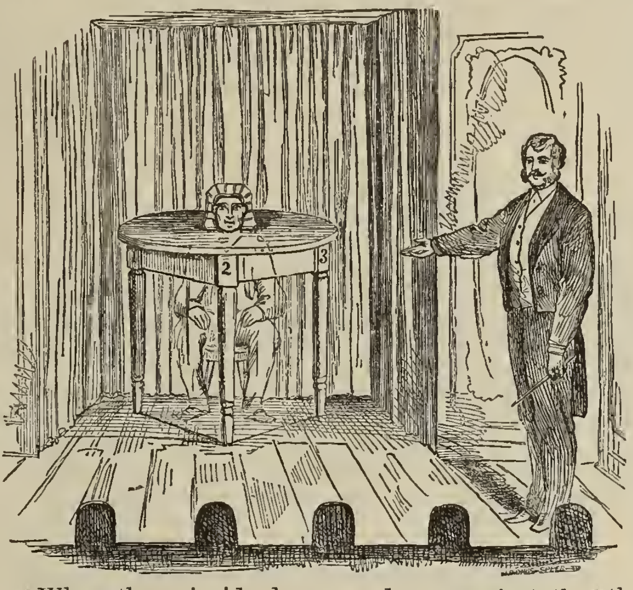
He generally stands at the wing, and always before approaching the table, walks to the footlights, addressing the audience as a pretext for doing so, until he is in direct line with leg No. 2, when he marches straight to the table. The box which is placed on the table, is simply for the sake of effect, and the fumbling in the pocket for the key with which to unlock it is to give the person who represents the sphinx time to put his head up through the trap.

The next illusion was an after-thought—that is, it is another deception somewhat similar, but which, if presented to the same audience during the same evening as the sphinx, they would not be able to recognize it as being performed in somewhat the same manner. I give this one here, as some of the older heads may find it useful in an evening's entertainment. This illusion calls for a cabinet very much like the ones used by spiritualists. It stands on short, light legs, to keep it from the ground. People from the audience may come up and examine it thoroughly, and if they choose may remain on the stage during the performance. The doors of the cabinet stand open. Two performers step inside, and the doors are closed upon them. They are hardly closed before they are opened by an assistant who stands outside. A moment before two persons stood inside, but now they have both vanished; into thin air apparently, as the cabinet stands empty. They must have dissolved into air, for they can go nowhere else; they will disappear just as thoroughly even if a person from the audience stands on each side of the cabinet. One looks under (and he can see under), and another watches the top to see that they do not fly out. With six people watching thus, the performers disappear in less than five seconds. The doors are open—the men are gone. The doors are closed, the six men watch, and in three seconds the doors open again—the two performers are there! They pop out and allow the cabinet to be examined again. "Where they did go to is a mystery," I hear some one say. They didn't go anywhere. I see from your sarcastic smile that you think I am a little touched with *dementia*, so I hasten to explain. To aid in the explanation I will again call upon the wood engraver for an illustration.

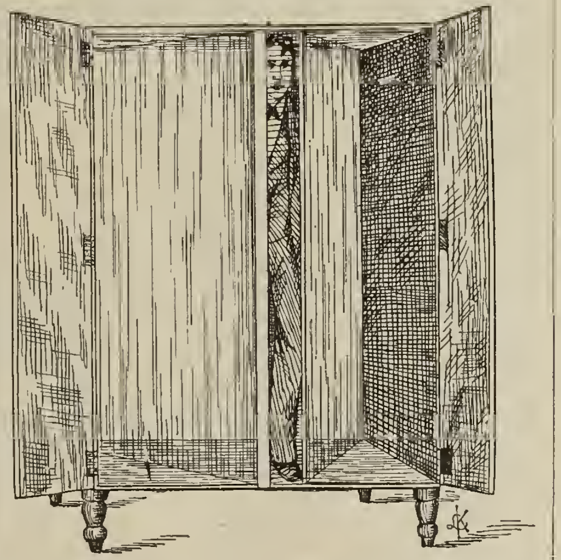
"Do you notice two dotted lines on the floor of it? They have something to do with the reason why the men stayed in the cabinet."

"Still we cannot see."

"Neither could the men in the cabinet; but they could feel, and that was all that was necessary." This cabinet is about eight feet high and four and a half wide, and is made with two doors which meet at the central post. The two sides are double, that is, inside of the cabinet, being another pair of doors hinged at the back, and when they open (or close, as they meet) they come together at the central post also. It is needless to say that these doors are kept closed on the side until the outside doors are shut.



When these inside doors are drawn against the central post they reflect the two sides, because that side of the auxiliary door is mirror glass. In operation, the performers step inside and the outside doors are shut. Immediately the glass doors are drawn to the post, which makes a V, behind which the men stand—hidden. The six watchers wonder when the outside doors are opened what has become of the men. Door is closed again, and the auxiliary ones are shoved back to their places. Doors opened—the men have come back! It is unnecessary to state that the whole inside, when the auxiliary mirrors are flat against the sides, is one uniform color. These things are very simple, almost absurdly so, when you know how they are done, but until you do, well, "you don't know, you know."



◆

SETTING AND FILING SAWS.

Having had charge of table-saws for a good many years, and wishing to get all the work out of them obtainable, I have experimented considerably in shape of teeth, setting teeth, swaging teeth, jointing saws, etc., a few points in regard to which it may do some one good to know.

Firstly, a saw should fit the mandrel, not tight, but slip on without play. Next, it should be jointed up true, which I do by holding a piece of one and one-quarter inch gas pipe, twelve inches long (the size or length is immaterial, except that that is the handiest size), square against the edge of the teeth. The saw should run full speed. By taking hold of each end of the pipe and crowding down on the table-top and up to the saw, it is soon jointed up round, and with the corners of the teeth full. This will not be the case when a stone is used, as the saw cuts into the stone and rounds the very part that one wants full. The gas pipe is soft iron and does not glaze or harden the points of the teeth. I file the front of the teeth nearly square across the saw, but file from both sides.

The old rule for slitting saws is to have the front of the tooth line to a circle of half the diameter of the saw. I file to a circle of two-thirds the diameter and leave the teeth quite crowning on the back to give them strength. I take off the saw to file and set. I prefer setting to swaging for table-saws. I set with a hammer, by laying the saw down on a little table with a flat piece of steel, very hard, beveled off on the edge to an angle of 25 degrees. Put the point of tooth three-sixteenths over, and hit it directly on the point. A saw set in this way runs much easier than to have the set extended back on the tooth.

We make on one table 5,800 cuts through two and three-quarter inch white oak plank, 28 inches long, each day of ten hours, with 14-inch saws. The mandrel should be lowered so that the saw does not stick more than one-quarter of an inch above the work.—*Mechanical News.*

◆

THEATRICAL EFFECTS.

In nothing has the property-man improved so much of late years as in the quality and effectiveness of stage lightning. Only three or four years ago the old method was adhered to. A torch with a flame surrounded by a tin box perforated with fine openings, and the box filled with powdered rosin, did duty for this effect. The prompter gave a shake of this torch; the powdered rosin escaped in small quantity and flared up. This was the nearest the stage could come to counterfeiting the artillery of Jove. Now a calcium (or better, an electric) light is completely masked in the wings. When the cue is given for the lightning, the light is unmasked for a second and the rays allowed to flash on to the stage through a lens of greenish glass. The effect of a blinding flash of lightning is perfect. And yet so simple? Yes; and it is the simplest things on the stage that gain the greatest success.

The effect of scudding clouds in a storm at sea is only the dragging across the dark flat a net with gauze patches sewed on it and touched up by the painter to resemble clouds under the uncertain light of the stage.

A fog or mist has always puzzled machinists, and puzzles them yet. The best they can do is to hang successive curtains of tarletan or mosquito netting (gauzes they call these curtains on the stage) across the stage at the different entrances, and raising them successively as the fog is supposed to disappear. There is no illusion at all. It is never used except when absolutely necessary, as in "Midsummer Night's Dream," and even then is often cut out after the first night's trial.

◆

No man can be said to be a practical workman unless he thoroughly understands the theory as well as the practice of his employment. Some men are content in the simple accomplishment of results without endeavoring to study the whys and wherefores which lead to their production. Such workers accept without investigation the formulas of their trade, and do not aspire to a knowledge of the principles upon which these formulas rest. They may be very good artisans in their way; they may, so far as their immediate tasks are concerned, be excellent workmen, but it is needless to say that they are not composed of the material which makes the great, the rising and progressive spirits of the age.

◆

MISERY LOVES COMPANY.—The *Railway Review* says:

> "Two English railway companies have discharged 2,500 employes and reduced the salaries of their clerks 10 per cent., owing to depression in trade."

This shows that the present stagnation extends all over the world, and is by no means confined to this section of it.

INTERNAL CORROSION AND SCALE IN STEAM BOILERS.

Mr. Robert Wilson, in his valuable "Treatise on Steam Boilers," says:

"As a rule, steam boilers explode from one cause alone—over-pressure of steam." "It often happens," he says, "that boilers are too weak for the pressure they are worked at, and no accumulation of pressure beyond this is requisite to bring about their destruction."

A boiler may be unfit to bear its working pressure from four causes, which he enumerates: (1.) Its original design and strength not being understood by those who fix the pressure. (2.) The strength, although originally sufficient, having been gradually reduced by wear and tear. (3.) By a sudden overtaxing, as by unequal contraction. (4.) By bad workmanship or material.

I propose to confine my remarks to the second of these causes, and to inquire whether the aggregate of casualties which are attributable to wear and tear cannot be reduced, and whether a remedy cannot be found for the weakening of the various parts of the boiler by corrosion and "pitting," and by the over-heating of furnace plates and tubes, consequent upon the formation of lime scale upon them.

Internal corrosion is a trouble from which few boilers entirely escape; but marine boilers are the greater sufferers. Land boilers are subject also to very serious and often rapid decay from external corrosion, but I do not propose to make more than a passing remark on external decay. The principal causes arise from undue exposure to the weather, unscientific mounting on possibly damp brick-work, leakage consequent upon faults of construction, or negligent management on the part of the engineer in charge. These sources of corrosion are commonly known, and the measures necessary to prevent them are now well understood, although it must be admitted they have been often culpably neglected.

Internal corrosion may be divided into ordinary corroding (or rusting) and pitting.

Ordinary corrosion is sometimes uniform through a large part of the boiler, but it is often found in isolated patches, which have been difficult to account for.

Pitting, which is still more capricious in the location of its attack, may be described as a series of small holes often running into each other, in lines and patches, eaten into the surface of the iron to a depth sometimes reaching a ¼ of an inch. Pitting is the more dangerous form of corrosion, and the peril is increased when its ravages are hidden beneath a coating of scale or fur which may have gathered over it. For without great watchfulness this insidious canker may go on unsuspected until a catastrophe reveals it.

Ordinary corrosion has been commonly accounted for by the presence of acids in the water, but the mysterious ways of pitting have been an enigma to engineers; and although a variety of theories have been advanced to explain its capricious and peculiar methods, none were conclusive.

It was long suspected that galvanic action, or electricity in some form, had to do with both corrosion and pitting. One theory was that voltaic action was set up between the iron shell and brass tubes, and another that differences in the quality of the iron plates produced the same result. Experiments were made from time to time, to test these hypotheses, but they seem to have ended, for the most part, in the conclusion that electricity was inoperative either as a cause or a cure. Considered as a cure, it was set aside by some eminent engineers as mere empiricism; but most thoughtful men admitted that the action of electricity, if it really existed, was not understood. New light has since been thrown upon the subject, and altered views now prevail.

There is another form of decay in boilers, known as grooving. This also comes under the head of wear and tear. It may be popularly described as a kind of surface cracking of the iron, caused by its expansion and contraction under the influence of differing temperatures. It is attributable generally to the too great rigidity of the part of the boiler affected, and it may be looked upon as resulting from faults of construction. It is, therefore, outside the scope of this paper, except in so far as it may be, and frequently is, aggravated by internal corrosion, which fastens upon the cracks and eats them more deeply into the iron.

The hard calcareous scale which is deposited by the water on the internal surfaces of the boiler may be taken roughly as identical with the fur which forms on the inside of a tea-kettle. It is composed chiefly of salts of lime, and is known by many names in different districts On the whole, it is perhaps a greater enemy than internal corrosion, especially in land boilers, as it brings in its train so many destructive agencies, and involves so many expenses. As of fire it may be said that it is a good servant but a bad master—for a thin covering of about the substance of a coat of paint is found to protect the iron from rust, and is therefore favored by all engineers.

Beyond this point, however, it is an unmitigated evil. In the first place, it necessitates a great waste of fuel, varying according to the thickness and character of the incrustation; but the waste of coal may be fairly put down at an average proportion of not less than 100 per cent. The reason is this, that scale is a very efficient non-conductor of heat, and when it is interposed between the furnace and the water the latter is unable to take up the heat, which, by consequence, goes away unused up the flues. Then again the iron, or other metal, of the furnace and tubes, being no longer protected by contact with the water, becomes red-hot, and is burnt and twisted, to the imminent danger of the boiler, while a heavy expense is incurred for renewing the plates and tubes so affected.

Scale will stop the feed-pipe, which supplies water to the boiler; or hardening over the fusible plug in the furnace crown, which is intended to melt and give warning when the water is dangerously low, will nullify this precaution; and it has thus caused both collapse and explosion.

Concerning carbonate of lime, which is often a source of danger, I must offer here a few remarks.

This is deposited as a pulverulent body, and under certain conditions, chiefly of neglect on the part of the engineer in charge, will form a hard scale similar to that we have been considering, but by proper attention a great deal of it may be got rid of by blowing down, or emptying the boiler to the extent of a few inches day by day, by the scum-cock, while it floats near the surface, or by the blow-off cock when it has settled at the bottom. If, however, this floury deposit is allowed to accumulate and thicken the water, it will produce priming, which may be described as "boiling over," the same process which is apt to take place in boiling a saucepan of milk, or of water thickened with flour. The water is driven with the steam into the machinery, and may knock off the cover of a cylinder, or blow out the bottom of it. The second great danger which it involves is, that lying in a mass upon the furnace plates, it may prevent the steam from rising, and thus the water being lifted on the top of the deposit by the steam held beneath it, the furnace is left without protection, and is liable to be over-heated, and to collapse by the pressure of the steam.

However, these particular dangers may be averted, as already indicated, by due care, without which no scientific appliance is of any avail; and touching this point, I may quote Mr. Michael Reynolds, the author of several excellent engineering works. After inculcating care in various ways, he says, in his practical and significant style: "Any boiler can be made sensitive and hard to manage. Fire it on no system, feed it with water just as the lead plug is in danger, and fill it to the whistle; and your boiler will one day give a big kick." Many a big kick, it may be added, has been occasioned by want of ordinary attention to well-known rules.—*Journal Soc. of Arts.*

◆

CARE OF SIDE-RODS.

In putting in liners be sure and put the thick liner next the key, as it presents a more solid surface for the key to rest against; whereas in the case of thin liners being put next the key the bearing surface would be only just what would be presented by the depth and width of key. If the brasses are allowed to work in the strap, the key is liable to cut through the thin liners. After starting out, the rods should be watched very closely, and not allowed to run very long without a little keying. They may be all right in starting out, but after running awhile the liners get forced home, and a little lost motion is sure to occur. Never allow the brasses to work in the strap, as it has a very injurious effect on the engine in general; but keep the brasses up to their work by a little keying generally. After they have worn down to brass and brass, don't attempt to drive the key any more, and force the brasses out of shape, as I have seen some do.

In keying both back and front end, always have the pin on the quarter, as that is the correct place to key a main rod. If it is free in that position, it is free in every point of the circle, as it is a well-known fact that the pin measured through its horizontal diameter, when on the center is smaller than when measured through its vertical in the same position. The reason is obvious: in passing the dead centers is where the pins receive the full pressure of steam, and as friction is in a direct ratio to pressure, and friction means wear, the wear must of necessity be more at the centers than at any other point. Still some men will persist in keying up the rods on the center, and the consequence is hot pins, spoiled wearing surfaces, and melted babbitt.

If you should ever happen to start the babbitt, don't, as is the custom, slack the key so as to give the brasses from one-sixteenth to one-eighth of an inch play on the pin. First, try the rod, and if you cannot shake the brasses on the pin, slack the key so as to loosen them, and then key them up as you would in ordinary keying. The reason is that the metal, after melting, has been distributed over the pin, and has conformed itself to its shape and size, so you have a facsimile of the pin in the brasses. In the majority of cases of starting babbitt, if the key is slacked only just enough to allow oil to pass between the two bearing surfaces, the pin will not get very hot, and will give but very little if any trouble.

The cause of a pin becoming hot from pounding, is the blows or succession of shocks transmitted through the rods to the pin, by the alternate admission and release of steam to and from the cylinders; and instead of being an easy rolling motion when passing the centers, it is a succession of jerks due to lost motion in the brasses, the said shocks being so great as to force the lubricant out from between the two bearing surfaces, and excessive friction is the result which produces heat. That is not the only injury caused from loose brasses or for want of reducing; if the brasses have worn so as to cause a pounding, they should be reduced at once, as the shocks produced from either cause have a very deteriorating effect upon the engine in general; the shock is transmitted through the pins to the driving boxes, and from them to the frames, and if allowed to continue its effect is very perceptible.—J. D. C. in *Locomotive Engineers' Monthly Journal.*

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COMPOUND ENGINES OF THE GODIVA.

We illustrate herewith a pair of compound engines, recently built in England, which present examples of the average marine engine of the time. The engraving is reproduced from *Engineering*, and the details are given by it as follows:

The engines are of the compound intermediate receiver type with surface condenser. The cylinders are respectively 26 in. and 48 in. in diameter, with 3 ft. stroke, and are both steam-jacketed. The intermediate receiver surrounds the high-pressure cylinder. The valve faces of both cylinders are single-ported; the high-pressure cylinder, however, is fitted with a valve of the Allen type, giving double steam admission. The high-pressure cylinder, also, has a valve-face of hard cast-iron pinned on to the main casting. The ports of the high-pressure cylinder are 19 in. long, the width of steam and exhaust-ports being $2\frac{1}{2}$ in. and 5 in. respectively. In the case of the low-pressure cylinder, the steam and exhaust-ports are respectively $3\frac{1}{4}$ in. and $7\frac{1}{2}$ in. wide by 3 ft. long. The valve spindles are carried through guides at the tops of the valve-chests, but are not fitted with balance-pistons. The low-pressure cylinder is fitted with an auxiliary slide-valve for starting.

The cylinders are carried at the front by a pair of inclined cast-iron columns, and at the back by a pair of standards, each cast in one with half of the condenser. The exhaust steam does not pass down either of the standards, but is conducted to the condenser by a separate pipe. The standard which supports the low-pressure cylinder, however, is divided into two parts by a mid-feather, one of the parts forming an air-vessel on the delivery side of the circulating pump, while the other constitutes the hot-well. The condenser contains 559 brass tubes, $\frac{3}{4}$ in. in diameter outside, by 9 ft. $3\frac{1}{2}$ in. long, over all, and 8 ft. $11\frac{1}{2}$ in. between tube plates; the total cooling surface is 980 square feet.

The air-pump is single-acting, and 18 in. in diameter. It is fitted with bucket and delivery-valves only, these valves being simply three discs of brass. A water seal is maintained in the delivery-valve by a rim formed around the cover to which the valves are fitted. The circulating pump is $9\frac{1}{2}$ in. in diameter and double acting; it is fitted with india-rubber valves. Both air and circulating pump pistons are without packing. The circulating pump forces the water through the condenser, the water making two runs from end to end.

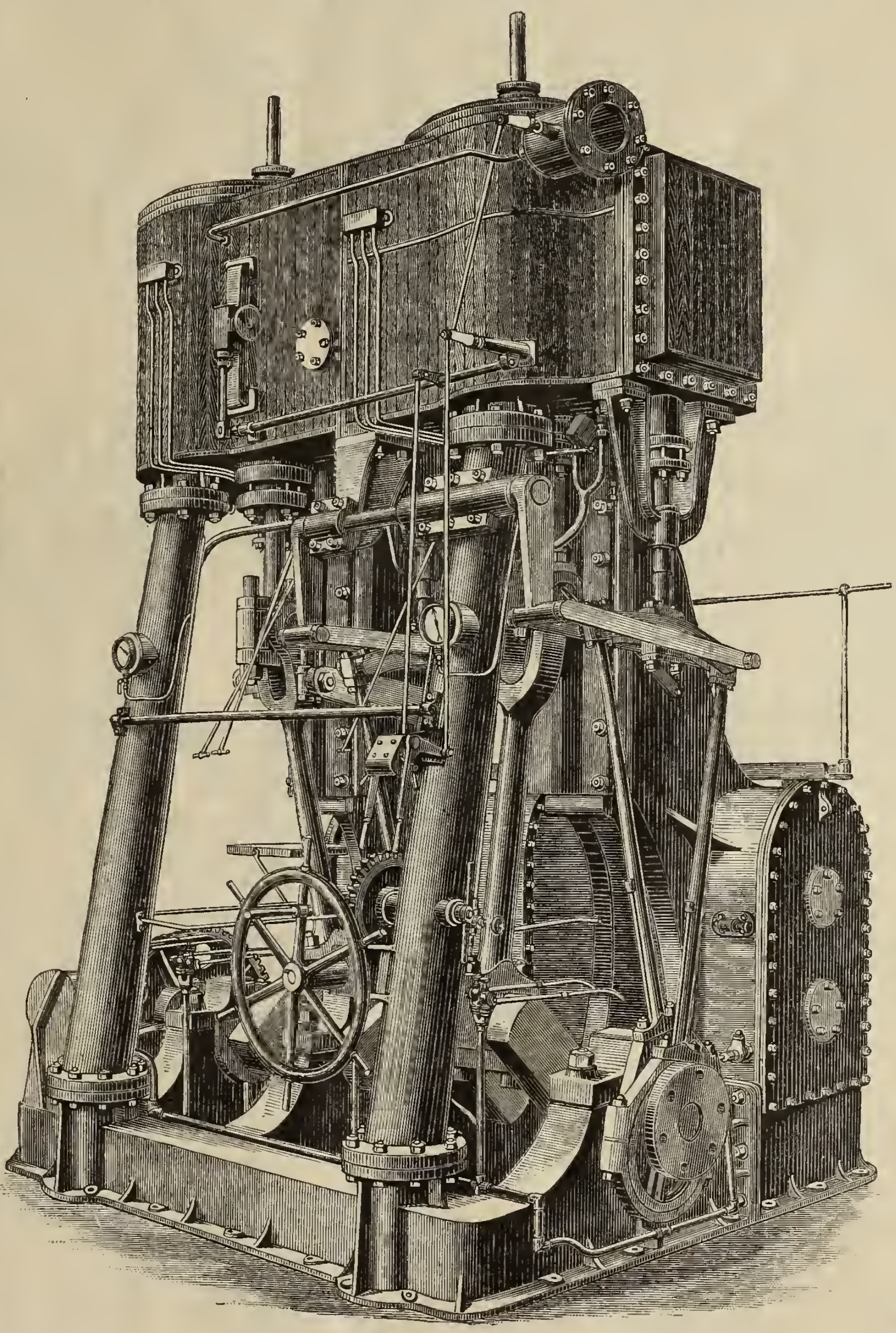
The crossheads are forged solid with the piston-rods, and have shoes $17\frac{3}{4}$ in. long by 13 in. wide, working in slipper guides. The crosshead pin-bearing is $5\frac{1}{2}$ in. in diameter by 7 in. long. The connecting rods are 6 ft. 3 in. long between centers, and have large end-bearings $9\frac{1}{4}$ in. in diameter by $10\frac{3}{4}$ in. long.

The four crankshaft-bearings are each $9\frac{1}{4}$ in. in diameter by 15 in. long and the pillow-blocks are bored out to receive the brasses, which are cylindrical externally. Between the upper and lower brasses of each bearing, however, there are inserted a pair of distance-pieces of H section, the projecting ribs of these distance-pieces fitting into grooves in the plummer-block and brasses respectively, and so clipping the edges of the brasses to the plummer-blocks and preventing the brasses from tightening sideways against the shaft. This arrangement is an exceedingly neat one.

◆

At A Recent Meeting of engineers in England, Captain Curtiss thought that the waste of fuel in torpedo boats might be greatly reduced if some plan could be devised by which the fire would burn downwards through the freshly put on coal instead of upwards.

This would require the use of a boiler similar to that mentioned by E. N. Dickerson some time ago. The circulation was so bad, he said, that it ought to be put on trunnions!



Compound Engines Of The Godiva S. S.

ERRATIC ACTION OF A COMPOUND ENGINE.

We read in a foreign contemporary that an English gunboat has had new compound engines put in her, and that upon trial they developed the powers stated below:

> For one hour the engines were worked at the highest grade of expansion, giving 106 horse-power in the high-pressure cylinder, and 384 in the low-pressure cylinder—total 490. The machinery was then worked up to full power, the steam being 82 lb.; the vacuum, 26 in.; revolutions, 96 per minute; giving an indicated horse-power, high, 322; low, 572—total, 894. The engines were next tried at one hour jet-injection. The mean steam in the boilers was 75 lb.; the vacuum, 19 in.; revolutions, 75·8 per minute; horse-power, high, 193; low, 361—total, 554.

We content ourselves with the remark that the high-pressure cylinder does not seem to get a fair show!

The New Government Postal Note, soon to be issued, is of a slate-black color. The design is the result of the determination of the government to devise a note which could not be "raised" from the amount for which it was issued. This point is secured by the removal of the vertical row of figures signifying dollars in the old note, and the substitution of a set of coupons at the left of the notes, each representing a dollar. For a note of $1.25 the dimes and cents will be punched in the new note from rows of figures situated as in the old note, and the dollars will be denoted by tearing off three coupons and leaving one joined to the note.

◆

A Foreign Contemporary says, in speaking of high speed locomotives:

> "Mr. Wootten, however, manages to get his engines over the road at 75 miles an hour without accidents, and if he does this there is no reason why we should not be able to do the same with small wheels."

He doesn't do it except when he runs down hill.

A Builder was offered bricks one-eighth of an inch below the regular thickness. "What matters an eighth of an inch in a brick?" said the merchant. "It matters three thousand more bricks for my job," was the reply.

In an establishment employing fifty hands a loss of one minute each time of ringing the bell means fifteen hours in a week; this shows the value of trifles.

Painful Experience of a Dead-head.—He stole a ride from Sing Sing to Tarrytown, N. Y., and, the train not stopping at that town, jumped off, without closing his throttle. He revolved many times on reaching the ground, and came up with his face toward Sing Sing, the place he started from. The night was dark, and not being able to distinguish landmarks, he deliberately walked back to Sing Sing, not much the gainer.

A Mexican correspondent of the *New York Sun* says:

> "There is much ingenious talent among the Mexican people. A friend of mine, who is an official on the Mexican National Railway, was asked the other day by an Indian boy in Acambaro, how to calculate the difference between the area of the outside and inside of a cylinder. He said he would not have been more astonished if he had been suddenly hit by a rock on the head. [Possibly his astonishment was caused by an inability to answer.—Eds.] The boy, who was sixteen years old, said that he was making an engine, and my friend went with him and found two complete engines—one a stationary, with boring-machine attached, and the other a miniature Baldwin locomotive, both in perfect working order. He had made them all with an old file and jack-knife. My friend told Don Eurebio Gonzalez, the Celaya millionaire manufacturer, who is a very public-spirited man, about him. He said: 'Send him to me, and if he can do one-tenth of what you say, I will send him to the United States.' The boy went, and the next day was forwarded to the United States by express for five years in the Baldwin locomotive works."

◆

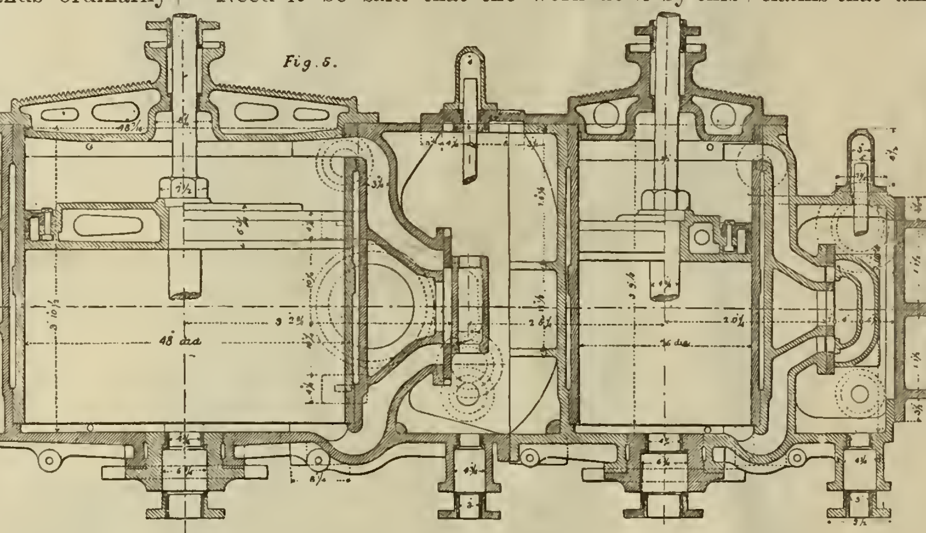
It Is Reported that Messrs. Titus Salt, Charles Stead, of Saltaire, England, and William Donaldson, of Glasgow, the owners of 28,000 acres of mineral lands near Chattanooga, who are now visiting that section, have decided to erect two large blast furnaces on their tract, with a capacity of 250 tons per day. The investment will reach $500,000, and will be expended within the next 15 months.—*Iron Age.*

"JAM" AND JAM MACHINES.

Machinery for jam-making is shown by an English firm at the Health Exhibition in London. Two principal apparatus are used, one a fruit-stalking machine, and a steam boiling-pan, with patent stirring arrangement. The moving part of the fruit-stalking machine consists of a revolving wheel, mounted on the underside of a frame. Below this is a semicircular wire sieve, underneath which is a trough leading into an oak vat. The upper part of the frame is boxed in, leaving a space above the wheel, a feeding hopper being placed in front and a door at the back. The fruit is fed into the hopper, and falls upon the rapidly revolving paddles, which alternately draw it across the surface of the sieve, and throw or toss it back into the upper part of the machine. By this treatment the fruit is almost instantaneously separated from the stalks, and passed through the sieve ready for boiling up with sugar, while every now and then the attendant moves a lever which opens the door at the back, and allows the stalks to be thrown out by centrifugal force. The machine is arranged so that it can be readily taken to pieces and cleaned, while spare sieves are kept, with finer or coarser wires, to suit different kinds of fruit.

The extent of the business will be understood by a few facts regarding the amount of fruit used.

"For supplying steam at Messrs. Pink's works there are three horizontal return flue boilers, amounting to 170 horse-power; last year they made up 3,790,188 separate packages of jams and marmalades, the net weight of which was 3,656 tons. The number of hands ordinarily employed amounts to 1,000. Another jam industry, which has been established lately is near Cheltenham. There 700 acres are already planted, or in course of planting, with fruit-bearing trees and bushes. The majority of the standard trees are plums, of which there are 30,000. There are 9,000 damson trees, 5,000 apple trees, mostly standards, 852 pear-trees, and 582 cherry trees. Among bush-fruits black currant bushes are the most numerous, numbering 220,000. There are 20,000 red currant bushes, 130,000 gooseberry bushes, and 120,000 raspberry bushes. Nearly 100 acres are covered with strawberries. The fruit is all made into jam on the ground. Nearly all the fruit used is grown in the market gardens which surround the metropolis. A great deal in the quality of jam depends on the rapid transference of the fruit from the tree to the boiling pan. The proper plan is for the fruit to be plucked before the sun is on it, and to be made into jam before nightfall."



Cylinder Section of the Godiva's Engines, See first page.

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POLITICS AT THE BOTTOM OF IT.

Mechanics protests, with justice, against the reckless use of steam boilers in many New York buildings. Every large apartment house has a boiler, and an engineer who holds a certificate from the Board of Examiners at Police Headquarters. Says our contemporary: "Just what the certificate is worth, and how nearly it represents the capacity and degree of intelligence of its holder, everybody ought to know, and no conscientious employer will place confidence in an applicant to the boiler-room unless he has personally satisfied himself of his ability.

Cases are understood to be on record where applicants of established experience and capacity have been refused certificates, while others, guiltless of the most superficial knowledge of their prospective duties, have experienced no difficulty in securing the desired qualification. The inspection of boilers, so far as the city inspectors are concerned, and the examinations of the boiler attendants, appear to be about on the same level, leaving a wide field for the introduction of reform."

◆

An English Engine Driver was lately looking at his engine, when the very spot his eyes rested on blew off. This was at the joint of the top plate and the left-hand side plate of the fire-box shell, and at a point about 18 in. from the back of the box.

PUMPERNICKEL.

"Pumpernickel is a national food, and has served since ancient times to nourish the honorable and upright Westphalians. Pumpernickel is a bread, but that alone, like faith, cannot furnish complete felicity. Accompanied by Westphalian ham and the *'Olle Klaare,'* or old rye of Westphalia, happiness is secured.

"The word pumpernickel is said to have originated in 'French times,' when an arrogant Frenchman being quartered with a worthy Westphalian farmer, threw the coarse black bread down scornfully before his horse, 'Nickel,' saying, *'Ca est bon pour Nickel.'* (It is good for Nickel.) Other etymologies of the word are also given.

"Black bread is a pure product, baked from coarsely ground or broken, unsifted and unbolted rye.—*German Milling Paper.*"

Is it, indeed? this shows how far astray our contemporary goes when it attacks technical subjects. Pumpernickel is cast in the foundry, in green sand, and is composed of yellow pine sawdust, sour beer and parting sand.

◆

Frank Admission By Prof. Rogers.—A short time since the writer asked Mr. Sharpe, of the firm of Darling, Brown & Sharpe, if he would undertake to grind a perfect cylinder. His reply was very suggestive. He said: "We are not making perfect mechanism of any kind any longer in this establishment. A few years ago we felt competent to undertake perfect work of any and every kind, but we have grown wiser since then."

Need it be said that the work done by this company is in many respects of a higher grade than it was 10 years ago. Five or six years ago, when ruling lines 120,000 to the inch more or less, the writer thought nothing of obtaining for the probable error of a set of measures of graduations figures low down in the millionths of an inch. It has since been learned by some not very pleasant experience that figures do not always tell the truth, especially figures which represent what are known as "probable errors"—that while straining at very small gnats, sevvery large camels walked by unperceived.

◆

We Frequently Receive Letters inquiring how the *Locomotive* can be obtained. The *Locomotive* is intended for free distribution through our various agents and inspectors, and can always be obtained by calling at any of the offices of the *Hartford Steam Boiler Inspection and Insurance Company.*

If parties desire to have us mail the numbers as they are issued from this office, we charge fifty cents a year to cover expense of mailing and postage.

If any of the Asssciations of Stationary Engineers in the country desire copies, we will mail a package of six (6) free on application.—*The Locomotive.*

◆

As A Sample Of The Push in business and the speed with which improved machinery allows American manufacturers to drive their works, it is said that a tree growing at 6 o'clock A.M., can be cut, ground into pulp, manufactured into paper, used in late editions of an afternoon daily, telling the same day of its wondrous change within 12 hours.

At The Last Meeting of the American Society of Mechanical Engineers. Mr. Oberlin Smith referred to the possibility of error in cutting, and attempting to correct screws resulting from deflection of the horizontal parts due to the influence of gravity, and suggested that by placing them in a vertical position, irregularities, if any, from this cause might perhaps be avoided. It appears that experiments in this direction have been conducted in some of the European States, but up to the present they have not received much attention in this country.—*Iron Age.*

◆

A Chinaman writes to a contemporary as follows:

"The majority of the names that you see on signs of laundries or tea stores kept by Chinamen are simply fancy names adopted for their particular significance; for instance, 'Hop Sing' means 'deserving of prosperity,' 'Woh Loong' means 'success through concord,' 'Nee Wah' means 'integrity and harmony.' You may say they are simply mottoes, having no reference to the proprietor or the members of a firm whatsoever."

What does How You mean?

◆

Improvement In The Locomotive of the present is the study of many, and ingenuity is taxed to its utmost to get more power out of it. John B. Fell, an English engineer, proposes to give increased boiler power by separating the boiler from the engine, giving it the place now occupied by the tender, and removing the water and coke to the carriage carrying the engine, by which he claims that ample space could be provided for both engine and boiler, and that there would be no difficulty in getting double the quantity of steam produced by the most powerful express engine.

It might prove handy, also, to have a couple of boilers in the baggage car!

◆

Pungent Observation by the London *Engineer.*—"This is the order in which a train from Waterloo was made up recently. (1) Engine, (2) a very old van, (3) a second-class carriage, (4) a first-class carriage, (5) a third-class carriage, (6) a first-class carriage, (7) a third-class, (8) a first and second composite carriage, (9) a third-class carriage, (10) a composite first and second-class, (11) a first-class, (12) a third-class, (13) a brake van, (14) a first-class, (15) a composite first and second-class, and finally, three vans for milk, &c. Nicely arranged train. So easy for passengers to find the sort of carriages they want—first, second or third-class, very old, old, or recent."

◆

David Ranck, M. E. (*Millstone* Editor) says a great many nice things, a great many funny things, and some sprightly things, which have, withal, truth for their bases. This is his latest witticism:

"Engineer, did you ever read a copy of The Mechanical Engineer, published by Egbert P. Watson & Son, 150 Nassau street, New York City? No? You are not so well up in your profession that you don't need any instruction, are you? And if you could get for $2, twenty-six issues of a practical engineering journal worth a whole library of theoretical text-books, it ought to be a good investment? Yes? Well, that's just what The Mechanical Engineer is. Try it, and our word for it, you'll be mighty glad you did."

If all the advertisers in David's "*Millstone*" get as many inquiries as we did from the above, we do not wonder at the popularity of it.

◆

It Is Reported on reliable authority that Alexander McMaster will be appointed government boiler inspector in place of Robert Learmouth, who vacated the office to take the position of chief engineer of the Anchor line. Mr. McMaster was chief engineer of the old Commercial line of propellers for about eleven years, and up to the time when the effects of that line fell into the clutches of the law. He is a first-class machinist as well as engineer, is thorough-going and conscientious, and, therefore, well qualified to faithfully discharge the duties of the position for which he is mentioned.—*Unknown Contemporary.*

A NEW MACHINE COMPANY.

The present slackness in trade does not deter capable men from embarking in new enterprises, and we are glad to know that Messrs. C. E. Billings, L. H. Holt, Geo. D. Edmunds, E. K. Stocker, and F. C. Billings, of Hartford, Conn., have organized a new machine firm to be located at Rocky Hill, Conn., near Hartford, on the Connecticut River. Mr. Charles E. Billings is the president of the new company, and is well known as a most ingenious practical mechanic, and his associates are gentlemen of long experience in the line of trade they embark in. Success is assured from the start.

◆

PETROLEUM FUEL FOR STEAMERS.

Petroleum is largely used in Russian waters for steam vessels, to what extent is shown by the extract appended from *Engineering:*

"The steamers began to burn it a dozen years ago, and the fuel has proved its excellence to such a degree that at present there is not a vessel on the Caspian using wood or coal. But perhaps the most satisfactory testimony is afforded by the fact that the use of the oil is becoming common where wood is tolerably plentiful. Altogether, probably not less than 300 steamers on the Volga and Caspian burn nothing but oil fuel to-day. Various kinds of pulverizers are used, the general principle being to mingle the oil refuse with a jet of steam and inject it into the furnace in the form of spray, where it makes a powerful and steady blaze."

The advantages of the fuel are such as to render competition on the part of wood or coal hopeless. To start with, one ton of oil refuse will do the work of two tons of coal even in the most wasteful apparatus in use on the Caspian. Less fuel being required, and the oil further taking up, weight for weight, less room than coal, a greater amount of space is available for cargo. Then no stoking is required, one man being sufficient to look after all the furnaces; the fuel is smokeless, a very important consideration for vessels of war; there is no banking of fires, the flame being turned on and off like an ordinary gas jet; and, finally, the fire can be regulated to any degree of intensity by simply adjusting the injector.

In the case of the vessels running from the mouth of the Volga, the engineers turn on the flame in starting, and concern themselves no more about their fires until they get to their destination in two days' time. The experience of a dozen years has rendered the Russian Admiralty so satisfied with liquid fuel, as used on board the ten or twelve steamers and gunboats of the Caspian fleet, that it has recently taken steps to fit up one or two vessels in the Black Sea to burn oil refuse.

It must be remembered that this is petroleum refuse, from the refineries, and can be had for next to nothing. Weight for weight, petroleum is less valuable than coal, but if prices are adjusted relatively, petroleum will answer as well here as elsewhere.

◆

ENGLISH OLEOMARGARINE.

Oleomargarine, it is asserted, is made in this country from clean, unrendered fat of newly killed beeves, but by this paragraph, cut from a report of the Health Exhibition in England, it seems that it is there made by soap-boilers! We read in *Engineering:*

> Oleomargarine is shown by Messrs. John Knight and Sons, of Silvertown, the well-known soap-boilers. It is used, and very largely used, for making butterine; a word which generally loses its final syllable by the time the article itself gets into the retailer's shop. For the preparation of oleomargarine the stearine is extracted from animal fat, leaving a compound of the two remaining principles, oleine and margarine, or oleomargarine. This substance is treated in various ways, the mysteries of which are not revealed by the butterine makers who are Messrs. Knight and Sons' customers. The stearine is utilized for candle-making. Messrs. Knight and Sons sometimes produce as much as 20 tons per week of oleomargarine.

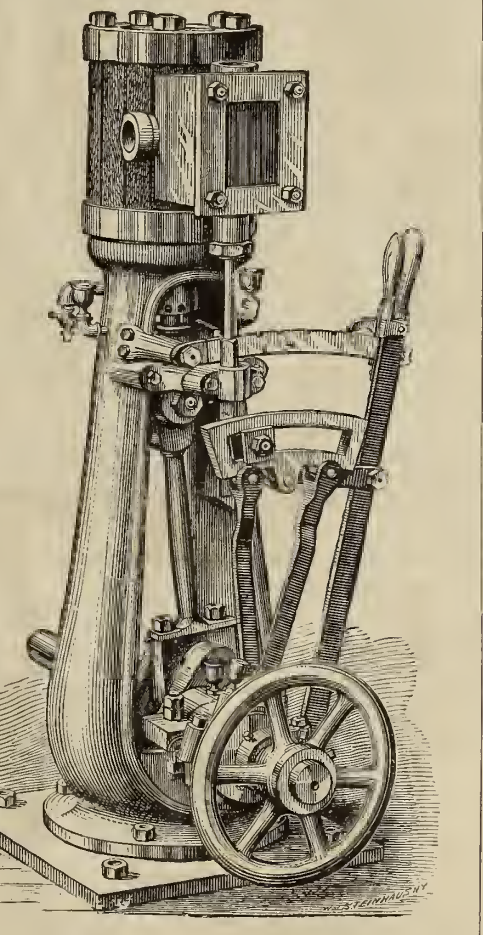
This adds a new terror to the commodity. "Weal pies is werry good, said Mr. Weller, 'when you know they ain't made of kittens.'" Oleomargarine must be very bad when made of oap-grease.

◆

If You Wish To Make "Sarsaparilla" syrup, you must take 10 drops anise oil, 20 wintergreen oil, 20 sassafras oil, to a gallon of syrup, but you must not put any sarsaparilla in.

THE GREENFIELD MARINE VERTICAL ENGINE.

The engraving represents the Greenfield marine vertical engine, which is especially adapted to yachts, tugboats and canal boats. The main bearings are cast solid in the frame, and also the guides, and there cannot be any derangements of the parts or unequal pressure on the same from getting out of line. The bearings are long and the shafts of large diameter, and all parts are provided with proper means to take up the wear. These engines are supplied with the link-motion for reversing, and for working expansively, and are claimed to combine, theoretically and practically, all that should be expected from an engine of this character. A plain slide-valve is used, and all the steam joints are ground, dispensing with the annoyance of rubber or gum packing. The cylinder has a black walnut jacket of neat design, and all the bearings are supplied with brass oil-cups, and the cylinder with a lubricator. The crank-shaft, piston-rod, valve-rod and cross-head pin are of steel. A critical steam-test is made of every engine before it leaves the shop, and all the necessary adjustments are carefully made, so that the engine is ready to run the moment it is placed in position. In operation they are noiseless, and can be managed by a person of ordinary intelligence. A pump is furnished with the engine when so ordered, and is driven from the main shaft by an eccentric.



These engines are built in sizes from 2½ to 65 horse-power, and are also built in the same sizes for stationary purposes, for which they are very desirable, from the small amount of space required and the fact that they can be fastened to the ordinary floor of a building.

Address the makers, W. G. & G. Greenfield, East Newark, N. J.

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SPEEDY AMERICAN LOCOMOTIVES.

The special newspaper train over the Baltimore and Ohio road, conveying Washington correspondents from the convention, left Chicago at 2:10 P. M. on the 7th, and arrived here at 2 P. M. on the 8th inst., making the run of 813 miles in 23 hours, while the actual running time was 19 hours and 30 minutes only. The running time from Chicago to Chicago Junction (273 miles) was 5 hours and 35 minutes, an average of upward of 52 miles per hour. At one time 57 miles were accomplished in 59 minutes. The final 27 miles, from Barnesville to the Ohio River, was made in 28 minutes, and six miles of the distance was run in 4 minutes, or at the rate of 90 miles an hour. The 463 miles from Chicago to the Ohio was run in 11 hours and 20 minutes, including 38 stops; actual running time 9 hours and 20 minutes, or the unparalleled average for the distance of fully 50 miles per hour. From the river to Washington no special effort was made other than to bring the entire run within 23 hours, until Washington Junction was reached, when the engineer was instructed to run the last 44 miles at the rate of a mile a minute. He exceeded the limit, and ran the last 16¾ miles in 14 minutes.

◆

In The Past Twenty-Five Years the *Scientific American* has had many editors. Robert MacFarlane was the first, and he remained many years, until his health caused his retirement. To him succeeded Egbert P. Watson, the senior editor of this paper, who also retired for the same cause, after many years of service. Jesse H. Lord came next, and he retired after an experience similar to his predecessors. Park Benjamin tried his hand, and elapsed in due course, and now Jesse H. Lord is again "to the fore" at his old post. Mr. Lord has our sincere sympathies, for he is a good writer and a tip-top mechanic.

◆

Never Screw Up A Joint under steam pressure. The chances are that it will give way disastrously. Thirty-two big boilers are used by the New York Steam Heating and Power Company. Recently a new escape-valve was put into one of the groups of boilers, and tested while the boilers had a full head of steam on. The test was made by Albert G. Brown. He found that the packing leaked. Calling a man to his assistance, he undertook to stop the leak. While he was at it the valve-joint blew out, and a great cloud of steam spurted out upon him, scalding his face, neck, arms and thighs so severely that he fell fainting to the floor.

◆

A Writer In The *Age of Steel* says:

"I have seen a good deal of fine work turned out of St. Louis machine shops, but about the finest job that has come under my notice was a couple of smooth rolls for a local flour mill. One of these the foreman laid lengthwise on the top of the other, and while he held a lighted candle on the side of the set, I tried to catch a glimpse of the candle rays from the other side by trying to look between the rolls. Although that part of the room was dark, I couldn't discover the faintest ray of light. The rolls were next placed side by side, in contact with putty, between each end, so as to form a trough, which was filled with water. I hope no one will think I am exaggerating when I say that not a drop of water leaked between the rolls to the floor, although it was allowed to stand for quite a while."

◆

Mr. Coe, United States local inspector of steamboats at Port Huron, gave a license to a Canadian engineer for the steamer *Evening Star*, plying between Detroit and Toledo, and the fact coming to the knowledge of the engineers of Port Huron, they took steps to defeat the action by applying to a lawyer, who referred them to the United States Prosecuting Attorney, with the information that they had a good case, as the inspector had made himself liable. They afterward called on Mr. Coe and explained to him that they considered he had done the American engineers an injustice in making this appointment, and desired him to withdraw the license, stating the result of their conference with the lawyer. Mr. Coe, after fully understanding the position in which he had placed himself, decided to take immediate action and informed the Canadian engineer that he must revoke his license. The law in this case precludes an inspector from issuing a license to an engineer who has not declared his intention of becoming a citizen of the United States.—*Marine Record.*

◆

Ordinary Gold And Silver Leaf are used to a great extent on the stage in spectacular sets. So are colored foil papers, also bronze powders of all shades. A coat of glue is laid on and the bronze powder thrown upon it. It produces a rough metallic-looking surface. Another dodge is the counterfeit presentment of precious stones. For a very moderate sum one can get a splendid palace studded with gigantic sparkling jewels. They are made of zinc and can be had in all colors. The sparkle of an iceberg comes from "frostings" of crushed glass sown on a coat of glue.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE CARE OF BOILERS.

Editors Mechanical Engineer:

I have been reading numerous letters from your correspondents, and have noticed that some of them seem to take a dislike to articles containing any information about steam boilers. I have come to the conclusion that they are not engineers; if they were, it seems just as important for them to take an interest in anything new about boilers. The first thing to be considered is, how much pressure will it safely carry ; second, the design is to be studied; third, how are all the different forms of the sheets braced against the pressure; fourth, can it be easily examined and cleaned; fifth, does it possess any advantages over other forms of boilers already in use; if so, make a note of them, and bear them in mind, and constantly be on the alert looking for anything of interest connected with the business. The boilers, like many other details of the engine department, too often get the cold shoulder.

Several years ago, when my experience as an engineer first began, I used to send the fireman inside the boiler to clean it, and to remove all the sediment that might have been left after blowing down, and took his word for it when he said it was all right. On one occasion, however, I asked him if he was sure that all the sediment was out of the boiler? He said he was very sure that none had been left. Bearing in mind that what he had done in the past had come out all right, and having some respect for his feelings, I did not go inside myself, but closed the boilers and refilled again. I got up steam, and had been running about five hours; upon looking into the furnace I discovered a bulge on the bottom of the boiler. The discovery was made in time to avoid any accident; but from that time I decided that henceforth I would go inside and examine for myself, and then there would be no chance for doubt on my part.

For three years it had been my custom once a year to apply the hydraulic test, and, while under pressure, to look for any leaks that might be seen; if there were any I would mark them, and when the pressure had subsided, have them caulked. I always exposed to view all parts of the boiler that could be seen without tearing down the masonry, when undergoing such a test; after the test I went inside the boiler, tried all the braces, and sounded every square foot of the shell, to see if there were any thin places. I also ground all the safety-valves, and put everything connected with the boiler in good order. The fourth year I thought my employers would be better satisfied to have the boilers inspected by an expert. I made the facts known to them. After questioning me some time, they consented to my plan, and authorized me to employ an inspector. I did so, and previous to his coming, had the boilers thoroughly cleaned and ready for inspection. Upon his arrival he asked me if the boilers were filled ready for the pressure? I told him that they had been left open for him to examine inside (these were flue boilers). At that he seemed indignant, and said very sharply that he had not come prepared to go inside; but I told him that I wanted to have an examination as well as a test, and I should demand one, as he had come for that purpose.

He finally came to the conclusion that it would be a great deal better to be sure about the matter; so you see it is policy to know a little about boilers yourself.

Bristol, R. I. F. S. Bradford.

NEW LAKE STEAMER.

Editors Mechanical Engineer:

One year ago the Detroit and Cleveland Steam Navigation Co. built an iron boat for the Detroit and Mackinac route. The vessel is over all 215 feet; width 34 feet, depth 11 feet, tonnage 690. The boat was fitted with a beam engine which came out of a vessel that ran on Lake Champlain. The wheels are feathering, 22 feet diameter, making on average 30 revolutions per minute. The speed of the boat is 17 miles per hour. The size of cylinder is 44 diam. by 10 feet stroke. The General Manager of the line, David Carter, thought by compounding the engine that they would save 20 per cent. on fuel, and he recommended to the board of directors that this be done. They authorized the change and Mr. Carter contracted with the North River Iron Works (late Fletcher, Harrison & Co.), to make the alteration in the engine by putting in a high-pressure cylinder, 36 in. diameter, by 6 feet 8 in. stroke. The engineer of the boat informs me that she makes the same time as before the alterations, and saves 33 per cent. in fuel.

I enclose you a clipping taken from the Detroit *Free Press*, of the trial trip. I waited until I could find how the engine performed and how much saving there was in fuel before sending it to you.

"The trial trip of the steamer '*City of Mackinac*,' of the Detroit and Cleveland Steam Navigation Company's line, called forth a number of persons interested in vessels. The reason was because the steamer's engine had been compounded, making her the only side-wheel steamer on the lakes that has an engine of this class. The main object of the company in compounding the engine was to save fuel. × × × ×

"On her trip down she passed Woodward avenue at 3:19, Third street at 3:21, Grassy Island light at 3:49, Mamma Juda light at 3:58, Park's Wharf, Amherstburg, 4:22, and Bois Blanc light at 4:25, making the whole distance of eighteen miles from Woodward avenue, in one hour and six minutes. On her return the steamer made somewhat better time, taking the current into consideration, making the distance from Bois Blanc to the Michigan Central elevator in one hour and eighteen minutes. It was found that if the stroke of the engine were lengthened the steamer would make considerable better time."

The following officers have been appointed for the steamer this season:

Captain, Alex. McKay; First mate, K. Finlayson; Second mate, J. McLarty; First engineer, R. Stage; Second engineer, W. McDonald. J. H. Reid.

Detroit, Mich.

PUTTING UP STEAM PIPES.

Editors Mechanical Engineer:

In your last paper a correspondent asks how steam pipes should be connected. Some may think this is an unnecessary question, as there cannot be many ways to put up steam pipes; but it is not unnecessary, as there is a right way and a wrong way to everything, and very often steam pipes are put up by the last method.

Where steam pipes are long and are carried horizontally some distance, they should always be highest on the engine-end. This is to give the condensed water a chance to run back into the boiler, instead of into the steam chest. Also, where pipes are long some provision should be made for expansion, either by slip-joint or otherwise. If this is not done the strain on the pipes, tending to break them across at the joints, is immense. It is a common practice with some steam-fitters to catch a pipe in an elbow, or a union, two or three threads, and haul the whole rig endways, or vertically together. I think this is wrong. A pipe should have no other strain to carry than that of the pressure inside, and, if it runs a long way, should be supported at intervals of not less than ten feet apart.

New York. J. M. Middleton.

FROM MINNEAPOLIS NUMBER 2, STATIONARY ENGINEERS' ASSOCIATION.

Editors Mechanical Engineer:

In looking over the columns of The Mechanical Engineer I notice correspondence from different associations of stationary engineers throughout the country.

An association was organized here last February with 25 charter members ; since that time the membership has increased to 40. The officers are as follows: J. G. Lacy, Pres.; John Norton, Past Pres., H. F. Pierce, Vice Pres.; W. M. Derby, Rec. Sec.; W. M. Sage, Fin. Sec.; G. L. Johnson, Cor. Sec.; W. P. Winkley, Treas.; Samuel Erb, Cond.; W. McMillan, Door-keeper. Inspectors, S. T. Johnson, E. S. Getchell, A. R. Cole.

We are working in good shape and have good prospects in future. We expect to be represented at Baltimore in September, at the National Convention. Wishing success and prosperity to all other associations, we remain— Minneapolis No. 2.

TOOL TO BORE OUT HARDENED WORK.

Editors Mechanical Engineer:

I understand that a party inquired through your paper for a tool to bore out hardened work. I have a tool, or lap mandrel, especially adapted for lapping out case-hardened work—such as thimbles, pins, etc., for motion work. It grinds it perfectly smooth, no matter how hard it is. Will you please give me his address, so I can correspond with him? M. H. McN.

Meadville, Pa.

[This probably refers to the inquiry made by a Louisville correspondent, as to the best method for lapping out hardened work. If our present correspondent has anything new and useful in this line, he should make it known.—Eds.]

SPLINE AND KEY.

Editors Mechanical Engineer:

Will you please decide a dispute which has arisen here. Is a key a spline, and is a spline a key? Some contend the words mean the same thing, and that if I tell a man to put a spline in a shaft he knows what to do without further instruction, except as to size. I think this is not correct. If a foreman ordered me to put a spline in a shaft, I would sink a *fixed* key in it, or a feather, as some call it. If I had orders to put a key in a shaft, I would put in a loose key with a gib head on it, so that I could pull it out if I wanted to. Am I right or am I wrong?

Boston, Mass. John King.

[You are right.—Eds.]

WHO CAN BEAT IT?

J. R. Soules, master mechanic, says in the *Railway Age*:

Engine No. 312 on the Canada Southern division of the Michigan Central railroad, engineer J. Pimlock, has run 3,000 miles per month at a cost not to exceed $5 per month for repairs from April 26, 1881 up to June 2. She has made the run from Detroit to Toledo, making nine stops, in one hour and forty-five minutes, pulling four coaches, one baggage and one express car, the distance being 65½ miles. She was rebuilt by O. P. Dunbar, who was then master mechanic of the Michigan Central Railroad at Grosse Isle, but now master mechanic of the Wheeling & Lake Erie Railroad.

I would like to hear of any locomotive engineer who has run his engine, making the same number of miles in same length of time, at a less cost for repairs per month than Mr Pimlock.

TO MAKE SOUND CASTINGS.

It frequently happens, says the *Polytechnisches Notizblatt*, that in working castings porous places are found beneath the surface which render the casting useless. On examining the cavity closely, a little smooth and hard bullet will be found within it. Simple air bubbles can be produced as foam in melting the metal; but these bullets indicate that particles of the metal have been broken or thrown off, and this could only happen while pouring it into the mould. The mould generally consists of a double flask filled with sand. In pouring the metal from above it spurts when it comes in contact with the bottom, just like any other liquid. That is, little particles break off, forming balls, and harden in the air. This cooled iron floats on the surface of the melted iron, and the air that carries with it forms bubbles, which also harden on the surface; these bullets and bubbles frequently collect in nests, which are either on the surface or in the corners, and are not melted again by the rest of the fused metal. The metal that falls perpendicularly frequently tears loose single particles of sand from the mould, and this sand, floating on the metal, forms cavities wherever it rests, and doubly spoils the casting.

According to the *Techniker*, all this can be avoided if the pouring-hole is arranged at an angle of 30° to 45°, and in such a manner that the metal shall enter the mould from beneath, if possible. With such a pouring-place the metal will enter the mould without spurting, and if care is taken to furnish a suitable escape for the air it will fill the mould solidly. The only disadvantage is that it would require a larger flask, and, for most patterns, even this can be avoided by skill.

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An Average Day's Work for a bricklayer is 1,500 bricks on outside and inside walls; on facings and angles, and finishing around wood or stone work, not more than half of this number can be laid. To find the number of bricks in a wall, first determine the number of square feet of surface, and then multiply by 7 for a 4-inch wall, by 14 for an 8-inch wall, by 21 for a 12-inch wall, and by 28 for a 16-inch wall.—*The Builder.*

◆

The Office And Works of the Marchand Manufacturing Company, Limited, are located on Frazier street, Allegheny, Pa., and consist of a brick building, 40x80 feet. The works are fitted up with the best automatic machinery. Owing to the great increase in business, next year the company will erect an additional building 100 feet square.

Mr. Marchand is an inventor of over 35 years' experience, and has taken out over one hundred patents.

MAKING A LARGE MARINE CRANK-SHAFT WITHOUT SPECIAL TOOLS.

By Norman W. Wheeler.

All the old fellows know how to do it, of course, but some of the boys may like to be told how we built up a crank-shaft without special tools, and how we succeeded.*

The sketch will show the dimensions. The journals and crank-pins were of steel and the web of wrought-iron, the counterbalance-weights being of cast-iron and bolted on.

The principal tool available for the work was a 72-inch swing Betts lathe, which would swing the webs on the face-plate to bore the pin-holes, but would not swing the cranks over the rest, nor would the tool-post go in between the webs after the cranks were put together, so that we could not turn up the pins after assembling, although we could manage to trim up the journals if they should need it, as the webs would straddle the rest in way of the middle journal and allow a cut of about one and a half inches without shifting the tool. Under these circumstances it behooved us to be very careful about our fits, distances, and the squareness of things generally.

The webs came from the forge rough-finished, and the first job was to plane them parallel on the sides—but we did not get them true enough in that way to suit, so we tried the lathe by its own face-plate, to see if it would face exactly

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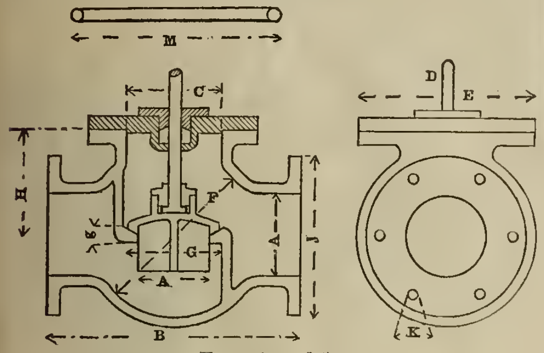
*Mr. Wheeler does himself injustice in addressing the younger readers of this paper, for the method he describes is a most ingenious mechanical arrangement, which any engineer might be proud of.—Editors.

FOUNDRY PRACTICE AS ALLIED TO PATTERN-MAKING.

BY JOSEPH P. MULLIN.

THE GLOBE-VALVE.

Figs. 1 and 2 represent a side section and end elevation of a common globe-valve, and as globe-valves are an important detail in pattern-shop and foundry practice they will afford a good subject for this article.



FIGS. 1 and 2.

The following table gives the principal dimensions of globe-valves from $\frac{1}{4}''$ to $5\frac{1}{2}$ inches inclusive.

TABLE OF DIMENSIONS OF GLOBE-VALVES—HAVING HEXAGONAL FLANGES—FROM $\frac{1}{4}''$ TO 2'' INCLUSIVE.

	A	B	C	D	E	F	G	H	I	J	M
Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins	Ins	Ins.	Ins.
$\frac{1}{4}$	$\frac{7}{16}$	$1\frac{5}{8}$	$\frac{7}{16}$	$\frac{5}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{13}{16}$	$1\frac{5}{8}$
$\frac{3}{8}$	$\frac{9}{16}$	$1\frac{7}{8}$	$\frac{9}{16}$	$\frac{5}{16}$	$\frac{7}{8}$	1	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{15}{16}$	$1\frac{5}{8}$
$\frac{1}{2}$	$\frac{3}{4}$	$2\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{8}$	1	$1\frac{1}{4}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{1}{4}$	$1\frac{3}{16}$	2
$\frac{3}{4}$	1	$2\frac{5}{8}$	1	$\frac{3}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$	1	$1\frac{1}{8}$	$\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$
1	$1\frac{1}{4}$	$3\frac{3}{8}$	$1\frac{1}{4}$	$\frac{1}{2}$	$1\frac{3}{4}$	2	$1\frac{1}{4}$	$1\frac{1}{4}$	$\frac{1}{4}$	$1\frac{3}{4}$	$2\frac{3}{4}$
$1\frac{1}{4}$	$1\frac{1}{2}$	$3\frac{5}{8}$	$1\frac{1}{2}$	$\frac{1}{2}$	2	$2\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{4}$	$2\frac{1}{16}$	$3\frac{1}{4}$
$1\frac{1}{2}$	$1\frac{3}{4}$	4	$1\frac{3}{4}$	$\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$\frac{1}{4}$	$2\frac{3}{8}$	$3\frac{3}{4}$
2	$2\frac{1}{4}$	$4\frac{1}{2}$	$2\frac{1}{4}$	$\frac{5}{8}$	$2\frac{5}{8}$	$3\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$\frac{3}{8}$	3	$4\frac{1}{2}$

TABLE OF DIMENSIONS OF GLOBE-VALVES—HAVING ROUND FLANGES AND BOLT-HOLES—FROM $2\frac{1}{2}''$ TO $5\frac{1}{2}''$ INCLUSIVE, ADVANCING BY HALF INCHES.

A	B	C	D	E	F	G	H	I	J	K	M	L
Ins	Ins	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins	Ins.	No. of bolts
$2\frac{1}{2}$	10	$3\frac{1}{4}$	$\frac{7}{8}$	7	$6\frac{1}{2}$	$3\frac{1}{8}$	$4\frac{3}{4}$	$\frac{7}{8}$	$6\frac{3}{4}$	$\frac{1}{2}$	7	4
3	11	$3\frac{3}{4}$	1	$7\frac{3}{4}$	$7\frac{1}{4}$	$3\frac{3}{8}$	$5\frac{1}{4}$	$\frac{7}{8}$	$7\frac{1}{2}$	$\frac{1}{2}$	8	4
$3\frac{1}{2}$	12	$4\frac{1}{2}$	1	$8\frac{3}{4}$	$7\frac{3}{4}$	4	$5\frac{1}{2}$	1	$8\frac{1}{4}$	$\frac{1}{2}$	8	5
4	13	$5\frac{1}{4}$	$1\frac{1}{8}$	$9\frac{3}{4}$	$8\frac{3}{4}$	$4\frac{1}{2}$	$5\frac{3}{4}$	1	9	$\frac{5}{8}$	10	5
$4\frac{1}{2}$	14	$5\frac{1}{2}$	$1\frac{1}{8}$	$10\frac{1}{4}$	9	5	6	1	$9\frac{3}{4}$	$\frac{5}{8}$	10	6
5	15	$6\frac{1}{4}$	$1\frac{1}{4}$	11	$10\frac{1}{4}$	$5\frac{1}{2}$	$6\frac{5}{8}$	$1\frac{1}{8}$	$10\frac{1}{2}$	$\frac{5}{8}$	12	6
$5\frac{1}{2}$	16	$6\frac{3}{4}$	$1\frac{1}{4}$	$11\frac{7}{8}$	$11\frac{1}{8}$	$6\frac{1}{4}$	$6\frac{7}{8}$	$1\frac{1}{8}$	$11\frac{1}{4}$	$\frac{5}{8}$	12	6

The figures in the first column denote the size of the valve, and those under *A. B. C. D. E., &c.*, exhibit the proportional dimensions of the parts marked with corresponding letters on the drawing. Thus: for a $2\frac{1}{2}''$ valve the total length over all is 10 inches; diameter of valve stem $\frac{7}{8}''$; diameter of flange $6\frac{3}{4}''$; diameter of bolts $\frac{1}{2}''$; number of bolts 4; diameter of hand-wheel 7'', etc.

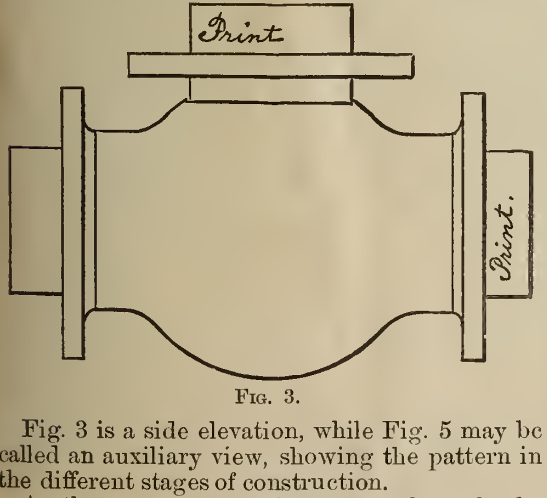


FIG. 3.

Fig. 3 is a side elevation, while Fig. 5 may be called an auxiliary view, showing the pattern in the different stages of construction.

As the pattern must be parted through the center, we first get out two pieces of wood, face them true on one side, then peg them together with two dowel-pins, and hold them in place with a stout screw. This screw should be set so that when the pattern is finished it will be about the center of the globe, or body of the pattern, as shown at *B*, fig. 5.

The blocks when thus prepared, must of course be large enough in diameter to allow for turning the globe, or body of the pattern; also long enough to make the neck and prints, with a liberal allowance for cutting off at each end.

In making small sizes of valves, we may say, up to $3\frac{1}{2}$ inches, that it is generally well to have the block long enough to make the branch; by so doing we can turn both the body of the pattern and the branch, while the piece is in the lathe, and thus save the time that would be occupied in preparing the wood for the branch and chucking it in the lathe, if these parts were turned separately.

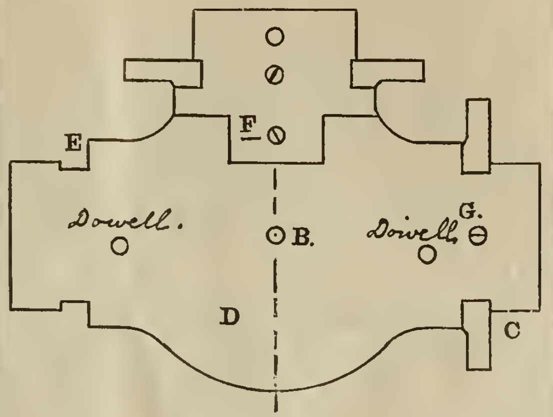


FIG. 5.

On very small valves, in fact all the sizes given in the first table, the flanges are generally hexagonal in shape, and may be cut out of the solid, but for the larger sizes, it is better to put them on in separate pieces as shown at *C*, fig. 5.

Having prepared the wood as directed above it may be put in the lathe and rough-turned down to within about $\frac{1}{4}$ inch of the finished diameter. We then make a center line around the body of the globe, as shown by dotted line *D*, fig. 5. And then at the proper distance from this center line—on each side—cut in the checks for receiving the flanges, as shown at *E*.

The piece intended for the branch should in like manner be checked in for the flange, and also have a tenon turned on the bottom end as shown at *F*, fig. 5.

At this stage of the proceedings the pattern is taken out of the lathe, and the screw which holds the pieces together may be removed and the halves taken apart. The flanges may now be fitted in place and held firmly with one or more screws, as shown at *G*. When this has been done the halves of the pattern may be put together again and secured in place with screws, as before. It is then put in the lathe and turned to the finished size.

We now take the pattern out of the lathe and at right angles with the parting, and parallel with the center line of the body, we cut off the side of the sphere, and also work out the recess to receive the tenon *F*, and in that manner put on the branch as shown in the figure.

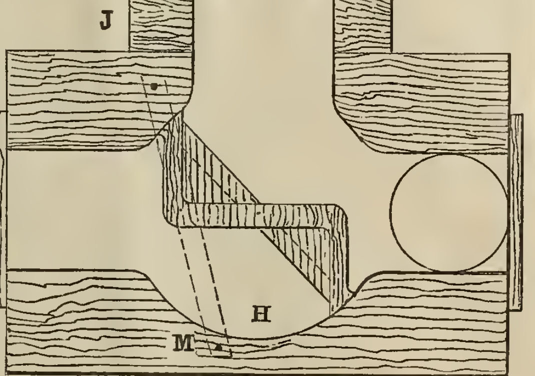


FIG. 6.

At fig. 6 we have shown a plan of the core-box required when the partition and valve-seat *G*, Fig. 1, follows with an equal thickness of metal around the circle of the valve-seat opening.

To make this box we first get a piece of wood about one-half inch longer than the pattern including the prints, and of sufficient width and thickness to allow us to work out the sphere and still have about one inch of thickness left on the bottom and sides of the same, as shown at *H*.

We then mount the block upon a face-plate and turn out the center. When this has been done we may take it out of the lathe and cut it off to the right length—taking care to have the center of the sphere an equal distance from each end, so that by reversing the position of the partitions and valve-seat both halves of the core can be made from one box. If the block is not wide enough to make the opening for the branch we will then have to put on the extension piece, shown at *J*. We then lay off the openings for the neck and branch and cut them out by hand.

In order to be able to reverse the position of the partitions we must have two pairs, or four pieces; each piece being one-quarter of a circle. They may be turned out of two different pieces, and afterwards cut apart, and when fitted in position, held so with a strip of wood made fast to the top edge and screwed to the face of the box as indicated by the dotted lines and screw-heads shown at *M*.

When the core has been made and is ready to take out of the box, we remove the screws and draw each piece separately, and then turn the core over and lift off the body of box. Each half is thus made separately and pasted together when dry.

For small sizes of valves, or when there is a great number to be made off the same pattern, these partitions should be made of brass, as they will then keep their shape and can be drawn from the sand much easier.

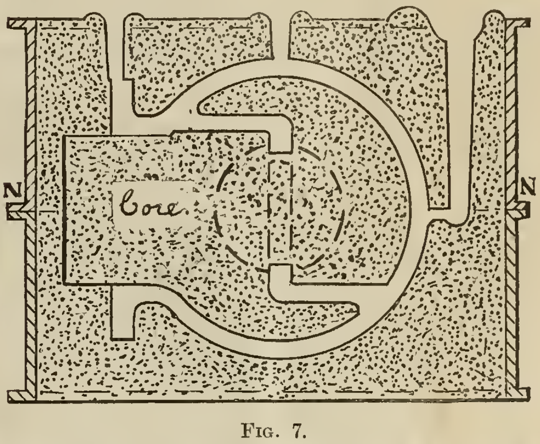


FIG. 7.

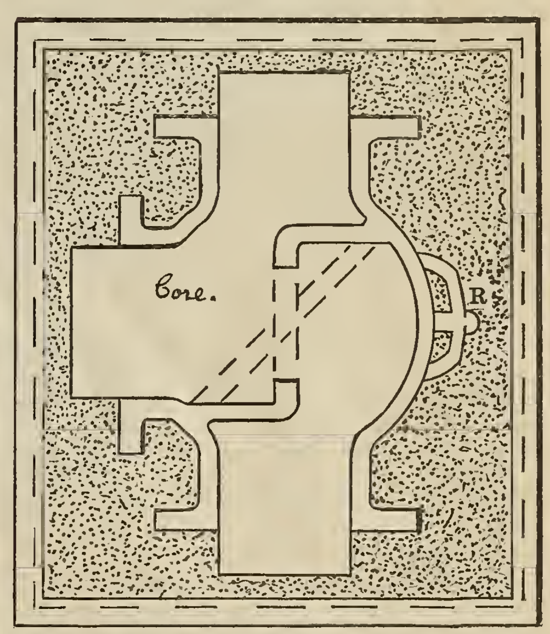


FIG. 8.

MOULDING.

Globe-valves may be cast in almost any position—either vertically or horizontally—and some moulders even prefer to set them on an angle.

A very good method of casting large sizes is shown at figures 7 and 8, and is as follows:

First take one-half of the pattern and lay it—face down—on a turn-over board. Then set in proper position the bottom section of the flask shown in fig. 7; fill it in and mould it up level with the top; turn it over and make the parting at *N*. Then set the other half of the pattern in place, put on the cope-flask, set the feed-gate and riser-pins, fill it in and ram it up in the ordinary manner of doing such work. We now lift the cope off, and draw the pattern, then finish the mould, cut the runners, *R* and set the core as shown in fig. 8. When this has been done and the cope set in place and made secure and tight the mould is ready to receive the metal.

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"CAPTAIN ERICSSON has done many things for which the American people are grateful, and there is every reason to believe that the principle upon which the *Destroyer* is constructed is correct."—*American Machinist.*

It is very kind of our contemporary to patronize Captain Ericsson.

HIGH-SPEED TORPEDO BOATS.

After several years of competition between some of the principal naval powers for the acquisition of the fastest and most powerful fleet of torpedo boats, a lull appears to have occurred in connection with the matter. The speed and great destructive power of these small craft, combined with their cheapness, have caused them to be greatly sought after during several years, and it is difficult, at first sight, to fully account for the present comparative indifference to them.

The results that have been attained with the present types of torpedo boats are so extraordinary that it only appears necessary to go a little farther, and extend the principle to sea-going cruisers, which might be efficiently protected against machine and shell guns, carry armaments of moderate power, and have a speed of twenty knots per hour. The principle adopted in torpedo boats appears to be almost on the point of being developed to something like this extent; while on the other hand the present boats are so weak in defense, owing to their small size, that the machine guns now becoming common at sea, are almost sufficient to render them useless.

Mr. Yarrow read a paper on the 9th ult. in which he gave some interesting particulars respecting the classes of torpedo boats now in existence. The largest torpedo boat yet built is 124 ft. long and 11 ft. 8 in. broad. Mr. Yarrow says that with a length of 160 ft. to 170 ft., and a beam of 19 ft. to 20 ft., a speed of 19 knots might be attained, with 1,200 indicated horsepower. In such a boat, the central portion inclosing the machinery, magazine, and torpedo-launching apparatus, could be completely protected at the sides by steel plating $1\frac{1}{2}$ in. thick, and on the top by deck plating 1 in. thick. This armored part would have sufficient buoyancy to support the ends if they were filled with water. Mr. Yarrow points out that these thicknesses are not absolutely proof against the shot of machine guns if hit under conditions favorable to the guns, but this consideration applies to all comparisons that are made between guns and armor.

It is interesting to notice the manner in which the small craft which now exist have grown in size since they were first introduced. The *Lightning* was 75 ft. long and 10 ft. 10 in. beam; and the boats constructed by the Russian authorities in 1877 were 75 ft. in length and 10 ft. in beam. In 1877 the Russian Government decided to build not less than 100 torpedo boats, which were to be of the smallest possible size, suitable for keeping the sea for a few days, and adapted for transmission by rail from the Baltic to the Black Sea. With this view the above-named dimensions were determined upon. The trial of the first boat took place in 1877, when a speed of 18 knots was obtained; and the others were completed in rapid succession.

In 1879, a large boat was constructed for the Russian Government 100 ft. in length, and 12 ft. 6 in. in beam. We have already seen with what facility the former boats could be transported by land; and it is interesting to observe how with this increased size of boat the power of steaming long distances at sea was obtained. This larger boat left England in August, 1880, with a crew of three officers and nine men, and steamed from London to Nicolaief in eighteen days, inclusive of stoppages; the distance run being 4,800 miles. The average speed upon the voyage was 11 knots per hour.

Numerous vessels of this size and class were afterwards constructed, and may be said to have formed the first of a new type of sea-going torpedo boat. Four of the class were rigged, and crossed the Atlantic under sail, arriving safely at their destination. One made the voyage from Plymouth to Buenos Ayres in seventy-two days. The captain of a similar boat, which made the voyage from London to Rio, said that they were laid-to in a heavy S.S.W. gale, of a force the like of which he had not experienced for twelve years, and she behaved admirably.

The larger type of torpedo boat appears to be able to keep the sea with great safety and to make voyages of long duration. They are apparently quite seaworthy craft; and the demand which has continually been made and still exists for increase of dimensions is not for the purpose of making them safe at sea, but to enable greater and more comfortable accommodation to be provided for the officers and crews; and also in order that the power of steaming longer distances may be obtained.

The progress which has been made in torpedo boat building since Thornycroft gave it the first impulse, is marvelous considering the short time in which it has taken place. It is wonderful not only on account of what has been done, but much more so because of the vast possibilities it appears to open up for the future.—*Engineering.*

THE HORSE-POWER OF MARINE ENGINES.

By a well-known rule of the Board of Trade, sea-going steamships must carry a chief engineer if the engines are over 100-horse-power nominal. But the Board of Trade does not say how the power is to be calculated. The result is, that a ship-owner may, within somewhat wide limits, rate his engines at any power he pleases, and thus dispense with the services of a chief engineer. Engines that are called by one man 120-horse-power are called by another 99-horse-power. That the grievance exists there can be no doubt, but it is difficult to suggest any remedy. Who is to define what engines are and are not of 100-horse-power nominal? It may be new to some that there are no fewer than eighteen recognized ways of calculating the nominal horse-power of marine engines, and these vary so much in their results, that while an engine with, let us say, cylinders 33in. and 62in. in diameter and 45in. stroke, is rated by one rule at 149-horse-power, by another it is rated at 249-horse-power. The existence of such anomalies long since attracted the attention of Lloyd's, and the engineer surveyors to the body were requested to report on the subject. This they did in 1878. The results of the inquiry were disheartening.

After carefully considering the problem, they expressed the opinion that it is absolutely impossible to fix upon any rule whatever, based upon dimensions of engines or boilers, which would give a result with every variety of engine, or even with particular types of engines, at all proportional to their actual power, and they submitted for the consideration of the committee the following:

"The registered horse-power is very misleading and worse than useless, and it does not come within the province of this Society to attempt to lay down a commercial standard for marine engines. Would it not be advisable to leave it out altogether from the Register Book, and only insert the sizes of cylinders, length of stroke, and working presure of steam?"

The true difficulty of the whole subject lies in the fact that "100-horse power nominal" has no definite meaning of any kind now. In years gone past there was practically no scope for differences among engines. The greatest pressure that could be carried in box-boilers using sea-water, was about 20 lb. on the square inch. The paddle engines in vogue were tied up in the matter of piston speed within narrow limits, and expansion never exceeded half the stroke. Under these conditions it was not difficult to prepare a rule which gave, roughly, the actual power exerted. The Admiralty rule runs thus: multiply the square of the diameter of the piston in inches by the speed of the piston in feet per minute, and divide by 6,000; the quotient is the horse-power. Thus an engine with a cylinder 42in. diameter and the same stroke, making $42\frac{1}{2}$ revolutions per minute, would by this rule be 175-horse-power. Not a word is said here about the pressure; but it was well known that the average effective pressure would not greatly exceed 15 lb. on the square inch. Calculating the true power on this basis, we have, $\frac{1385 \times 15 \times 297{\cdot}5}{33{,}000} = 187$-horse power nearly, which is not far from the nominal power. It may be urged that this rule could be modified to suit existing practice; but those who argue in this way must overlook the fact that there is nothing approaching uniformity of practice in the matter of piston speed, boiler pressures, or ratios of expansion. It is difficult, consequently, to avoid agreeing that nothing can be done.

Various attempts have been made to devise a useful rule; the results of these experiments will be found set forth in the eighteen formulæ given by Mr. Parker in his report to Lloyd's. It may be instructive to give some of them here. The proposed Merchant Shipping Act of 1871 contains the Admiralty rule modified to suit compound engines in which $\frac{D^2 + d^2 \times \text{speed of piston}}{6000} = \text{N.H.P.}$ Here D is the high and d the low-pressure cylinder. Six rules are based on the formula $\frac{D^2 + d^2}{c}$ where c is a constant varying between 26 and 33. Two rules have the form $\frac{(D^2 + d^2) \times \sqrt[3]{S}}{C}$ where S is the stroke in inches, and C is 100 in one case and 90 in another. Again, we have $\frac{(D^2 + d^2) \times \sqrt[3]{S}}{40}$ where S is the stroke in feet. Two others have the merit of simplicity; one allows 840 cubic inches of cylinder capacity per horse-power; the other takes the area of the high-pressure piston divided by 5; and so on. It is needless, we think, to say more to prove that the words "nominal horse-power" as applied to a marine engine really mean nothing.

We feel in a measure bound to suggest a remedy. We do not pretend that it can be satisfactory, but it is better in our opinion than any of the rules which we have quoted. Although there is very great room for diversity of practice in the matter of engines, there is very little in the construction of boilers. It would be far more easy to settle the nominal power of a boiler than that of an engine. The size which the grate area, bears to the rest of the boiler, even to its cubical displacement, is fixed pretty closely. The normal draught does not differ much between any two or three or two or three dozen well designed marine boilers, and it would not be difficult to prepare a rule based on some such figures as those here appended.

Let it be assumed that $7\frac{1}{2}$ lb. of coal are required to produce one nominal horse-power for one hour, and that 15 lb. can be burned on a square foot of grate per hour. Then it is evident that the nominal horse-power of the boiler will be got by multiplying the grate area by 2. Thus a boiler with three grates each 7ft. long by 3ft. in diameter would be $(7 \times 3)3 \times 2 = 126$-horse-power nominal. In practice such a boiler would supply steam for about 500-H.P. indicated, or say five times the nominal power. It makes no difference what the size of the engines may be. There is this in common among all marine engines—that there is not any wide diversity in the consumption of fuel per horse-power indicated—of course we are speaking now of good compound engines, such as are put in the best cargo boats—or in the rate at which coals are burned on each square foot of their grates. The grates are, after all, the factors which decide how much power shall be exerted; and they therefore supply the only available basis on which to determine whether a certificated engineer shall or shall not be carried. We do not suppose that any such rule is perfect, but we venture to say that a rule, based on the grate area of a boiler, must be more satisfactory all round than any one of the eighteen to which Mr. Parker refers. No matter what the pressure carried or the grade of expansion, or the piston speed, the power must ultimately depend on the grate area; and there is, perhaps, less difference between the practice of makers in this respect than in any other. If there is not grate surface enough, the fact tells its own tale, as in the case of the *City of Rome.* The engines in this fine vessel were not in fault, and the whole of the disappointment attending her first voyages was solely due to the fact that she had not boiler power—in other words, grate surface—enough to develop the required speed.

Mr. Parker and Mr. Milton say in the report before referred to: "Whether the question is looked at from the point of view of the power or the value, quite as important an element as the size of engines is the evaporative power of the boiler. Unless the boiler can supply as much steam at the full loaded pressure as the engine is capable of using, no more power will be obtained than would be developed by a smaller engine; yet it is absolutely impossible to lay down any rule for determining the evaporative power of different boilers, for not only does the relative efficiency of long and short, or small and large tubes—of which the heating surface largely consists—differ greatly, but the general arrangements of the boilers exercise a very great influence upon the evaporative power, and the estimation of these differences must always be a matter of judgment. For instance, it is a common experience for boilers which have originally been badly designed to steam better after many tubes are taken out and the heating surface largely reduced, owing to the circulation of the water being improved."—*London Engineer.*

GLASS-RIMMED IDLER PULLEYS.

A Pittsburgh firm is making pulleys with glass rims for cable roads. They are about thirteen inches in diameter, and about 2½ or 3 inches wide, and with a groove in the center of the rim to recieve the cable. Only the rim or tire is of glass, the interior part being occupied by a spider made of iron which fully supports the glass exterior, and likewise contains the hole for the reception of the axle upon which they run. The thickness of the rim from the surface to where the iron part commences is about ¾ of an inch. From experiments already made it has been proven that these glass pulleys will successfully resist any pressure brought to bear upon them, they will reduce friction to a minimum, and they will last an indefinite time. Cables on roads such as those referred to do not always remain on the pulleys, but sometimes when in operation are raised up, and upon being relaxed strike the pulleys with considerable force; even under these adverse circumstances the glass has been tried and found to resist such violence without flaw or fracture, so that all objections to its use have been met and answered. Glass will cost a little more than metal at first, but in the end will be cheaper.

The cables used on traction roads are very expensive, some of them costing from $100,000 up, so that the saving on these alone will amount to a large sum. The journals or bearings in which the pulleys run will also be of glass, and will need no oil whatever, a point much in their favor, as they are placed in an inaccessible position. This glass is made extra tough and strong, and the pulleys now being manufactured are blue, the parties ordering them preferring that tint. They take 72 hours to anneal, the average time for ordinary glass ware being about ten hours. Ordinary glass is too brittle and liable to fracture under sudden impact, and they have to be manufactured with great care. This firm make wheels and other parts of machinery for various purposes of glass. One novelty is a guide over which the silk thread passes in the process of winding, in silk mills. The thread runs through a groove in this guide with such rapidity as to wear away iron or steel in a short time, but glass never wears out, and this firm are manufacturing thousands of them for New Jersey, Massachusetts and Connecticut silk mills. They are very small in size, but great numbers are required. The firm have now contracts on hand for cable pulleys alone which will keep them very busy until July, and they are running full force.—*Pottery and Glassware Reporter.*

[Let them try a wire-drawers die and see if they can make that.—Eds. M. E.]

OPTICAL ILLUSIONS.

BY EGBERT P. WATSON, JR.

NO II.

An illusion which, although it does not come wholly under the head of sleight of hand, and is a very neat thing, is called "The Pillory." It is frequently used by so-called spiritualists, and always mystifies everyone. Of course the medium claims that it is done by the aid of the spirits. The performer brings on the stage an ordinary wooden pillory, (Fig. 3), and calls for an examination of it. Those who do so will find nothing more than an ordinary pillory, made by taking a one-inch pine board, with holes for the neck and hands, as shown. It is hinged at the end, so that it can be opened. At the other end there is a staple. From this hangs a hasp, which fits over another staple in the bottom board. A padlock can be put through the bottom staple, and when locked in position everything is held securely.

The padlock should have a spring lock, that is one which locks itself when closed. Those who are trying to find something wrong can see nothing but the pillory, the staples, the hasp, and lock. These may be looked at all night, and nothing out of the way can be found.

"Now," says the performer, "we will open the lock and leave it open. Then we will take this stick of sealing-wax, light it, and stop up the key-hole, so that no key can be used to open it without first breaking the seal. Wait a moment, though; if the wax is dropped on so, it will get inside the lock, ruin it, and prevent it from closing. For the purpose of saving the lock we will take a small bit of paper, wet it on the side which goes next to the lock, and thus stick it over the hole. Now we will put on our wax, while it is still warm. Will some gentleman kindly mark it with his ring or any mark he may choose?"

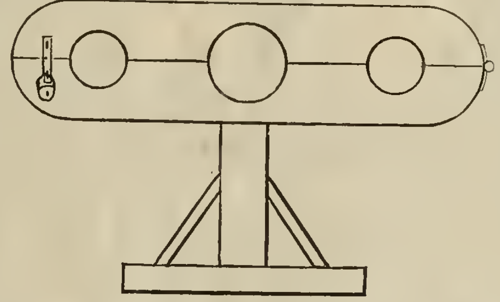
He then gives the lock to some one to hold, and asks some other gentleman to open the pillory. When it is opened he puts his neck in the central hole and one wrist in each of the side ones. These side holes are only large enough to accommodate the wrists, leaving no room for his hands to be drawn out. Then the top is shut down on the neck and hands, and the hasp slipped over the bottom staple.

"Will the gentleman who holds the lock kindly come forward and hook it into the bottom staple?" The one who has it does so. "Now, when the lock is snapped shut it will be impossible to unlock it without breaking the seal over the key-hole, won't it?"

"Yes, it seems so," says the one who held the lock.

"Very good; it may be just possible that the spirits may not aid me to-night, but I hope and think they will. Please snap the lock and tell the audience how things look."

"From all I can see," is the report given to the audience, "this man is firmly locked in the pillory. The hinges are well put on, and, in any event, the screws are inside when the pillory is closed. The locked end is locked. The hasp slips over the bottom staple and the padlock through it, holding the hasp securely. The staples themselves go entirely through the board and are solidly clinched on the back. The board itself is without a crack, and the key to the lock I hold in my hand."



"Thank you," says the performer. "Will you two gentlemen each take a corner of this small curtain and hold it before me for a moment?"

This holding of the curtain is to take the place of going into a dark cabinet as many performers do, and has the advantage of being much more simple.

In less than two minutes the performer calls for the removal of the curtain, which on being let down discloses him standing behind the pillory as before, but with both wrists and his head out, the padlock on, locked, and the seal unbroken.

"It is very simple when you know how to do it," says the performer. The man who sealed the lock identifies his mark on the wax. The performer breaks the wax from the hole, scrapes off the paper, calls for the key, unlocks the padlock and opens the pillory. "Who wants to be the next victim?" As no one does, he closes it, thanks those who assisted him, and goes on with the performance.

The mystery of the pillory is not in the padlock, the staples, the support, the hasp, the boards, the key, nor the hinges; even the screws are all right.

"Then what is there wrong about it?"

"Did I say anything about the paper over the key-hole?"

"No."

"Well, that is just where the secret lies. I put my bit of paper over the key-hole to keep the wax out? Oh! no. The wax is put on paper and marked, and all that. Did it ever occur to you that the moment the curtain was held up that I could push my wrist far enough forward to allow me to touch the lock? When I touch the lock, what do I need to do more than to slip off the wax seal? The wax isn't on the lock. All that holds the wax is the paper, and the paper simply sticks to the lock by reason of its being wet. Slip off the wax seal, and take a small duplicate key from the mouth, unlock the padlock, get out of the pillory, and lock it all up again; put the seal back, hide your duplicate key, and call for the removal of the curtain. That is the way the spirits do it. When the seal has been identified, you must make a great deal of fuss breaking the wax, scraping the paper off, etc., so your audience will not see the point you wish to conceal."

Here is something which may be new to you. This is the box trick, and is very handy to pick up other people's coins with.

It is apparently a small wooden box, about four inches long, two wide and three-quarters deep, with a sliding cover.

"Have you a small coin with you, say a quarter, or half dollar?"

Profiting by what was said in relation to its being a good trick to pick up other people's coins with, the auditors profess to be poverty-stricken.

"Well, never mind; here is a quarter which I have in my pocket. Mark it."

It is marked.

"Place it in the box."

In order to do this, draw the cover half off and into the opening the quarter is dropped. The performer then closes the cover and shakes the box. The coin can be distinctly heard rattling about; yet on being opened an instant afterward there is nothing there.

"Strange, isn't it," says this modern Mephistopheles, as he closes the box again, and, shaking it, "that you hear the coin now?"

We thought so, too, when we first saw the deception, and, try our level best, we could see no reason why the coin should have disappeared; and, in the second place, where it could have disappeared to. In addition to that we couldn't see how the coin could be heard rattling around in the box after we had seen that it was gone; and what seemed most curious was the fact that no matter how quickly the box was opened, on hearing the rattling, no coin was there.

(To be continued.)

AN ENGLISH OPINION OF OUR TECHNOLOGICAL INSTITUTES.

The English government recently appointed a commissioner to visit this country and report upon the technological institutions, and after visiting them personally the commissioner—Mr. William Mather—says of the Stevens Institute:

"My inspection of the school convinced me that, for mechanical engineering alone, I had never seen its superior. The theory and practice of the science are never separated through the four years' course. The name of Professor Thurston is well known in the engineering profession in England, and the fact that he has charge of this department is a guarantee for the training of the students in the principles of science, as well as in their application to mechanical construction."

Of the Rensselaer Polytechnic Institute, at Troy, Mr. Mather says that as a school of engineering it has won the highest reputation, and that its graduates have taken part in the most important and original engineering work in America. Professor Greene, the principal, is highly spoken of, and the whole object and spirit of the school is said to be to turn out thoroughly scientific men who know how to apply their knowledge.

The School of Agriculture and the Mechanic Arts, Cornell University, is mentioned with approval, and it is a notable fact that Cornell is "amongst those who are coming out of the old methods of what is termed 'intellectual culture;' the applied sciences are becoming recognized as forming as sure a basis for character and culture as the dead languages and higher mathematics for those who have to take part in developing and applying the resources of the country."

Of the Boston School of Technology Mr. Mather says: "This institution worthily enjoys a high reputation in America." Its graduates enter into the scientific professions without difficulty.

BREAKAGE OF SCREWS.

A writer in the London *Engineer* says: "The main cause of the fracture of screws is corrosion. Any one who examines a screw that has been a considerable time in use will discover that while that part of the surface which faces aft is perfectly sound and free from corrosion, and while the greater portion of the surface of the blade which faces forward is also sound, there will be a band of considerable breadth reaching from edge to edge of each blade, which is deeply corroded and eaten into holes, whereby the strength is so impaired that the blade finally gives way at that part. This band of corrosion is not at the end of each blade, nor is it near the middle of the screw; but its center is about one-third of the blade from the end, or two-thirds from the middle of the shaft. I will not at present offer any opinion as to the cause of this corrosion, and how it is to be prevented."

This may be true of old screws, but it is not of those which break without being corroded. Considering the work the screw does, it is marvelous that so little metal-section should do so much.—Eds.

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SIDE-RODS.

Many devices have been attempted to supersede side-rods, but none seem to fill the bill as well as Stephenson's side-rods; that they are an indispensable evil in our present knowledge of mechanical science is universally admitted; and the man that can produce a substitute that is as effective and simple without the existing evils of the side-rods, will confer a blessing upon the civilized world; for it is an acknowledged fact that a large per cent. of disabled engines, ditched trains and smashed cabs is the effect of injudicious keying of side-rods.

Of late we have had brought before the mechanical world a great many devices all claiming to do away with and to be superior to the side-rods, but I notice with but one exception they have all been signal failures.

The Webb engine belongs to the compound class, with three cylinders and four driving wheels. The two high-pressure cylinders are outside connected, and located back of the saddle, or in about the same position the guides occupy in an ordinary four-wheel connected engine. To get an idea of what excessive strains and shocks the engine and permanent way have to endure when running at high speed, pick up one end of a side-rod and note the weight, then picture to yourself that weight moving vertically through a space of 16, 18, 20 or 24 inches, as the case may be, at the rate of from 200 to 300 times a minute, and you have some conception of the destructive properties of side-rods. J. D. C.

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CARELESSNESS AND LAZINESS.

Carelessness and laziness are bad around any machinery, more especially wood-working machinery. They are the cause of more breakdowns and smash-ups than all other causes combined. Changing help often is another very serious thing in the life of machinery. One man gets used to a machine, and gets a little better pay somewhere else, then a new man comes who must go through the experience of getting used to it; by the time he gets fairly broken in, he has destroyed more than he could pay for in a year if it was charged to him. There is another class, very careful men, who always keep oil-holes plugged up nicely, and will oil a bearing and stick a plug in that fills the hole, driving all the oil out if the shaft is nicely fitted, and leaving the smallest possible amount for the shaft. They will go through this operation regularly and believe they have "fulfilled the law" twice each day in this way, never stopping to find out whether the shaft is really oiled or not. The oil is poured in and the plug put in, and that settles it, and when, every little while, some gear sticks on a stud, or a feed-roller shaft is half worn off, they fall back on the fact that their machines have been oiled regularly and the oil-holes have been nicely plugged up all the while. That is, or may be a fact, and all this time they never have looked over their machinery to see that the holes have been really kept open so they were sure oil would get to the bearings.

Very often, especially when using poor grades of oil, the bottoms of oil-holes get filled with gum, and a man may as well try to get oil through his boot heel as through it. Who ever saw a good locomotive engineer who did not carefully look his engine over after getting to the end of the route? As soon as he steps down from his engine his hand is on this box and that, and on the connecting-rods, and he feels of a nut here and a bolt there, and satisfies himself that his horse is all right before it goes to the stall; and if it is not right, everything wrong is reported, and before it is ready for another trip all the necessary repairs have been made. How is it about a wood working machine generally? The one running it has looked at his watch as many as ten times before shutting down, and just as soon as the engine stops he is half-way up the street on the way home; he never gives a thought whether boxes are hot or loose, or any nut slack or bolt broken, or anything else wrong. I do not propose to keep a man or men long in a shop after their day's work is done, for they have plenty of good, solid work if they attend properly to it during the day, and I do not grudge a man the relief he feels to getting away from the hum and tear of saws and planing machines; but if we would extend their lives to any definite time, we must see that they are well taken care of, even if it takes a little of the time that we may properly call our own.—*Dominion Mechanical News.*

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TRADE TOPICS FROM EVERYWHERE.

Mr. B. F. Johnson, proprietor of the Greeley Mills, Greeley, Col., proposes to put more machinery in his mill, erect a 100,000 bushel elevator, and put in a 100 horse-power engine.

Messrs. A. L. Jacobs & Co., Pana, Ill., intend to increase the capacity of their mill by the addition of considerable new machinery, and will also build a new warehouse and store-room.—*Millwright and Engineer.*

The Brown & Sharpe Manufacturing Company, of Providence, are engaged in erecting a new brick extension to their extensive works. The new addition will be four stories in height and about 80 feet long.

The York Manufacturing Company, Limited, of Portsmouth, Ohio, manufacturers of steel scrapers, will enlarge their factory by the addition of another story. They will shortly enter into the manufacture of roller and ice skates of new and improved patterns.

The Sperry Electric-Light, Motor & Car-Brake Co., Chicago, are placing in their works a new engine-lathe, four hand-lathes, and a milling-machine, and one drill and emery wheel in addition to their regular line of machinery, preparatory to increasing their working force.—*Industrial World.*

Fay & Scott, machinists, of Dexter, Me., are at work on a machine shop and foundry, which they expect to move into about September 1. The machine shop is to be built of brick, 40 × 80 feet, and two stories high. Their business is the manufacturing of machinists' tools, such as lathes, shapers, milling machines, planer centers, &c.

The newly organized American Iron Glass Pipe and Plate Co., Haverhill, Mass., have selected a site and purchased a lot for its new manufactory of combination porphyry, silica and glass pipe, and will at once break ground for the erection of the factory, which is to be built of brick. The establishment will be completed in the early autumn.

A company has been formed in Boston to introduce electric motors, for running all kinds of machinery, in New England, under the patents of Leo Daft. The company's circular is said to be the first piece of printing done by electric power in the country.

A paper in Ilion, N. Y., has been printed by electricity for some months.—Eds. M. E.

W. H. Thompson is proprietor of the Phœnix Iron Works, which are situated on Wasson street, between Superior and St. Clair streets, Cleveland. He is now building steam engines and doing a general machine business. The machinery is all new and of modern patterns. Mr. Thompson was for fifteen years connected with the Cuyahoga Steam Furnace Company, and has had large experience in this business.—*Iron Age.*

The Pratt & Whitney Company, Hartford, have shipped for Glasgow, Scotland, a part of a large order for machinery for a sewing machine factory. An order has just been received from Germany for a number of special machines, and the company are filling a Government order for machinery for the Springfield armory. The contract for gun machinery for the Spencer armory, at Windsor, has just been completed. A new, and what promises to be an important branch of manufacture with the company, the making of fluted reamers by a new process, has recently been begun.—*Iron Age.*

Briggs & Kelley, Ayer, Mass., make a specialty of heavy and light machine-tool and woolen machinery castings. Mr. Kelley, of this firm, has built a new cupola, which he considers a most economical arrangement over the old style. By its use he melts 8 pounds of iron with 1 pound of coke on small heats. The cupola is a round one, 38 inches, lined to 28 inches, and the tuyeres are all inside. Mr. Kelley says that any cupola can be fitted with these tuyeres at small expense, and he will warrant the furnace to do the work, as he has tried heats of 3,000 to 4,000 pounds, and used half scrap iron and waste iron from the shop. He claims to be able to melt 5,000 pounds in an hour in a 28-inch cupola.—*Iron Age.*

Walter Scott & Co. are erecting a machine shop and foundry at Plainfield, N. J., for the manufacture of all kinds of printing machinery as well as general foundry and machine work. The buildings now in course of erection are of brick, and will be of the following dimensions: Machine shop, 350 × 62 feet, two stories, each story 15 feet high; smith shop, 80 × 32 feet; boiler-room, 35 × 32 feet; engine-room, 45 × 32 feet. The foundry will be 130 × 70 feet, with wings 16 feet high, and center 30 × 24 feet high, to accommodate a traveling crane of 10 tons capacity. The shops will be fitted with traveling and walking power cranes, and rails will be laid through the entire set of buildings. The works will occupy 6½ acres and will be finished by August 1.

◆

In A Recent English Device for filtering water for domestic uses, the filtering medium is a paper disc of close texture, formed of a pure vegetable fiber pulp, with which is incorporated a certain proportion of animal charcoal from which the phosphates have been removed.

These discs are readily removable, and intended to be thrown away and a new one substituted after a few days' use.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

AS BOILER-SHOP FOREMAN.—The writer of the articles on Steam Boilers in this paper is open to an engagement to take charge of works. Has had long experience on all kinds of work, and understands it in detail. Is now employed, but wishes to change. Address, Button-Set, care Egbert P. Watson & Son, 150 Nassau St., N Y.

MARINE ENGINE DRAUGHTSMAN, 13 years experience, now holding responsible position in one of the largest British Engineering and Ship-building Works, where highest class of mail steamers and gunboats are built, desires a situation in the United States. Has sea-going experience and is competent to design all classes of machinery and superintend construction. Draughtsman, care Mechanical Engineer, 150 Nassau Street, New York.

USEFUL INFORMATION FOR ENGINEERS, Boiler-Makers and Firemen, with facts and figures. Price, $1.00. Sent free by mail on receipt of price.

W. Barnet Le Van, 3607 Baring Street, Phila., Pa.

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BLUE PRINTS OF WORKING DRAWINGS neatly executed with the utmost dispatch.

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THE MECHANICAL ENGINEER.

New Series. Vol. VIII.—No. 1.
Enlarged 1883.

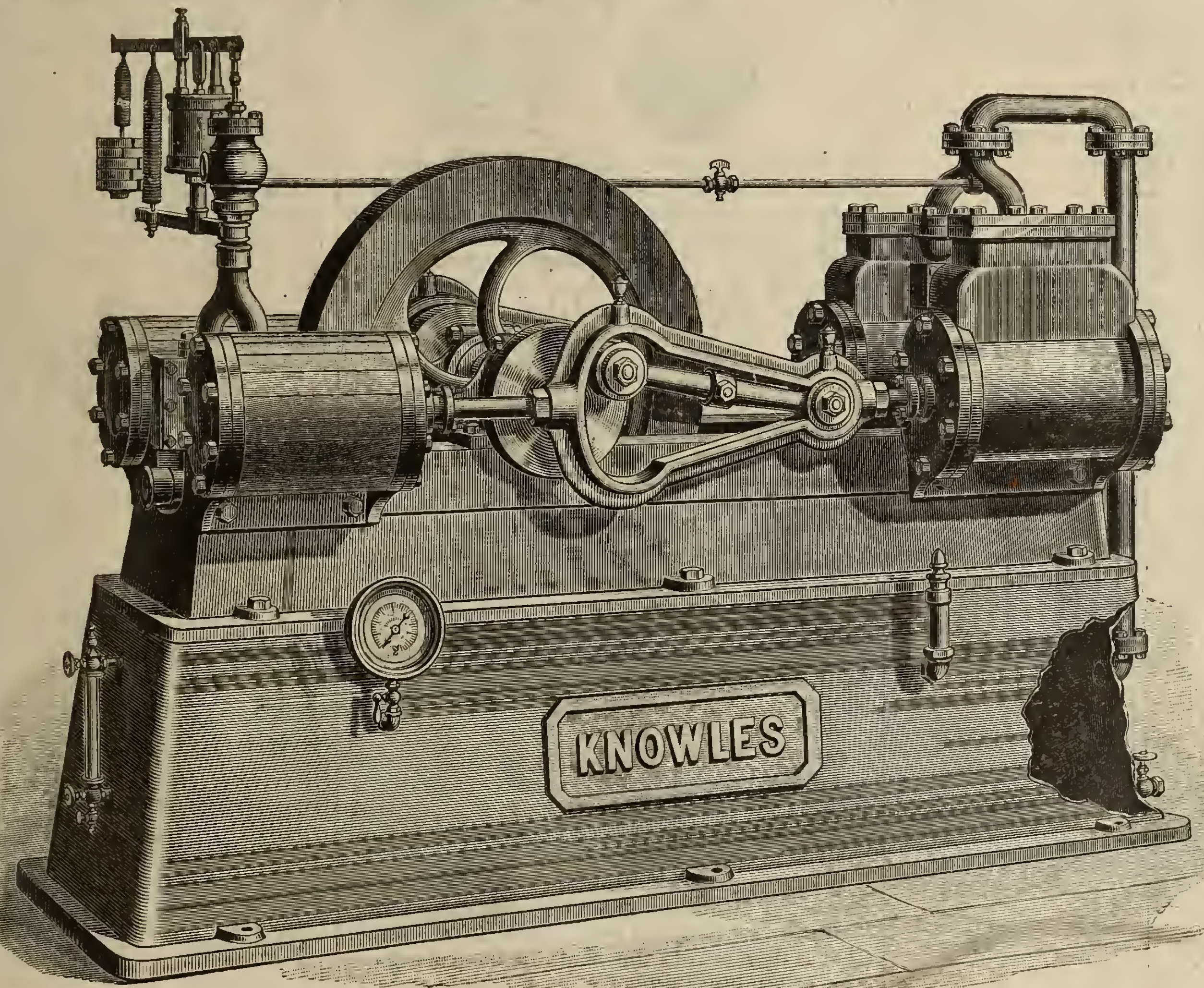
New York, July 12, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

KNOWLES' IMPROVED BREWERS' AIR PUMP.

In the operation of racking off beer from large vessels into smaller ones, air pressure is employed. Direct suction, or draught, is unavailable, for the reason that (from the nature of the liquid) an ordinary pump would not work. The beer froths, and aerates to such an extent that a direct acting pump would be inoperative.

The apparatus employed for producing the air pressure is very simple, and is shown in the engraving herewith. The steam cylinders are on the left, and the air cylinders on the right. The construction and action are as follows: In compressing the air heat is generated, and as this would be injurious if passed into the beer at a high temperature—the air is cooled in the cylinder in which it is compressed by the injection of a small quantity of water. This also serves to seal the valves and fill the waste in the clearance spaces. After performing its office the water passes out into the receiver at the bottom, which is formed in the bed plate as shown by the corner broken out on the right. The air receiver is also provided with gauges to indicate the amount of water and the pressure the air attains, and there is a safety valve, shown directly beneath the air cylinder head, which is loaded less than the strength of the casks from which the beer is racked, avoiding, of course, the possibility of bursting it by accidental over-pressure.



Knowles' Improved Brewers' Air Pump.

The apparatus is entirely automatic, and requires no special attention after being once started, for the speed of the pump is governed by the pressure of the air in the receiver. This regulator is shown on the left over the steam cylinder, and its action is readily understood. It is so adjusted that any increase of air pressure partially or wholly shuts off the steam, thereby stopping or slowing down the machine.

The operation of racking off can be carried on at several points at once if desired, without affecting the air pressure. This pump is duplex or double; the cranks being at right angles there are no dead centers, and the motion is steady and even throughout the stroke, without jar or pulsation.

The apparatus is manufactured by the Knowles Steam Pump Works, 93 Liberty street, N. Y.

◆

Slate For Roofing originally costs, per square, $4.50, and lasts at least 60 years; boards cost $2.00, and last 8 years; shingles cost $4.00, and last 12 years; corrugated iron costs $6.00, and lasts 20 years; tin costs $6.50, and lasts 20 years. Making the average costs per annum as follows: slate, 7½ cents, boards, 25 cents, corrugated iron 30 cents, tin 32½ cents, and shingles 33⅓ cents. Slate, without reference to other considerations than original cost and life, is almost four times cheaper than boards, more than four times cheaper than corrugated iron and tin, and nearly five times cheaper than shingles.—*Slaters' Journal.*

Yes, and hotter than Tophet.—Eds. M. E.

◆

It Is Proposed to deal with quicksand foundations by turning the sand into rock through the use of fluid chemicals, similar, possibly, to those by which artificial stone is made.

The *Scientific American* says:

> "A. E. C. ask how to make an enameled flesh color on raw hides, as used in making artificial limbs. A. We would advise to first coat the raw hide with a thin coat of rose madder and then apply a very heavy coat of best wearing body varnish, and allow it to dry very thoroughly before using it."

This would not give a flesh color, or anything approaching it. Rose madder is one of the most delicate colors we have, and a thin coat of it would look funny on raw hide. Rose madder on raw hide varnished would make a curious looking surface. The hide would show through everything. If our friend, who asks the above question, wants to make the surface he mentions, he should take white lead and whiting, half-and-half, and wet it up with five parts, by weight, of raw linseed oil; add one part boiled oil. Tinge the whole with the color known as light red; make it of the consistency of thick cream, and cover the hide with it smoothly. After it is dry and hard it can be sand-papered or pumiced smoother.

A Medical Paper warns young doctors against prescribing "shotgun mixtures" too freely during the summer months, as certain combinations of drugs are apt to decompose each other in hot weather. A shotgun prescription is made up of many different drugs, in the expectation that one of them may hit the mark and cure the patient.

◆

A Machinist Asks in *Cotton, Wool and Iron:* "Why is it, when you turn a shaft up to the lathe-dog on one end, and then shift ends of the shaft in the lathe, you have to dig the center over so as to make it run true with that which you have already turned, and quite frequently have to straighten the shaft? Is it because the lathe-dog pries on one side all the time, the center acting as a wedge and also as the fulcrum over which the dog pries, thus pressing the shaft off and boring in the middle?

No, it isn't. The work runs out, when changed end for end, because either the lathe center is not true or the spindle is not.

A Few Days Ago a Portland boy got a piece of steel into one of his hands. A surgeon examined the wound and decided that he would have to cut two inches to extract the piece of steel. He took the boy to the Western Light station, and tried electricity as a surgical aid. A steel instrument was inserted until it reached the piece and the instrument was then magnetized and drawn from the wound, the piece with it; leaving only a small hole where it had entered.—*Unknown Source.*

◆

Horseshoeing In Palestine.—A Smyrna letter says: "The horses of Palestine are shod with a shoe that covers the bottom of the foot, except a slight opening sometimes in the center, without calks and turned up behind.

The horse himself must have written this; it is possible that there were no calks on the opening, but how could the opening be turned up behind?

◆

India Ink is made water-proof by bichromate of potash.

NAILS.

A large dealer in builders' hardware said recently that the demand for clinch or clout nails and for chisel-pointed wire nails had largely increased within a year, as compared with that for the ordinary cut nails, and that flooring nails with the wedge-shaped heads were also used in place of the nails with the flat upset heads. His reasons were that better work resulted from the better nails, and there was far less waste. For the coarsest purposes the less first cost of the ordinary cut nails with the flat head induced builders to continue their use; but he believed the improved form and better material of the tough wire and clinch nails would, in time, drive out the inferior material and defective form. The principal advantage of the wedge-shaped head, as in floor nails, is that the head never breaks off in driving, as it is only a gradual enlargement of the body of the nail, instead of an upset across the nail. But the chisel point of the wire nail is its especial merit, as it cuts a clean passage through the fibers of the wood for the following of the body of the nail, instead of "stunting" and mutilating the fibers, as the blunt-pointed nails do.—*California Architect.*

◆

THE OLDEST LOCOMOTIVE ENGINEER is turning up with great profuseness, so to speak; he appears in contemporaries in all parts of the country, and there are almost as many of him as of Washington's body-servants.

◆

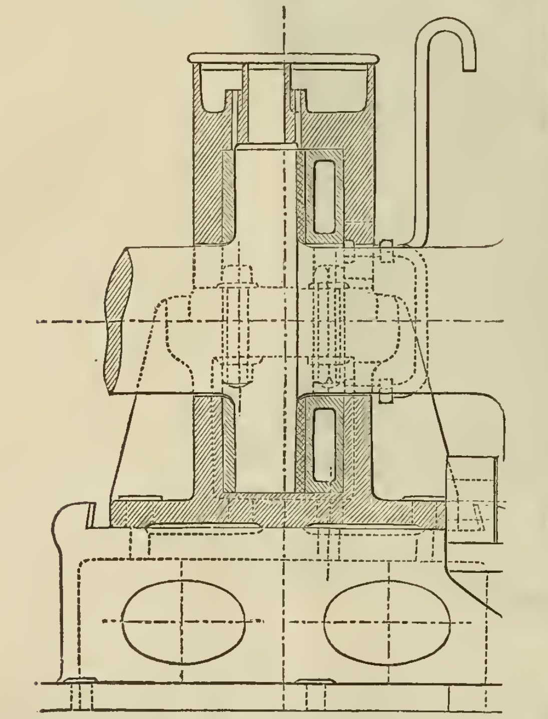
THE REV. MR. CUYLER says that college athletic exercises "lead inevitably to drinking."

So does salt fish for breakfast.

◆

AN ENGLISH THRUST BEARING.

An English thrust bearing which is sufficiently novel to warrant reproduction here is shown in the engraving. It is, as may be seen, simply one large collar forged on the shaft provided with suitable brasses for it to work upon. Just what sort of a comrade this would be on watch we cannot say from the looks of it, but we may say we do not like its appearance very well. The dimensions are not given, and we have not the original engraving at hand, but our criticism would be that there is too little surface, and the whole of it is on one face. If this gets cutting the entire bearing is ruined, whereas with our our own thrust bearing (ten or twelve collars on the shaft) any one, or two, or three, may be cut without destroying the efficiency of the bearing. As to the foot pounds of thrust itself on this bearing, if the surface is the same on one face as it is in these faces, the work in friction is the same (theoretically), though we cannot help feeling that the shaft would run lighter with ten collars than with one. All the eggs are in one basket with this bearing, and that is proverbially bad policy.



◆

ONE POUND ROCKET does not mean the weight of it, but that the bore of the case will admit a leaden ball which weighs one pound.

MARINE GOVERNOR BY BELL AND FULLER.

The tendency of marine engines to race, or run away, in heavy weather is well known to engineers, and they are compelled to stand by the throttle and watch every increase in the revolutions. The apparatus here illustrated is intended to do away with this vigilance and render the engines self-regulating in the heaviest weather.

As may be seen, this marine governor is very simple in detail, having but few parts in motion. It is absolutely positive, and automatic as well, for the pitch and send of the ship brings the governor into action. Without referring to the letters so liberally dotted over the surface of the engraving, the reader sees that this governor is merely a globular valve having its seat in a shell of the same shape set in the steam pipe. To this valve is attached a long stem weighted at the outer end. When the ship is on an even keel, the steam-ports are all clear and the engine works as usual, but so soon as the vessel begins to roll, or pitch to any degree, the governor comes into action and shuts off or admits steam. This is so plain as to need no further explanation in regard to the principle.

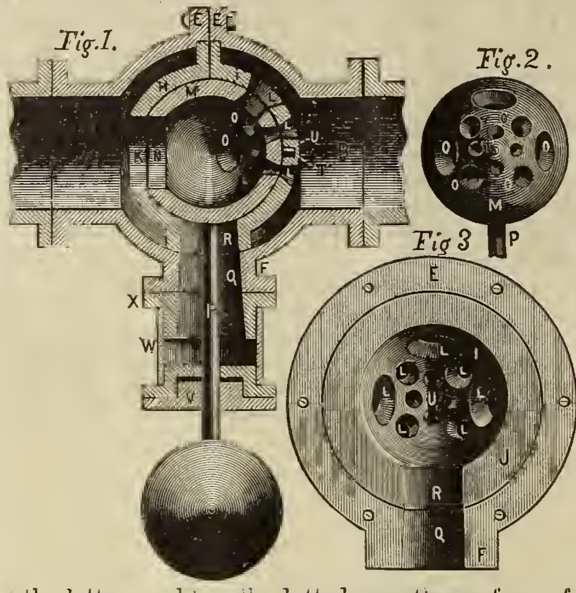


Fig. 1.
Fig. 2.
Fig 3

Aside from its automatic action this governor is as readily worked by hand as any throttle valve, and the engine may be so governed if desired, independently of the self-acting principle. The lower stuffing box is connected with the valve chamber by a short length of rubber hose *W*, which permits the necessary oscillation of the stem.

This invention has been patented by Messrs. A. H. Bell and A. Fuller. Address the latter at No. 10 Renwick street, New York city.

◆

OBERLIN SMITH has recently invented a new speed indicator, which has some valuable features. It is briefly described as follows in a paper read by him at the American Society of Mechanical Engineers' last meeting.

It consists, essentially, of a clock movement so connected with a dial indicating mechanism that it will throw the latter into gear with a spindle (that is driven from the shaft to be tested) exactly at the beginning of a given minute and out of gear exactly at its end. After the expiration of the minute there is some "waste" time allowed (preferably about one-half minute) before the clock can commence another counting cycle. At any time during this one-half minute the instrument can be removed from contact with the shaft, set back to zero, and applied again, there or elsewhere. This "overtime" gives opportunity for a leisurely application and removal, and allows the spindle to attain the full speed of the shaft before it is called upon to do any indicating work.

◆

ACCORDING TO PECLECT, the relative conductivities of heating surfaces in boilers have little or no effect on their efficiency, a different thing from their economy. A copper boiler will not make more steam in a given time than an iron boiler of the same dimensions.

◆

A 4,000 CANDLE POWER ELECTRIC LIGHT was recently placed on the top of the Washington monument, 430 feet high. At a distance of two miles there was sufficient light to enable a person to read a newspaper.

BOOK NOTICES.

THE MATERIALS OF ENGINEERING. Part III. By Robert H. Thurston, A.M., C.E. New York, John Wiley & Sons.

The present volume is the closing one of a series upon the materials used by engineers which have been previously noticed by us. Non-ferrous metals and alloys, copper, tin, zinc, brass, bronze, etc., are alluded to at length, and detailed descriptions of the proportions of the several metals entering into any alloy are specified. The quotations from authorities are very full, and the treatment of the matter such as to render it available either as a text book, or a handy work of reference for manufacturers, machinists, and all engaged in the construction or designing of machinery.

WORKSHOP RECEIPTS. For the use of Manufacturers, Mechanics and Scientific Amateurs. New York, E. & F. N. Spon.

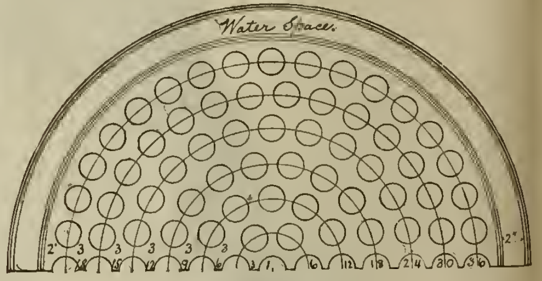
The Messrs. Spon are doing excellent work with this series, for the information contained in each volume is of great value to the classes for which it is compiled. The topics treated are very many, and minute details are given as to manipulation, and manufacture of materials that cannot be easily obtained in stores. The chapter on fireworks, for example, in this volume mentions "Cherters copper" as one of the ingredients essential to success. Not one in a thousand outside of the trade ever heard of the term, but it is very easily made and instructions follow in the book for making it. All the costly colored fires which are so useful in displays of all kinds, are specified as to their mixtures, so that for a small sum any one can manufacture them as needed.

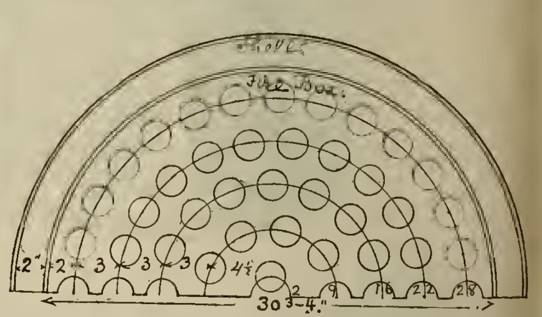
We cannot enumerate the heads of chapters, but it is safe to say to the reader that he will find in this series, reliable information upon every process known to the arts in use at the present day.

◆

LAYING OFF THE TUBE SHEETS OF VERTICAL BOILERS.

The diagrams represent a method of laying out the tube sheets of vertical boilers, which may be as new to some of our readers as it is to us. Suppose we have a boiler 48″ diam., and wish to know how many tubes 2″ outside diam. it will contain: we describe a circle of 3″ radius (6 in. diam.) and find it will space just six tubes, leaving 1″ between them for water space—this same principle follows all circles, the circumference is equal to six times the radius. In the 48″ boiler shown the figures 3, 3, 3, above the semi-diameter line denote the distance from center to center of the several tube courses; the figures beneath the semi-diameter line show the number of tubes each circle will contain. By adding them all together we get the number of 2″ tubes in a shell 48″ diameter; or of any other diameter by following the same rule. Each circle will contain as many tubes as there are inches in the diameter. This is contributed by the writer of the articles on *Types of Steam Boilers.*





◆

A PAPER ROOF, so called, is now made which is fire proof, water proof, lighter, stronger and more durable than either the wood or iron roofs that have heretofore been used.

MODIFIED SCOTCH BOILER OF THE RIVER BOAT WINONE, KENNEBEC RIVER.

By Norman W. Wheeler.

This boiler was built at the Goss Marine Iron Works, Bath, Me., to supply steam to a 14″ and 28″ by 21″ compound engine, running 140 revolutions per minute, with 100 lbs. per square inch on the steam gauge.

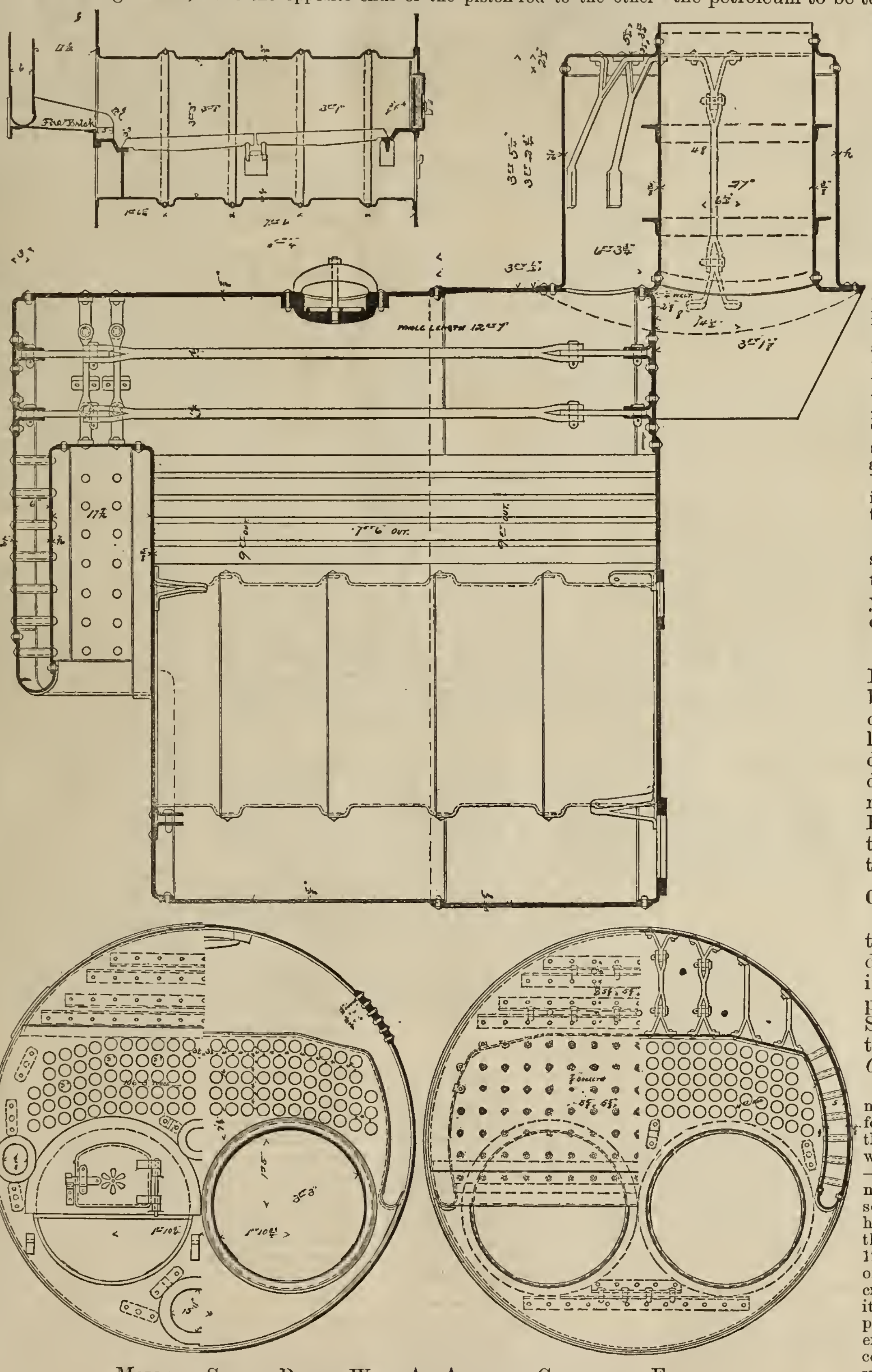
The deviations from common practice consist in the method of rendering the furnaces self-reinforcing, and in the suppression of some of the most difficult work in the return connections of the common Scotch boiler by ending the connection just below the top of the bridge walls, and inserting a plate carrying a fire-brick bottom to the connection. Thus the back connection becomes similar to a water-leg fire-box in a locomotive boiler.

This connection avoids the continuation of the lower parts of the furnaces beyond the flue-sheet, and also avoids the troublesome dust-pocket usually found beyond the bridge walls, and also the stagnant and unprofitable body of water usually surrounding the lower parts of the connection, where is generally found a collection of dirt hard to get rid of. It also avoids the necessity of any man-door in the back connection, for the soot and dust fall upon the brick connection and may be raked out at any time over the bridge wall upon the grate, with a hoe operated from the fire-doors.

This part of the arrangement I claim for myself, having never seen it elsewhere, but the design of the furnace reinforcement is due to John Madden, boiler-shop foreman.

The drawing shows the way of doing it so clearly as to render description almost superfluous. The furnace is made in rings joined with butt-straps, and the ends of each ring are flanged out like the fire-box of a vertical boiler, to meet the shell plates. These rings are fitted to lap into each other, and are single-riveted and caulked, the ends of the furnace being flanged square, to rivet to the head-plates.

I presume no one will question the static strength of this furnace—provided it be made *round*, which is not hard to do—and few will question the advantage of having the rivet-heads protected somewhat from heat by their position in the recesses, instead of projecting beyond the general surface, as they must when ordinary enforcing rings are riveted on.



Modified Scotch Boiler With An American Corrugated Furnace.

As to cost, we do not find it appreciably different from that of putting in the usual reinforce rings, when the first quality of steel plates are used. The extra riveting is compensated for by the fact that it is mostly done by the machine.

The plates of this boiler, including the angle-stays, are all of the best Nashua steel, and the stays proper are of Portland extra refined iron; the rivets and socket-bolts are Burden's, while the sockets are of gas-pipe with *square* ends. The longitudinal seams in the shell are butt strapped outside and inside, and treble-riveted in double shear, the outer rows of rivets being $\frac{3}{4}$ ins. and the others $\frac{7}{8}$ ins.

The front breeching and flue-doors are omitted in the drawing. They are of the usual kind.

We expect this boiler to last a long time, and to give little trouble from leakage.

◆

Any One Who Devises a radically new steam engine in these days will have to arise extremely early. A contemporary says:

> A novel motive power employs a radially bored cylinder, and a piston and piston-rod conforming to the circle of the same. The piston-rod extends in both directions from the piston through the opposite heads of the cylinder and is connected with a bell-crank lever, having threc arms, to one of which the pitman is attached, and the opposite ends of the piston-rod to the other two arms. The balanced slide-valve is also worked by rod connections with this crank lever.

Not at all novel. This engine, as above described, in all its essential features was invented and patented by William Wright, of Newburgh, N. Y., and one of them was put in a United States gunboat during the war.

◆

A Cylinder Lubricator known as "Noble's Pulsating Cup" is new to us. The amount of lubricant passed is regulated by means of a loose valve placed in the lower chamber of a cup with a top and bottom seating. The steam pressure in the cylinder forces the valve upward, closing it to the top seating, and allowing the oil that has accumulated to flow through. When the pressure is relieved the valve falls by its own weight and more oil gathers, which passes into the cylinder in turn. The quantity of lubricant to be supplied at each filtration is regulated by altering the distance between the seatings, and so regulating the lift of the valve.

◆

To Ascertain whether a sample of petroleum is sufficiently volatile to be dangerous, Herr Montag points out a very simple and conclusive method. He fills a glass three parts full with the petroleum to be tested, and fills up the glass with boiling water, at the same time holding a flame over it. If the vapor disengaged becomes ignited, the petroleum should not be considered a safe liquid to leave exposed to the atmosphere.—*London Engineer.*

Concerning Free Trade Fanatics, the *Sun* has these glowing words:

> "Their conduct reminds us of the peace fanatics, who flourished thirty or forty years ago, bent on the suppression of war and of armies and navies, and upon the establishment of universal peace. Their motives were heavenly and their arguments too good for this world. The stern discipline of facts has suppressed the peace fanatics, and we hear of them no longer. Very likely the free trade fanatics will also learn better some time or other."

Solomon (meant to have) said: "Though thou bray the free trader in a mortar yet will not his foolishness depart from him."

For The Past Twenty-Five Years tin mines have been discovered in this country with great regularity, but the tin itself does not appear. Another discovery of tin has been made recently in the Black Hills, and it is to be hoped, this time, that there is some truth in the report.

CONCRETE FOUNDATIONS.

Engineers who hesitate to use concrete for foundations may be interested in knowing that that of the pedestal for the Bartholdi Statue is laid with this material. Says the *Railroad Gazette:*

> "The foundation, which is now completed, is remarkable for its bolder use of concrete than has heretofore been anywhere attempted in this country—perhaps in the world, it being nearly 53 feet high by 91 feet square at the base and 67 feet high at the top, and containing the enormous mass of nearly 12,000 cubic yards. There is, of course, concrete and concrete, but such a bold use of it in a situation where it is exposed to heavy strains and is expected to last for all time, confirms what has often been suggested, that considerable economy might be realized by a greater use of it. The strains upon the foundation will be very great, as the pedestal alone (the backing of which is also to be entirely composed of beton, faced by heavy red granite blocks), will rise to a total height of 117 feet above the foundation, and the statue itself 151 feet further, making the total height 330 feet, or 53 feet higher than the Brooklyn Bridge towers."

◆

Braithwaite, who designed the locomotive Novelty in 1829, died recently at Gisborne, N. Z., aged 83.

◆

In The Last Twenty Years the Brotherhood of Locomotive Engineers have paid out $650,000 to relieve members.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

A RESPONSE TO MR. J. W. NYSTROM'S COMMUNICATION ON CAST-IRON BOILER-HEADS.

Editors Mechanical Engineer:

In your issue of June 14, 1884, page 140, there appears a communication signed John W. Nystrom, purporting to be some remarks made by him at the meeting of the Franklin Institute in May last.

As published, the communication differs in some respects from the written paper left by Mr. Nystrom with the Secretary of the Franklin Institute, of which paper I send you a copy, which you may keep for reference. It contains matter which, whilst perhaps interesting to the parties immediately involved, is not of such character or general interest as to warrant publication.

The following misstatements appear in your paper, which I feel it my duty to contradict, together with some errors in computation, which may, if unobserved, lead others to the same wrong conclusions as Mr. Nystrom appears to entertain.

In the first place, Mr. N.'s calculation of the strength of the shell rests upon the assumption that the metal upon one side of a cylinder alone resisted the pressure exerted across the entire diameter; now in this matter his calculation shows twice the strain upon the metal that really existed.

In the next place, Mr. Nystrom computed the area of flat surface upon which the pressure was operative, to be 36 inches in diameter, or in other words, the outer flat surface of the head; the fact is that the flat inside surface of the heads receiving pressure was $31\frac{3}{4}$ inches in diameter, a thick flange and an adjoining fillet making the difference.

The statement that I said that I had *adjusted* the gauges before and after the experiment is not true; I did state that I had the gauges *tested* before and after the experiment, up to the highest pressure shown in the experiment, and found the elasticity of the springs unimpaired.

The calculation of the pressure at command from the pump used in the test rests upon an assumption that the plunger of the pump was one inch in diameter, and Mr. Nystrom stated that he "measured it when the meeting was called to order." I do not doubt that Mr. Nystrom thought he measured it, but the part of the pump which he measured was really a guide, only, at the upper part of the plunger, the portion which was below, and smaller, making the fluid displacement, Mr. Nystrom never saw.

Mr. Nystrom's criticisms are all predicated of a misconception of the purpose and intention of the experiment, and hence his mistakes.

The purpose as declared by the resolution and preamble of the Institute, was to show that at present the engineering public were without satisfactory information as to the subject of cast-iron flat boiler-heads, and that whilst it was not a sufficient cause for public alarm, it was and is a proper subject of inquiry, and the resolution which is the only authoritative expression the Institute made on the subject is below:

"*Resolved,* That the Committee on Science and the Arts be requested to ascertain and report the properties and strength of cast-iron, as a material for the construction of boiler-heads and other vessels for retaining fluid under pressure, together with such rules for estimating the strength and proportioning of such structures in the different forms now in use, with economy and safety, and also the proper modes of testing and using such structures, as will be useful to those practically engaged in the manufacture and use thereof."—(From the Minutes of the January meeting of the Franklin Institute.)

The charge made by Mr. Nystrom that the untruths have been published and the truth suppressed, rests entirely upon Mr. Nystrom's believing some matters which he stated as proper deductions from theoretic formulas, against the belief which the other members of the Institute have, in demonstrations made in their presence, contradicting his conclusions; those of your readers who feel sufficiently interested can find it in vol. LXXXVII, pages 160, 207 to 209, 279 to 281, 348 and 349 of the Franklin Institute Journal.

The purpose of the experiment was to show what pressure flat cast-iron surfaces could withstand under hyrostatic test. The shell or wrought metal part of the drum was purposely made of unusual strength, and special precautions used to make it fluid-tight, so that it should leave only the flat cast-iron surface for consideration.

The strength of the ductile metal shell was foreign to the inquiry, and the introduction of this matter to notice was entirely gratuitous.

So far as "arguments" on the subject, either "specious" or otherwise are concerned, neither the writer nor any one else, excepting only Mr. Nystrom, indulged in any on the subject before the Franklin Institute meeting.

The writer simply made a public experimental demonstration, and reported the results as observed by more than twenty persons, and also by Nystrom at the same time, which results contradicted Mr. Nystrom's calculations.

The charge of perverting Mr. Nystrom's formula rests only upon his mere statement; I merely copied it and quoted it as he wrote it upon the blackboard at the meeting; the result that I stated as following legitimately from his formula was obtained by a number of members at the meeting, and my quotation of his formula agrees with the recollections of the members then present.

The statement as to the bursting of Gaffney's boiler-head by a stream of water squirted upon it, has been contradicted directly by witnesses under oath, and rests upon indirect or hearsay testimony entirely, which has never appeared in court.

Should Mr. Nystrom desire to make such "practical" test of flat cast-iron heads by squirting cold water upon them when under 100 lbs. steam pressure and the appropriate temperature, it is to be hoped that he will do so at a safe distance from everybody else; his recommendation that I should make it at short range seems, to say the least of it, unfriendly to me.

The statement that no report has been received from the Sub-Committee of Science and the Arts, up to May 26, 1884, is a mistake; the said committee has thrice reported progress, twice before May 26, and once since, as appears of record.

The sub-committee consists of Mr. Washington Jones, of the Port Richmond Iron Works; Professors H. W. Spangler, D' Auria, Koenig and Marks, of the University of Pennsylvania; Mr. Otto C. Wolf, Dr. Chas. M. Cresson, Mr. Hugo Bilgram, and myself. Dr. Robt. E. Rogers is not a member of the committee, as Mr. Nystrom has stated.

I would only add that the committee are engaged in experimentally ascertaining the rules which should govern the proptioning of such structures, and will probably make over 200 tests of heads differently proportioned, which operation will take several months to complete.

I enclose a copy of a paper which I read at the June meeting upon the subject of testing the strength of vessels; you can publish it if you see fit.

At the stated meeting of the Franklin Institute, held June 18, 1884, by unanimous consent of the meeting I submitted a statement with proofs, showing the errors of Mr. Nystrom's statements, and in reply Mr. Nystrom stated that as to the matters which he had stated as having occurred in the United States Circuit Court, he had no personal knowledge, not having been present, but he had made the statements upon information, the source of which he was unable to give; to the other matters he made no answer or reply. Your readers have, therefore, to consider the matter, if they feel enough interest in it, upon the positive and explicit testimony of the court records, made by duly commissioned and sworn officers, and corroborated by the recollections of counsel and the notes of the court, as opposed to the indirect information from a party who does not appear willing to show himself. I am satisfied with any conclusion that can rationally be reached under such a conflict of evidence. With those to whom both parties are personally known, there can be no harm done, but with others who have seen your publication, wrong and damaging impressions might result were such mis-statements permitted to pass uncontradicted or unexplained, and as the matter has appeared to impeach the purity of the channels for the administration of justice, it is due to the court as well as myself, that the facts should be set forth in the clearest light.

For the accuracy of the several statements herein concerned, I beg leave to refer you to the Secretary of the Institute, Dr. Wm. H. Wahl, Henry M. Heyl, Chairman of Committee of Science and Arts of the Franklin Institute, and Wm. P. Tatham, Esq., President of the Franklin Institute, and the Stenographic Commissioners of the Courts, Dr. C. R. Morgan and R. A. West, Esq.

I will add nothing more on the subject until the experiments in progress reach completion, when you can have a copy of the report at your service, and the details of the apparatus and experiments, should you think them of sufficient interest to your readers.

Whilst I feel that I owe an apology to your readers for occupying so much space with a matter of probably limited interest to them, I hope they will excuse it in view of the defensive position Mr. Nystrom's communication forced upon me. S. Lloyd Wiegand.

Philadelphia.

We are quite willing to devote the space required for this communication, but in justice to our readers we object to matter which discusses chiefly the motives which govern individuals under certain circumstances. This page is devoted chiefly to technical matters, and we desire to keep it free from personalities. In Mr. Nystrom's original communication there were certain assumptions respecting the motives of others which were offensive, and we struck them out. Otherwise the article is as it was written. Having given both parties a hearing we must decline further letters of the same character. If anything on the subject of Cast-Iron Heads in Boilers is submitted we shall be pleased to read it.—Eds.

◆

THE CARE OF BOILERS.

Editors Mechanical Engineer:

One of the greatest evils which engineers have to contend with is incrustation and scale in boilers. The competent engineer is always anxious to learn anything new concerning the treatment and cure of this evil. It is well known that many of the ingredients used to loosen or dissolve scale are injurious to iron.

Not only has the engineer to contend with matter held in solution and suspension, but frequently with oil, and acids which find their way from the engine cylinder into the feed-water, and thence into the boiler. The oily matter rises to the surface, or is held in suspension for a time, and unless the boiler has large disengaging surface and steam-room, the grease causes priming, or wet steam. Moreover, the greasy scum stops up gauge-cocks and other small orifices in the boiler attachments, and is a source of much annoyance and loss. The acids in the majority of non-mineral oils attack the iron under the scale, which bakes to the shell. In removing this scale by scraping, the skin of the iron will sometimes flake off, which proves that corrosion has commenced under the stratum. The surface of rolled or forged iron is stronger than the metal under it, and after the skin is destroyed by corrosion, chemical action is more rapid. Iron pipes laid in the ground for conveying hot water are sometimes destroyed in a few months, if the skin is eaten off. Galvanized pipe for hot water, if laid in damp earth, wastes very rapidly. It is only necessary to call the engineer's attention to the condition of a feed-pipe that has been in use for some time. When it is removed we usually find that it is eaten away at the ends where it was cut and threaded, but is otherwise in good condition. The same will be noticed at the end of a bolt which is tapped through the shell below the water-line. I recently examined a boiler which was almost free from scale or deposit below, but from head to head at the water-line the shell was covered with a stratum of spongy matter, varying from $\frac{3}{4}$ of an inch to 1 inch in thickness, and from six to eight inches wide. This proved to be oil from the cylinder, and other matter which had combined with it and baked on to the shell and heads.

This substance was very easily removed by scraping with a putty-knife. The greatest difficulty was encountered in removing the matter from the front head, as the heat of the escaping gases had hardened it, and it was a difficult matter to remove it mechanically. The furnace was so constructed that the side walls did not come in contact with the shell at the water-line. There was a space of three or four inches between the masonry and the boiler, except at the extreme top courses, which were laid on the shell. In this design the hot gases are supposed to envelop the steam space, preventing condensation, and by drying the steam, producing better results by supplying approximately dry steam to the cylinder.

But on examining a portion of the shell through a hole cut in the masonry, it was found to be somewhat protected from the hot gases by ashes and scale which had collected on the exterior above the water-line. This, in my opinion, is one reason why there are not more shells burned, distorted, and crystallized when this setting is adopted. As the soot and fine ashes which collect here protect the shell from overheat, it would seem to dispel a delusion (which exists) that steam is superheated by such settings. It is not the case, unless some provision is made whereby this space can be kept clean.

Another proof that superheating does not take place is, that the matter inside, on the front head (which was swept every time that the tubes were brushed out), was burned on very hard, while from other parts it could be easily scraped off.

In order to prevent the surface scum from hardening again on the head, the head above the tubes was plastered with asbestos cement. It is difficult to remove all oil from the surface in steam boilers, although most of it can be ejected through the surface-blow; but not one boiler in five has this valuable detail attached.

If the engine is used high pressure, no good reason exists why the oil from the cylinder should be allowed to find its way into the boiler, as slight expense will convert the open or spray heater into a surface-heater, and convey all drips, etc., from the exhaust into a drain, or cesspool. The same should be practiced if the exhaust steam is used for heating. It used to be the custom to put a quantity of beef tallow into the boiler previous to filling, every time that the hand-hole plates were knocked in, and it is still practiced by some to-day. But, in the main, the presence of animal fat in steam boilers is not desired by engineers. Tallow is an excellent lubricant for steam cylinders; but on account of its chemical action on parts which it comes in contact with, mineral oil has supplanted it as a cylinder lubricant.

An engineer on a side-wheel steamer used to oil his cylinder with what he termed his lubricating pills; they were composed of mutton tallow, beef tallow, and plumbago, rolled into balls about half an inch in diameter. The only apparatus was a plain cock screwed into the top cylinder-head. The cock was opened when the piston was coming up, the ball sucked in and the cock promptly closed before the valve opened for the downward stroke. A pill was inserted every half hour.

Beverly, Mass. Smoke Arch.

◆

FROM A NEW CORRESPONDENT.

Editors Mechanical Engineer:

Great benefit has been derived from reading the "*Letters to the Editor,*" which appear in every issue of your valued publication. But feelings of disgust have arisen when the flimsy articles from "the other side" have appeared. On reading these, the following extract came forcibly to mind:

"Familiarity with steam machinery, more especially with boilers, is apt to beget a confidence in the ignorant which is not founded on a knowledge of the dangers by which they are continually surrounded; while contact with steam, and a thorough elementary knowledge of its constituents, theory, and action only incline the intelligent engineer and fireman to be more cautious and energetic in the discharge of their duties."

Mr. Bradford's letter in your last shows him to be an engineer, in the true sense of the term. No engineer should allow his fireman to be the only one who enters his boiler. An engineer, claimed to be "first-class," was in the habit of leaving his fireman to do the cleaning. In course of time a change was made; the new engineer did not know it all, and as he took charge while the factory was running, he could not examine the boiler. Before two hours had passed, he asked the proprietor when the boiler was cleaned. The answer was, "we paid for cleaning it last Sunday." For the remainder of the week it was impossible to keep steam, and on Saturday night the boiler was blown out. The following Sunday an examination was made and half an inch of deposit was found upon the inside. Now, had the "first-class" man who never read a book or paper on engineering, been what he claimed to be, would that deposit have been found?

"*The Professor In The Machine Shop*" has come in for his share of abuse, but he must say as the boy said when the jackass kicked him: "I consider where it comes from." The following conversation was overheard a short time since:

"Did you read the *Professor In The Machine Shop* in the last issue?"

"No."

"Well I did, and I learned more from it about doing this work than I have in the two years and over I have been in this shop. That one article has more than paid me for the two dollars I paid for the paper."

The *Minneapolis Association of Stationary Engineers* have started on the right lead, and if they can interest a few of the employers in their behalf they are on the road to success. It would be well if all other associations would do likewise. It would do more than any other one thing to build up their membership.

The progress of all engineers' associations has been watched with great interest, and I have often wondered why the engineers were so backward in organizing. I can only explain it upon the hypothesis that they are not educated up to its principles, which, if we understand them aright, is education in the management of the steam plants under their charge.

Judging from the articles appearing in the different publications, they have selected men of good executive ability to act as officers, although they have been severely criticised. I am past three score years and have had some experience in mechanical associations, but must say, judging from what I have read, that the engineers have made remarkable progress, although opposed by some who are actuated by jealousy, as their writings plainly show. A Contributor.

Boston, Mass.

◆

ABOUT STEAM PIPES.

Editors Mechanical Engineer:

Your correspondent who recommends steam pipes laid inclining upwards from the boiler is in a dangerous error. The practice should be reversed. Water will not return to the boilers when heavy draughts are made for steam, but will be carried by the steam upward, even at a great elevation. There should be water catchers on long lengths of pipes and a receptacle at the further end to divert the water from entering cylinders, and worms, or coils, for heating. If your correspondent is an engineer, advise him to change his practice, or the results will be fearful sooner or later.

I could convert him in two minutes by relating what I personally know of accidents that have occurred by adopting his practice.

Portland, Maine. Engineer.

[We are always glad to receive letters which controvert errors of fact, or of loose statement. In this case, both sides are correct, for in some instances, where the boilers are small, the action this correspondent mentions would occur. We presume, however, that the writer in our issue of June 28th, had reference to steam which remained in the pipe after shutting down, and which, upon condensing, ran down the pipe into cylinder and steam-chest. Most of us have had this trouble, and it is a serious one on starting a large engine.

A large quantity of water varying with the capacity of the pipe and steam chest has to be blown out through the cylinder, and where the valves are on top, and the cylinder large, it does not go out as fast as it should. A good "water catcher" would be a desirable thing.—Eds.]

◆

A PLEA FOR COMPETENT ENGINEERS.

Editors Mechanical Engineer:

I am interested in the letter department of The Mechanical Engineer. I am trying to learn all I can about the steam boiler. I see, however, that some of your correspondents do not regard this subject in the right light. If the man who is "*one of the other kind*" will take a slate and pencil and solve a few problems he will find there has not been enough said about the "insignificant boiler," for I contend that boilers do not have brains enough in their domes to act at will, but the man in charge of them should have some brains in his head. For example, let him take a boiler 60″ diameter, 16′ long, with 60,$3\frac{1}{2}$″ flues, and 95 lbs. working pressure. Let him find the amount of pressure in pounds contained within. Engineers and steam users do not realize what a force they are handling.

After seeing what a boiler has to stand under the above conditions, can a man value his life or property who will trust an incompetent person in charge? Can you tell me why the laws of the United States value a person's life more on water than on land? No one is permitted to take a steam vessel across the lakes without having a competent and licensed engineer in charge. But the laws will permit unscrupulous men to employ incompetent engineers to take charge of steam heating apparatus in many of the public buildings in our cities. The recent boiler explosion at Gouverneur, New York, shows the importance of having a competent engineer. I am in favor of inspection and license.

Denver, Colorado. Inquirer In Denver.

◆

THE LOCAL LICENSE LAW.

Editors Mechanical Engineer:

I am very glad to see the local license question noticed in your paper, and hope there will be some way to have it altered, for I cannot see any justice in taxing the engineers of New York two dollars for the benefit of the "police." I cannot think engineers are any more troublesome than other men. I am sure their business requires steady, sober men, and their hours for work are longer than most working men. I dare say the wages of the police are greater than most engineers'. Then why should they not lay by something for a rainy day as well as others?

At the same time we must admit that their duties are very hard, walking up and down the shady side of the street, or standing in some well-protected doorway twirling the string of a heavy club around their finger. I do not know of a law that compels any man to be a policeman, but it seems to be a job much sought.

Now I am not opposed to paying two dollars for a license, but I wish it to go to the right place. As the law is made to protect the public it should be taxed to pay the examiners or commissioners, but let the two dollars go to support beds in good hospitals for the use of sick and disabled engineers, and let the police take care of themselves. I would like to know how the law reads and how the classes are divided. How is a man to know what class to apply for? S. A. Jones.

New York.

◆

A REQUEST WHICH WILL HAVE ATTENTION.

Editors Mechanical Engineer:

I have been an interested reader of your valuable paper for some time, and get a great amount of solid information out of it. What I would like, is for some one to give us through the columns of The Mechanical Engineer, how to design and proportion the valve motion of a Stevens cut off for a beam engine. I think it would be valuable to a great many like myself, who have not had the opportunity to learn such things but have a decided inclination to know of them. I generally read all the mechanical works I can, but have not yet found anything telling how to find the lengths of or to get the curves of the lifting toes on the rock-shaft, etc. Won't "Mr. Slocum" or the "Professor" give us the above, with an example worked out, say for a cylinder 32″ by 7′ stroke?

Portsmouth, Va. Young Engineer.

◆

A SUGGESTION FROM THE SCIENTIFIC AMERICAN.

Editors Mechanical Engineer:

We send herewith a copy of this week's *Scientific American*, containing some suggestions for rendering the transit from our ferries to Broadway more comfortable for pedestrians.

It concerns everybody having occasion to visit the city, and if you concur with our views, or have more feasible ones of your own, will you not help in a movement for bringing about some plan of relief by agitating the subject in the columns of your paper?

New York. Munn & Co.

[We have received the paper, and noted, cursorily, the article in question. It seems a matter of importance to all, and we shall be glad to consider it and receive communications from engineers as to the best methods of accomplishing the ends desired.—Eds.]

◆

ESTIMATING SPEED ON RAILWAYS.

In an account of a fast run over the Baltimore and Ohio Railway, a writer in the *Railroad Gazette* says:

> "The special's full time from Chicago to the Ohio River, 463 miles, was 11 hours and 20 minutes, an average for the entire distance, including the slow run out of Chicago, changing engines twice, 35 stops and all else, of 41 miles an hour. Deducting the stops, the actual running arrives at amazing proportions and goes upon record unquestioned as the fastest ever made. Taking out three minutes each for the 35 stops at railroad crossings, water tanks, etc., etc., 9 minutes at Newark, 8 at Chicago Junction, and the same at Garrett, the actual running time is brought down to 9 hours and 10 minutes—the astonishing average of $50\frac{1}{2}$ miles for the 463 miles as against $49\frac{1}{2}$ for 201 miles on the Cincinnati, Hamilton & Dayton, and 44 miles for 444 miles on the Pennsylvania. In this unprecedented run are, it is claimed by the Baltimore & Ohio, the fastest 6 miles, the fastest 16 miles, the fastest 125 miles, the fastest 143 miles, the fastest 271 miles, and the fastest 463 miles on record."

This train consisted of four cars, and the time was unquestionably good, as it is estimated, but liberal allowance for stops and the loose way in which they are given, leaves something to be desired.

Mention is made in the same narrative of a run of six and one half miles in five minutes, to wit:

> "Some wonderfully quick runs were made at times. In one instance, when George Alfred Townsend was on the engine, $8\frac{1}{4}$ miles were made in 7 minutes—one mile in 49 seconds; three in succession in 52, 55 and 56 seconds, respectively. At another time $6\frac{1}{2}$ miles were made in 5 minutes, and 26 miles in an even 26 minutes."

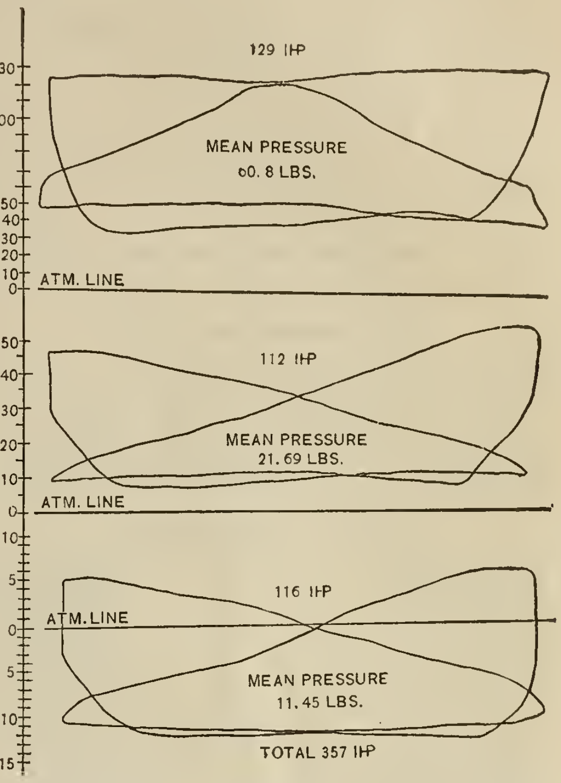
These runs were, doubtless, made down grade, and cannot be credited to the engine alone, but something must be conceded to the daring of the driver, who relied wholly upon the engines holding together for the safety of the train. Also, as an engineer on the Philadelphia and Reading R.R. remarked to us recently, "a good deal faster time is made on watches than on the track," by which he meant that careless observation, or the reckless discount of a few seconds, covered short distances at rates of speed much higher than the actual performance.

We quote again a portion of the narrative which records exceptionally good running:

> "At Washington Junction, $42\frac{3}{4}$ miles from Washington, engineer Amos Reed was given instructions to run ahead of No. 5's time. Reed is one of the finest runners on the road. At Monocacy, 6 miles, the record was 7 minutes; thence to Rockville $20\frac{1}{2}$ miles in $21\frac{1}{2}$ minutes. From Rockville to Washington, $16\frac{1}{4}$ miles, the run was made in the amazing time of $14\frac{1}{4}$ minutes, a half dozen or more newspaper men timing it with their watches in hand. The entire run was accomplished in the extraordinary time of $42\frac{1}{2}$ minutes—just a shade less than a mile a minute the whole way."

CARDS FROM TRIPLE EXPANSION ENGINES.

We publish herewith a set of indicator diagrams taken from the engines of the s. s. *Nierstein*. The engines are of the triple expansion type, and have been in constant work for six months.



The *Nierstein* is a cargo steamer of 1,000 tons dead load and a mean speed of nine knots per hour. The boiler pressure is 140 lb. per square inch, the mean indicated horse-power 360. The result of three months' working during very bad weather has been, according to the statement of the owners, a saving of fuel of 30 per cent. as compared to their best two-cylinder compound engines. Moreover, the engines being so arranged that each cylinder works its own crank and indicates almost exactly one-third of the total power, the working has been very regular and steady. The coal consumption during an ordinary run of twenty-four hours was 5 tons, the mean indicated horse-power during the time 360, thus showing a consumption of 1·3 lb. per indicated horse-power, while on the trial trip the makers claim that the coal consumption was as low as 1·1 lb. per indicated horse-power.—*Engineering.*

◆

CURIOUS REASONING.

A contemporary whose title is purposely omitted says:

> "The new unit of steam measurement, the *kal*, which Mr. Emery introduced some time ago, and which he thinks would be useful generally, and whose adoption he suggests as desirable in order to test its convenience and necessity, seems to have already met with a good deal of opposition, and it is apparently improbable that the unit will ever be extensively adopted by the engineering profession. Considering the difficulties, however, which such organizations as the New York Steam Company are liable to encounter in selling steam, the use of the term by them seems eminently proper, giving, as it does, to its consumers a unit whose significance a great proportion do not understand, which is, consequently, in a great measure, removed from the field of discussion, thus doing away with many of the annoyances which would otherwise result."

It is immaterial what term Mr. Emery chooses to apply to his units, and the subject is not of enough public interest to discuss it. What is curious, however, is the paragraph above, which says that it is all the better for the consumers if they do not understand the phrase; for then they cannot discuss it. We would like to ask our friends if they pay bills upon charges they do not understand the nature of? We think it quite probable that instead of "removing it from the field of discussion," it would introduce a great deal of very animated discussion, in which not many new terms (such as *kal*) would be noticed, but some very old and well tried ones would be exhibited.

◆

We Are Ahead Of Time this issue by reason of the holidays.

◆

One Chair in the furniture of Astor's new yacht cost $125.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors.
150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

A NEW VOLUME.

It has been our custom at the commencement of a new volume to mention the fact specifically, and to thank our friends for a continuance of their good will. A new volume is a sort of milestone in the life of a newspaper, marking off its progress. Notwithstanding the fact that the present is not the busiest season ever known, we have no occasion to be dissatisfied with the results of the past six months, particularly when these have been the best we have ever known. It is sufficient to advise our friends that THE MECHANICAL ENGINEER is steadily appreciating in value and, so far as the proprietors are concerned, has long passed the experimental stage. We judge, also, that it seems a good property to others, from the fact that, in the past six months, we have been approached by two different parties who desired to buy it. THE MECHANICAL ENGINEER is not for sale.

BUSINESS PROSPECTS.

By what we can gather from our exchanges in all parts of the country, manufacturers generally are full of orders, and are pushing their businesses with energy. There is nothing like the hurrah and feverish activity of 1880 and '82, but there is, undeniably, a healthy state of things prevailing generally. Our own business, in some degree, sets forth the improvement in trade over the earlier spring months; we have never had more inquiry for advertising space in the same time than in the current month, and we added, in one issue, over two columns of new advertisements and renewals, which for a paper that employs no canvassers, is not so bad. We do not wish to be understood as predicting a "boom"—so called. We hope there will be none. Booms are bad for trade. Every period of intense energy and activity, whether in trade or elsewhere, is followed by a corresponding reaction, and it is far better for the interests of all concerned that each one should try to make such goods as he can sell at a profit, rather than indulge in speculative ventures.

If manufacturers are having a good time millionaires are not so fortunate. Being a millionaire has great disadvantages in these days, particularly when the millions exist in nothing better than inflated stocks. Every reader of the daily papers must have marked the mortality in the fortunes of stock brokers in the past few months, and it is even said that the greatest of them all is toppling to his fall.

The pertinence of these allusions in a technical paper is very plain, for the contrast between the activity of manufacturers, and their indifference to what goes on in Wall street is one of the happiest omens for the future prosperity of the country. Manufacturers have learned that the people eat, drink, and are merry in despite of the lowing of financial bulls, or the moaning of bears in the same line. The business of the country does not stand still because Jay Gould, or Garrison, lost fictitious millions which they never had, but the carpenter builds his house and sells it; the miller makes flour and the mechanic buys it, whether stocks rise or fall. Once it was not so. Not many years ago manufacturers felt that Wall street ruled the country, but it is very evident that it has now no influence at all upon legitimate buying and selling of tangible things. In the last six months Wall street has been turned inside out, and at the present time it is very turbid indeed, with no promise of improvement. The difference between the condition of men who accumulate money by betting on the rise or fall of a certain stock, and those who make it in legitimate trade is very marked.

RUSTING OUT.

The late Prof. Samuel D. Gross said: "After fifty years of earnest work I find myself still in the harness; but although I have reached that age when most men, tired of the cares of life, seek repose, my conviction has always been that it is far better for a man to wear out than to rust out."

Why should he do either? The time was—of old—when men looked forward to fifty years of age as a period when they relaxed their hold on life, and thereafter moldered away into senility. To-day the man of fifty years who has lived temperately and cared for that "fit temple of the living God—his body—is in the heyday and high-noon of his powers. If he is of noble stuff disappointment and defeated plans only nerve him to greater efforts. "Age cannot wither nor custom stale his infinite variety." He neither wears out nor rusts out.

A great English physician, Sir Benjamin Brodie, said:

> "The failure of the mind in old age is often less the result of natural decay than of disuse. Ambition has ceased to operate. Contentment brings indolence, indolence decay of mental power, *ennui*, and sometimes death. Men have been known to die, literally speaking, of disease induced by intellectual vacancy."

The greatest men of the day are, many of them, long past three score and ten, and are as full of vigor as if half a century stretched before them. Among engineers we need only mention John Ericsson, who is over eighty years of age, yet still labors at his profession twelve hours or more daily with unabated ardor and enthusiasm. A sound mind in a sound body need fear no decay of its powers so long as life lasts.

EXACTLY RIGHT.

Take a pair of sharp pointed dividers and describe a circle. Now space the circumference into half a dozen equal divisions. Close the dividers to a degree that is almost imperceptible to the naked eye, say half of an ordinary line's thickness, and then space the divisions on the circle over again, and see how much the last point the dividers touch falls short of the original division. This gives a clear idea of the value of so-called trifles in errors of measurement, or fitting up work. It is one of the best object lessons we could have, and the most thoughtless, or careless workman, cannot fail to be struck with it.

The loss of a trifle in dimension may not affect the first member it is taken from, but we must not forget that errors accumulate and increase in compound proportion; the first is added to the second, and these two to the third, and the end is confusion. Undoubtedly many machines have failed by reason of bad workmanship alone. The principles were all right and the designs were good, but the mechanical execution of them was bad.

When, sometimes, our young friends feel that their superiors are needlessly exacting in demanding that they should split lines or centers, and work absolutely to dead lengths, they will, perhaps, recall these observations and see the force of them. "About right" is a false guide in machine work; exactly right is the only standard.

SEASONED IRON.

We have applied this term as a fitting expression for the peculiar behavior of iron under certain conditions. It is well known to practical workers in the metal that a forging, or casting, newly made is not so strong as it will be after a few weeks of rest. A special example is found in iron springs used for furniture, etc. These, when newly coiled, squat under loads they bear easily after six months of rest, and this, manufacturers are careful to give such goods.

Corroboration of the general application of the fact noted is found in some experiments mentioned by Arthur V. Abbott in Van Nostrand's Magazine; he says:

> "A curious fact observed during making the steel tests for the East River Bridge was the fact that the time which elapsed between the rolling of the bar and the experiment in the testing machine had a considerable effect upon the amount of reduction and elongation obtained. Bars which were placed in a testing machine as soon as they were cold were generally found to give a reduction and elongation of not over eighteen to twenty per cent. for elongation, and not over twenty-five to thirty-five of reduction; whereas test pieces cut from the same bar, after having been allowed to lie quietly for some weeks, gave an elongation of from twenty to thirty per cent. and a reduction of from forty to sixty per cent.
>
> "It would seem that the molecular condition of the bar just from the rolls is exceedingly unsettled, and if the bar be allowed to remain quietly for some time, a process analogous perhaps to that of crystallization takes place, and the molecules have time to arrange themselves in more accommodating positions so as to present a great accommodation to the stresses applied by the testing machine."

MARKING MACHINE PARTS.

Few minor matters cause more trouble and loss in the erection and operation of machinery in general, than the neglect to mark parts which could be transposed, or misplaced as to their locations. The eccentrics of engines have certain fixed places on the shaft which they are inclined to stray from, causing more or less trouble to get them back again. It would seem only ordinary precaution to mark the exact spots they belong in, so that by no mischance could an eccentric be misplaced. This is very seldom done, unless by engineers themselves; builders of engines, as a rule, think the precaution a needless one. Locomotives especially require this, for the engineers are often men without experience as machinists and cannot replace a slipped eccentric. What is true of this detail is also of others. Many a man down in a dark wheel pit or a shaft tunnel, or some obscure corner of a shop, has been in some doubt as to whether he was proceeding correctly or not for the want of marks. Even when parts are marked they are so faint and indistinguishable, as to cause uncertainty as to their meaning. The object of a mark, as we understand it, is to be seen; for the matter of that it should be even felt, for sometimes marks get into positions where they are not in sight, as on the back side of a coupling for instance, and in many inaccessible portions, which will occur to all mechanics. If we were marking rough castings for example, we would take a narrow round-nosed chisel, and cut in deeply as large as this letter. **X** A blind man could see that, or if he couldn't he might feel it. Marks made with a center punch are faint, ▪ too often, and are easily filled up with paint. Sometimes they are deliberately puttied up by painters, who fancy they disfigure the looks of the surface.

IS THIS GENERALLY KNOWN?

The President of an Insurance Company in this city said recently to a representative of THE MECHANICAL ENGINEER, that it was, perhaps, not generally understood by steam users that their insurances were vitiated by the employment of unlicensed engineers. If any accident occurred by which fires were caused, or the premises damaged so that the insurance people were held accountable for repairs, they were not liable unless a licensed engineer was in charge at the time. This clause, it is stated, is in all the policies of the particular company alluded to, but how it can apply in cities where there are no license laws it is difficult to see.

It behooves steam users in this city, however, whose policies carry the clause in question, to abide by it, otherwise they may find themselves disappointed in case they suffer damage at the hands of unlicensed engineers.

THE INDISPENSABLE SCREW PRESS.

The usefulness of a screw press in machine shops cannot be overestimated. It is as essential and as indispensable as a hammer. The smaller the shop the more use there is for it. The screw press need not be large or cumbrous, but the screw itself should have a very fine thread, to enable one man to exert great force. The thread should be as fine as possible consistent with durability. Aside from its convenience for straightening work, or putting offsets in the same where needed, the press can be used for forcing on wheels or other parts that are to be permanent; it will also break up castings without danger from flying pieces. In short, the screw press can be put to more uses than would seem possible from a mere contemplation of it, and it is surprising that it is not more universally met with.

SPELLING.

Reformers (alleged) in spelling are as perplexing to the average reader as an obscure cryptogram (cipher message), in that one cannot tell where the reform begins, or why it begins at all. Here is a contemporary, for example, who is perfectly sane and conservative for a page, and then, having occasion for the word "sulphuric" lays it down thus: "*sulfuric;*" it says sulphate is "*sulfate,*" and it spells graphic "*grafic.*" It spells electricity in the usual way, when, to be consistent, it should spell it "*lektrisaty.*" These are not mere typographical errors, but are repeated dozens of times. Reformers in spelling, it seems to us, are as dangerous as the metric system, and should be discountenanced.

This moves us to remark that bad spellers are by no means confined to the unlearned. Some of the best writers and men of unquestioned intellectual capacity have unique methods of orthography. We also say that, as a rule, machinists and engineers err as little as any class in this matter. We receive hundreds of letters from them in the course of business, and not one in fifty is misspelled. This is fact.

RESPECTING CRITICISMS ON THE NAVY.

While waiting a couple of hours in a lawyer's office awhile ago, I sought among the books displayed upon the shelves for some bearable reading matter, but could find nothing fresher than some numbers of the *Edinburgh Review* about a century old, and I got some amusement out of them, notwithstanding the age of the books.

Among other funny things I read an article recounted the achievements of Sir Humphrey Davy, to which was appended a lament for the future scientist, who would be forced to occupy himself with very small matters, inasmuch as Sir Humphrey had discovered and clearly formulated all the principles in the electrical field of science, leaving the future discoverer nothing, in fact, to discover, and very little, indeed, to arrange.

The tone and fundamental ideas of the effusion were strikingly similar to the critical discussions we see now-a-days in English and other papers regarding steam engineering matters, especially those concerning our navy that is to be. Without saying that the performance of our future ships will be the best possible, I would like to hint to self-sufficient critics that their articles may become as funny reading as that I have cited from the *Edinburgh Review*, in much less than a hundred years.

ENDOXUS, Jr.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LVIII.

I don't know whether what I am going to say will give offense or not, but I do know that no offense is intended on my part. I presume I shall tread upon some one's corns, but I must speak the word that is in me about a subject which seems very popular just now, and that is manual training schools. These, we are told, are to be the great sources of supply for future mechanics. Out of them are to come all the Ericssons and the lesser lights that are to take up the work we lay down. The world of engineering and of manufacturing is to go marching on and the manual training school pupil is to be the leading figure in the procession. I am sure every one—no, a large number—will say I am a fossil, and an old fogy; illiberal; behind the times; fat witted, etc., etc; but, despite all these expressions of disapproval, I do not think the manual training school pupil will be as represented in the reports of these institutions. He will have his place—the manual training school pupil—but it will not be in the front, for he is a raw recruit; he has never been under fire, and he does not know whether he is a soldier or not.

To drop metaphorical allusions and take hold of plain speech, I think the reason why many who go through manual training schools are doomed to disappointment lies in the fact that they are not mechanics; neither are they apprentices. They are not workmen, but they want workmen's wages, they aspire to direct but they know only the A, B, C, of their business. How then can they take places from the day they leave the school, which will pay them for the time they have spent in acquiring a superficial knowledge of the trade? I do not, I confess, understand how they can.

If I had a boy I would not send him to a manual training school if he intended to be a workman, and this, as I understand it, is what manual training schools are organized for. If I wanted my son to be a mechanical engineer, to design and build machines and engines, I would send him to a technological institute, such as the Stevens at Hoboken, N. J., and many others elsewhere, for the course pursued and the end aimed at do produce a class of superior men, who will, in due time, be of great service. The manual training school aims to turn out young men fitted for the work of the shop. If I do not misrepresent such schools they aim to furnish mechanics, or workmen ready made; this seems to me fallacious, and—not to be harsh in speech—cruelly deceiving the pupils. For example: There comes a great demand suddenly for workmen. I want more help; we all want more. Jones has a big contract and doubles his force. There are no men to be had; the supply is inadequate, just as it was four years ago. In this strait we turn to the training school. Send us, we telegraph, twenty young men who can do ordinarily good work. Let us suppose the order is filled and the young men are in our shop. Jacob goes to the first one and puts him on a lathe we have which persistently, and with malice aforethought, refuses to turn straight, or bore straight, and has its own ideas as to the correctness of its lead screw. We put our young friend on this lathe and demand of him that, no matter what eccentricities of behavior the lathe exhibits, he shall turn out first-class work with it.

The question is—can he do it? As I don't hear anybody respond for the pupil, I will answer myself, and say of course he cannot. Why should he? He is not a mechanic; he is not even a workman, much less the former. All his experience has been gained with lathes—that as one might say—did the work themselves. He has never had to do with the average machine shop lathe which has been handed down from remote periods, used by everyone, abused upon general principles, made and remade, and originally built by—who knows?

Perhaps some one—not an old timer—thinks I exaggerate the condition of the average machine shop lathe! Such persons should go with me a short day's journey in Connecticut, to a great shop noted for its exactness and fine mechanism, and see some examples of the tool I have spoken of. There are plenty of them everywhere.

Our young friend—the pupil—finds the lathe he is on is quite unlike the bran new one he practiced with, and if he gets his job done at all it is at the cost of so much time that his work is unprofitable to us. Then both parties are dissatisfied; the youth with his tool and we with his work. He blames the lathe, and we say his want of success is owing to the way in which he learned his trade.

"Three things I wonder at," saith one of Shakespeare's characters—"the way of a bird in the air; the way of a ship in the sea, and the way of a man with a maid." Had he ever worked at the machine trade he might have added the way of a mechanic with a wretched old hump-backed, small spindle, weak shears, shackly carriage lathe to his list of wonders. How deftly the real workman humors every caprice; how neatly he stops some whim by suddenly slamming the shipper bar back, and saying, "d—— n," (*da capo,*) and how perfectly correct to size and finish is the work he does! But our young friend cannot go and do likewise. He has not spoiled as many jobs as his elder brother has, before he learned that merely setting both centers in line was not a guarantee of straight turning. He has never sat down one moment to get a breath, after a conflict with such a lathe, serene in the consciousness that everything was all right at last, and beheld the finishing tool go slashing in on the last cut. He has never been afraid of losing his job if he spoiled the work, or, as the least punishment for ill-doing, had his ears tingle with the reproaches heaped upon him. All our young friend's ways have been "ways of pleasantness, and all his paths are peace."

That last sentence tells the whole story to the old timer, and covers all I have said before, for he knows by his own career that learning a trade, mastering the rudiments even, cannot be covered in a few short years, and that one learns as much by induction and sometimes by intuition (mechanical instinct) as by the precepts of an instructor. I am doing my job my way, and I think that is O. K.; couldn't be beat; but the boss hires a new man who runs a lathe near me, or a planer, and he beats me out of sight by his way. I learn something by that, and the next time I do the same kind of work I do it in the new man's way, but I refrain from telling him it is the first time that I ever did. That is experience, and for the very good reason that he has not lived long enough, or been far enough, our young friend of the training school is sadly misled if he is told he can go into a shop after he leaves his school and earn good wages.

He cannot. He has his uses—this pupil of whom I have spoken, but it is as an apprentice of a higher sort. He has learned the principles underlying his calling, and "this alone is great gain," but he has not learned the trade, and whoever starts him out in life with that belief assumes, in my opinion, a great responsibility.

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THE FLYING MACHINE LEGACY.

A brief item in this paper recently announced that Prof. Ritchel, of Bridgeport, Conn., had been the recipient of a legacy of $100,000, to be devoted to flying machinery experiments. This proves to be fact, and recently the enterprising *Sun*, of this city, sent a man to interview Mr. Ritchel. The account is appended:

When Prof. Charles F. Ritchel exhibited his flying machine in Philadelphia several years ago, William Maxwell, a wealthy land-owner of Wisconsin, chanced to see it. He had given considerable attention to aerial navigation, and was deeply interested in it. Three and four times a day he paid his way into the hall in which Prof. Ritchel was exhibiting, and brought with him many friends. He was so much pleased with the flying machine that he desired to have Prof. Ritchel build him one,

"I want it," the bluff old gentleman said, "for my farm in Wisconsin. When she goes up and scoots about the sky it will just make the boys wonder, and I know it."

In the flying machine Prof. Ritchel used a gas cylinder, and knowing the difficulty that Mr. Maxwell would have in making the hydrogen gas at his farm, he told him that there was a big chance of his not doing it successfully, and that then the boys might laugh at him. Before Prof. Ritchel left Philadelphia Mr. Maxwell gave him a check for $500.

"Look-a-here, Professor," he said at parting, "you are no good. You ought to sail from here right over to New York. I'll pay the damage."

Then he slapped the Professor on the back in the most friendly way and slipped the check in his hand. Not long afterward Prof. Ritchel exhibited his machine in Hartford and in Boston; while here he received this characteristic letter from Mr. Maxwell along with another $500 check.

> "Go it, old boy; I'm looking after you."

About six weeks ago Prof. Ritchel saw a newspaper paragraph to the effect that William Maxwell had died in Milwaukee, and had left $500,000 for experiments in aerial navigation, and that a Connecticut man (the name was not mentioned) had been left one-fifth of it. A day or two later it was published that the Connecticut man was Prof. C. F. Ritchel, and that he was an executor of the will. Prof. Ritchel wrote to Mr. Augustus Kroner, one of the trustees of the estate, and received the reply that Mr. Maxwell had left $100,000 for him to use in perfecting his system. The letter said that Prof. Ritchel was not an executor. Since then Prof. Ritchel has received seven letters from other persons, who say that they will leave him large amounts of money for the furtherance of aerial navigation.

"I'm glad that you are not another flying machine fiend," the Professor said, heaving a great sigh of relief. "I've been hiding for days so that they could not find me. Ever since Mr. Maxwell left me the $100,000 for the perfecting of my system my life has been a burden to me. It will probably be a year or so before the estate will be settled so that the money can be used for the purpose indicated. How it will be then I cannot say; but if the present is a forerunner, why, the best thing that I can do will be to emigrate."

Prof. Ritchel dragged out from beneath his desk a waste paper basket, in which several hundred letters were huddled together. Half as many were on the desk alongside of him.

"It's nothing for me to get fifty in a mail," he said mournfully. "I would not care so much about that, if I were not compelled to read them. I think that some of the writers are raving maniacs, and if they keep on I'll soon be in the same condition myself. Some of them write me every other day and some twice a week, and then apologize for not writing oftener. They are all very calm. This letter is a fair sample. Just look at the writing. If a straddle bug after a bath in an inkstand did not make better tracks than that, I, for one, should insist that it was not sober:"

> Providence, R. I., June 2, 1884.
>
> Sir: I see by the papers that you hold in trust money to be expended in experiments of a machine to navigate the air, and as I have tried two different experiments I have come to the conclusion that the only practical way is by applying compressed air as a motive power, to be applied to rotary wings. Now, as I wish to try some more experiments I should like to get one hundred and fifty dols. and if successful you can share one half the profits of the machine. —— ——.

"Some of the letters are truly remarkable," the Professor continued, "and the inventions they refer to run ahead of those which Gulliver came upon in his travels—where they proposed to extract sunlight from cucumbers, and bottle it for rainy days. A St. Louis man wrote me that he had invented a flying machine on the 'frog system.' It was arranged, he said, to take long jumps, and would think nothing of skipping over a town. I'll just read you a few extracts from some of the letters.

> "I have solved the flying machine problem. I propose to compress 50,000 cubic feet of hydrogen gas in a small cylinder. I can put the cylinder under my arm, and fly wherever I like.

"The coolness of some of these persons verges upon impudence:

> "Sir: I would like you to send me money to complete the only practical flying machine that there is. I will not tell you what it is, because, like all inventors, you would utilize the idea and say that it was your own. I can force you to use my plan.

"This man is enterprising, anyhow:

> "I have the only real flying machine on earth. Send me $500 at once for to start on the drawings and the first machine. I will send for $500 more if the first $500 is not sufficient.

"A Detroit man writes that he has the only possible flying machine. He has studied flying machines all his life and cannot err:

> "My machine can start in a cyclone, run an hour and a half, and then come down in the same spot where it started from.

"A man from Bangor, says:

> "I can build a flying machine and guarantee it. Send me a check for $500 at once.

"This person is an observer of nature:"

> "Have you ever observed a grasshopper? Well, my flying machine is constructed on the same principle. I have caught and examined many grasshoppers. When they rise in the air through their spring in their legs, they shoot out their wings, which is a considerable help to them. I propose to build a machine after the fashion of a grasshopper. Please send me $1,000 as a starter.

"The woods are full of flying machine fiends," Prof. Ritchel continued, as he swept several dozen letters into the scrap basket. "They are springing up everywhere. There was a time when all the cranks were at work on perpetual motion, but lately they have given that up and have turned their attention to aerial navigation."

Prof. Ritchel will shortly construct a flying machine which will run up in the air 200 feet. There will be no balloon attachment. The power used to rotate the two fans that will raise the machine will be supplied from air compressors on the ground, by means of a rubber hose. This apparatus will have no steering gear, and is only intended to show the principle on which the system is based. After the experiment another apparatus will be constructed with steering gear, and will carry its own air reservoirs. Prof. Ritchel's system is based on scientific principles, and, in a small way, has been successful. The money left by Mr. Maxwell is to be used in these experiments.

Prof. Ritchel says that it is impossible to construct a flying machine that will work where the balloon principle is used.

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NOVELTIES IN FIREWORKS.

One of the new things is a "golden shower candle." This sends out a ball which differs from that thrown by the ordinary Roman candle in that it leaves a trail of fire behind it and resembles a rocket in its flight. Then there are steel-spangled candles, throwing a ball, which explodes into a number of small, fiery spangles, producing a brilliant effect. In sky-rockets, the short-sticked rockets are the favorites, though the old-fashioned kind with long sticks continue to be manufactured. The colored parachute rocket, while not exactly a novelty, will probably be sold and used more largely than heretofore. These rockets, when at a great height, discharge a star of heavy caliber, suspended from a parachute, which is set free, expanded, and illuminated by the bursting of the rocket. The parachute explains the mystery of the floating stars, remaining visible so long a time and changing colors so frequently.

One of the campaign novelties are bomb-rockets, which, when at their highest altitude, explode with a loud report. They are used for salutes at political meetings and in parades. Then there are colored exhibition rockets, of unusual size, weighing from two to four pounds. They explode and discharge red, blue, and green peacocks' tails, comet-like stars, steel-spangled stars, and other effects. These are considered the finest rockets produced. A special novelty, made by one company only, is a rocket which throws out two parachutes with stars at one time. The greatest of all rockets, however, are probably the "Pleiades" rockets. They weigh six pounds each, and cost $60 a pair. When at their altitude they explode and throw out seven floating, changing lights suspended from balloons. Another startling rocket is the telescope repeater. This ascends to a great height and then explodes, releasing four more rockets, which continue in an upward flight and burst into showers of colored stars. The colored tripod rockets are something new. They have, instead of sticks, three legs, which are adjustable, allowing the rockets to be set perpendicularly on the most uneven ground, and obviating the necessity of a trough or guide of any kind.

Another novelty is the colored torch. These look like an ordinary pine-knot torch, and turn blue, red, or green, lasting about fifteen minutes each. Colored floral bomb-shells will throw out showers of colored stars and then project a bomb-shell 300 feet into the air, where it explodes and throws out stars of every hue. The colored floral fountain is one of the novelties in stationary pieces. It throws upward and outward liquid drops and spangles and sprays of fire, which produce the likeness of a large fountain in action. These are entirely new, and the manufacturers praise them highly. They are provided with a sharp wooden base which can be pushed into the ground. The colored star mine is another handsome illuminating piece. It consists of a substantial tube case, with a wooden base. It is charged with colored fires, stars and streamers of various hues. In the final discharge these are thrown up and scattered high in the air. Manufacturers of fireworks declare that these are similar to a volcano in action, and are warranted to strike terror to the soul of the boldest servant girl who ever stole out of a kitchen to witness an exhibition at Coney Island.

A number of stationary show pieces of handsome appearance and reasonable price are in the market. One represents a fir tree in variegated colored stars, intermingled with showers or sun-fire. Another sends out a showering cascade in fire of colored stars, shooting upward and at angles on the sides. The "shower of pearls" is composed of a massed battery of colored candles in the center, shooting stars high upward, while on each side are fountains of brilliant fire shooting downward. The colored illuminated vertical consists of a large wheel bearing on its arms a star of lance fires in crimson and green, which in revolving blend in harmonious colors in the center while the changing spur fires form extended rings on the outside. The Aztec fountain has a massed battery of candles at the top and a revolving piece in the center, and candles again below.

The sparkling caprice is considered one of the handsomest pieces made. It consists of an arm, in the center of which is a revolving piece which carries around the entire arm and flaming pieces on each end. When going very fast this whole piece suddenly stops and starts off in an opposite direction. The man in the moon is a comic face, illuminated, while streams of fire spurt from behind it. George Washington is also treated in the same way. The "phantom circles" are curious ring effects in fire. The center piece is an upright revolving ring, inside of which and revolving in an opposite direction is a colored flyer. Above and below this are colored flyers revolving horizontally and in opposite directions.—*New York Times.*

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A Little The Cheapest Bid for a "free notice" is a strip of tin sent to publishers by Chicago advertising agents. This is supposed to be a printer's rule and fair equivalent for words of praise; its intrinsic value is about $\frac{1}{4}$th of a cent.

NOTES ON ENGLISH MACHINE TOOLS.

By Edward I. H. Howell, of the Engineers' Club, Philadelphia.

Many English machine tools have been imported during the past few years, and it will be of interest to examine into the construction of the average good tool of this type, as compared with American makes.

The same styles of lathes are made by nearly all English tool builders, the variations being mostly in swing and finish. There seems to be an accepted model for each size, which with a few modifications is followed by all builders. Thus, for instance, all lathes, from the smallest foot lathe up to the heaviest tool, are built with a gap, or in the largest sizes with a break in the bed. A lathe without a gap or break would with most makers be a special tool, and only built to order. English shops prefer a combination tool, and will not buy two machines if one can be made to do the work. Change gears, and gears generally, are cast, not cut; the makers insist that this method makes a stronger and better gear, and quite as accurate as if cut. Few American tool builders will believe this, however. Hand wheels or handles on the apron of lathes for moving carriage or tool block, are always loose and with a long leverage, made necessary by the method of construction, which is calculated to develop the muscle of whoever runs the lathe. The carriage is usually geared, so that the handle moving it must be turned away from the direction of motion. English lathes are all heavier than American makes, and this with the design, which in the smaller lathe is but a reduction in size of the larger tool, makes all up to about 40 inches swing look very clumsy.

The English tool builder seems to despise all adjustments for quick changes and rapid work, and constructs a machine in which time and muscle are important factors. Small and medium-sized lathes of English make would be dear at any price in American shops, and the larger sizes would give satisfaction only on heavy work requiring little change, where a powerful tool at a low price is needed.

The universal use of the twist drill has developed the American drill press to a very high degree of perfection, and nothing better is made than our small and medium-sized machines. In England, however, the old flat drill still holds its place in the affections of the workman, and many of the smaller presses he uses would be considered obsolete in America.

In radial drills English builders offer a wide range of styles, some of the larger sizes being excellent tools, which could find a place in American shops where heavy work calls for a powerful machine. Still, for general work, the best of the American tools would give in every instance greater satisfaction.

English planers approach nearer to American designs than either lathes or drills; the smaller sizes are, however, entirely unsuited for shops on this side of the Atlantic, being clumsy and awkward to handle; and the large tools are not equal to American planers in quickness of adjustment and adaptability to various work.

English lists specify a range of sizes and styles in shapers greater than American shops think necessary to build; and although the smaller sizes of English shapers are clumsy, they are good tools. The largest sizes are probably superior to anything turned out in America so far as weight and power are concerned, machines of 8 or 10 tons weight, and 24 inches stroke, not being uncommon.

Slotting machines are probably the only English tools of which all sizes could be used in American shops with good results. The variety of styles built in England is remarkable, and the best shops turn out excellent tools at very moderate prices. Boring mills seem to be unknown in England, their place being poorly supplied by gap lathes, drill presses and horizontal boring machines.

In small machine tools are comprised the large class of milling and screw machines, and in all other small tools used by machinists, England has nothing but the simplest and crudest forms. However much the English manufacturer dislikes foreign machines, he is compelled to use American small tools (or their copies made in Germany). It seems to be impossible for an Englishman to copy exactly any machine; the result of all such efforts being usually a tool very different from the original and spoiled in the process. The ideas of the English mechanic are reflected in the tools he builds. Conservative to a fault, and distrusting all novelties, he considers American tools as mere makeshifts. The tools he builds must be solid, clumsy, and often out of all proportion to needed strength.

The English workman wishes a tool that looks as if it could not be easily moved, a piece of metal with "no nonsense about it;" when he takes hold of the handle to move the carriage of his lathe, he feels sure that there is a carriage there.

The influence of American ideas on the English tool builder is becoming more marked every year. Progressive Englishmen are coming to see the true value of the improvements introduced here, and at no distant day we may expect to see many tools from Great Britain which can be used with entire satisfaction in our shops.

[Not so long as our own shops can turn them out.—Eds.]

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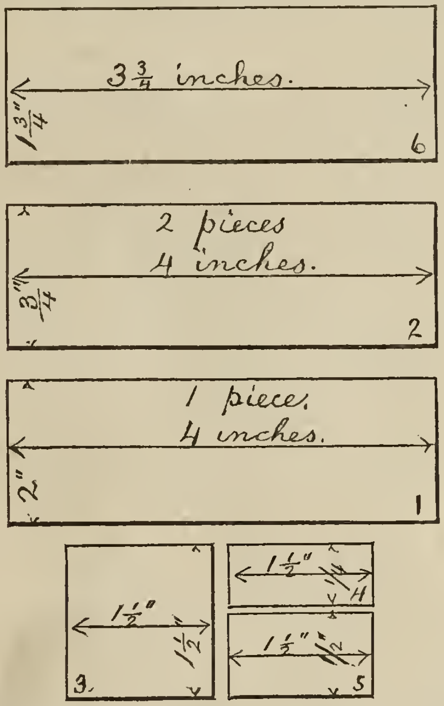
OPTICAL ILLUSIONS—No. III.

By Egbert P. Watson, Jr.

In the last article on this subject I mentioned a box trick and will now explain it and the construction of the apparatus:

The box itself is the only machinery used. No traps about the body or similar devices are called into play. As the box is the only deception, let us have a look at it. To all appearances it is as described previously—four inches long, two inches wide and three-quarters of an inch deep, with a sliding cover. The first thing to be done is to show how to make it, as well as how to use it. Proceed thus: Procure a piece of black walnut one-quarter of an inch thick and cut from it pieces to correspond with the following drawings:



This is what is called a "working drawing," and explains itself in less time and space than the same thing in words would do, as figures, dimensions and all are given.

After having made the pieces according to the plans, put them together in the following order, fastening everything with glue and small brads. Number 1 is the bottom; to this fasten the two sides, number 2. Before driving the brads entirely in, put number 3 on one end and number 4 on the other, taking pains to have the pieces all join neatly. Now fasten all these together.

Having fastened the bottom, sides and ends together, let us go to work on the cover. Number 6 is the article in question, and to one end of it we will fasten number 5. This makes a return, as it is called, and its duplicate or fac-simile may be noticed in many boxes with sliding covers. You will notice that the cover is marked in the drawing one and three-quarter inches, while the box is two inches. This is correct, because we must now make a groove in the inside of each of the sides (number 2) one-eighth of an inch wide by one-quarter of an inch deep from end to end. If the pieces have been made exactly to the sizes marked in the drawing, the grooving can be made to better advantage before the box is put together. Now it is nearly all finished. Fill up the holes left by the heads of the brads with putty to which burnt umber has been added. Rub the whole with a bit of cloth covered with shellac varnish. The best way to get good results from the use of shellac is to wet a small piece of cloth with it, and inclose this in another piece of cloth wet with raw linseed oil. This gives a fine finish. After the first coat has dried, which it will do while you are rubbing it in, sandpaper it off and put on another, as the first, by sandpapering, will fill the pores of the wood and cause the second coat to shine like a new coin. If you want a really fine finish, three, or even four, alternate applications of sandpaper and shellac will produce it. Now our box looks like Fig. 5.

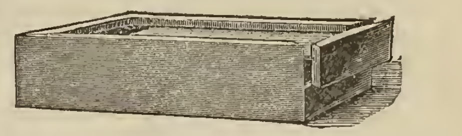


Fig. 5.

You will observe that the box, being three-quarters of an inch high, and the wood one-quarter of an inch thick, it must naturally follow that the open space between the "top of the bottom," as an Irishman would say, and the bottom of the cover, is one-quarter of an inch. Look back again to the working drawing and see what the size (depth) of the return on the cover is (No. 5). One-half inch it is marked; it just touches the bottom, you see. Now, look once more, this time at the open box. You see that the cover being open, a space is left at the end to the right, so that anything put in at the opposite end must naturally slide out.

In performing, the open box is held in the hand by the end, thus hiding what has been here spoken of. Of course the moment a coin is put into the box it slides into the performer's hand. Then the box is closed and shaken, and the coin is heard to rattle, but cannot be found when the box is opened again.

"Ah! but, Mr. Conjuror, you must be mistaken. The coin can't rattle when it isn't there. There is something yet you haven't told us."

That's so. I almost forgot to tell you how to make a coin rattle in the box when it isn't there. To do this, you must make a recess in the bottom of the box and almost through. In this recess a small piece of brass rests, pivoted at one end and loose at the other. On the other end of the recess a small piece of brass is fastened with its free end resting on, and holding by close contact, the top* of the loose end of the brass piece. The way it appears, with the box bottom upward is shown in fig. 6. Cover the bottom with a thin piece of veneer and paste a green cloth all over the whole of the bottom. When the coin is gone and you wish to make the box rattle (after closing), press on the bottom where the spring, *a*, is. This will release the metal piece, and by shaking the box the brass will rattle from side to side, giving the impression that it is the coin which produces the sound. The moment that the pressure on the spring is relieved, the "rattler" will stop, because the spring holds it against the bottom. By keeping your mind at work, the coin which you have caught in your hand may be disposed of by deftly dropping it into somebody's open pocket in the audience while you are there, and then afterward, when they begin to tire, suddenly call upon the person you have made an unconscious possessor of it to "shell out." If neatly done, this will cause considerable amusement, as no one will connect its presence in the auditor's pocket with your visit there. Upon the person's reproducing it, ask him to return it, not to you, but to the person from whom it was borrowed, whom you ask to identify it. The reason for this is, that should it pass through your hands to the owner, suspicion will naturally attach to you, people thinking that some "change has been made." This finishes "the box trick."

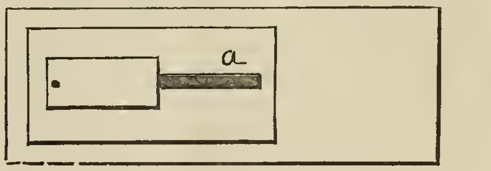


Fig. 6.

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*The top referred to is the portion which is up when the box is resting on its bottom.

Here is something which, for want of a better name, we will term "The tobacco-smoke illusion."

The performer asks for some gentleman to come up on the stage who smokes. After he finds one he inquiries whether the smoker can tell a good cigar when he uses it. The answer invariably is "Yes."

"In that case," continues our conjuror, "allow me to present you with one and ask your opinion regarding it. It is taken from a quantity made for one of our Bonanza Kings; the brand is called Hodcarriersrevenga Furiosa. There is only one restriction which I wish to put upon you—many ladies in the audience are very much prejudiced against the smell of tobacco smoke, and to avoid their being annoyed I propose to collect as much of it as possible. To do this I will take this ribbon (shows an ordinary one, about ten or twelve feet long) and tie one end of it to your cigar. The other end I knot around the foot of this clean, clear glass goblet."

This done, the cigar is lit and smoked, the performer holding the goblet in his hand, standing as far away from the smoker as the ribbon will allow. When the cigar is fairly well lit, he continues:

"The greater part of your smoke is invisibly passing along the ribbon to the glass and into it. To demonstrate that this is the fact, I will use this other goblet (in every respect like the first one) as a cover to the first, simply inverting one over the other."

In a few seconds the audience see that the covered goblet is filling with smoke, although tightly closed. When it becomes entirely full, the covering goblet is lifted, allowing the smoke to rise till the covered goblet is empty; then it is covered again and the process is repeated *ad libitum*.

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THE SIX GATEWAYS OF KNOWLEDGE.—No. II.

Another question that often occurs is, "Is there an electric sense?" Has any human being a perception of electricity in the air? Well, somewhat similar proposals for experiment might, perhaps, be made with reference to electricity; but there are certain reasons, that would take too long for me to explain, that prevent me from placing the electric force at all in the same category with magnetic force. There would be a surface action that would annul practically the force in the interior, there would be a definite sensation which we could distinctly trace to the sense of touch. Any one putting his hand, or his face, or his hair, in the neighborhood of an electric machine perceives a sensation, and on examining it he finds that there is a current of air blowing, and his hair is attracted; and if he puts his hand too near he finds that there are sparks passing between his hand or face and the machine; so that, before we come to any subtle question of a possible sense of electric force, we have distinct mechanical agencies which give rise to senses of temperature and force; but that this mysterious, wonderful, magnetic force, due, as we know, to rotations of the molecules, could be absolutely without effect—without perceptible effect—on animal economy, seems a very wonderful result, and at all events it is a subject deserving careful investigation. I hope no one will think I am favoring the superstition of mesmerism in what I have said.

I intend to explain a little more fully our perceptions in connection with the double sense of touch—the sense of temperature and the sense of force—should time permit before I conclude. But I must first say something of the other senses, because if I speak too much about the senses of force and heat no time will be left for any of the others. Well, now, let us think what it is we perceive in the sense of hearing. Acoustics is one of the studies of the Birmingham and Midland Institute, of which we have heard many times this evening. Acoustics is the science of hearing. And what is hearing? Hearing is perceiving something with the ear. What is it we perceive with the ear? It is something we can also perceive without the ear; something that the greatest master of sound, in the poetic and artistic sense of the word at all events, that ever lived—Beethoven—for a great part of his life could not perceive with his ear at all. He was deaf for a great part of his life, and during that period were composed some of his grandest musical compositions, and without the possibility of his ever hearing them by ear himself; for his hearing by ear was gone from him forever. But he used to stand with a stick pressed against the piano and touching his teeth, and thus he could hear the sounds that he called forth from the instrument. Hence, besides the Ear Gate of John Bunyan, there is another gate or access for the sense of hearing.

What is it that you perceive ordinarily by the ear—that a healthy person, without the loss of any of his natural organs of sense, perceives with his ear, but which can otherwise be perceived, although not so satisfactorily or completely? It is distinctly a sense of varying pressure. When the barometer rises, the pressure on the ear increases; when the barometer falls, that is an indication that the pressure on the ear is diminishing. Well, if the pressure of air were suddenly to increase and diminish, say in the course of a quarter of a minute—suppose in a quarter of a minute the barometer rose one-tenth of an inch and fell again, would you perceive anything? I doubt it; I do not think you would. If the barometer were to rise two inches, or three inches, or four inches, in the course of half a minute, most people would perceive it. I say this as a result of observation, because people going down in a diving bell have exactly the same sensation as they would experience if from some unknown cause the barometer quickly, in the course of half a minute, were to rise five or six inches—far above the greatest height it ever stands at in the open air. Well, now, we have a sense of barometric pressure, but we have not a continued indication that allows us to perceive the difference between the high and low barometer. People living at great altitudes—up several thousand feet above the level of the sea, where the barometer stands several inches lower than at sea-level—feel very much as they would do at the surface of the sea, so far as any sensation of pressure is concerned. Keen mountain air feels different from air in lower places, partly because it is colder and drier, but also because it is less dense, and you must breathe more of it to get the same quantity of oxygen into your lungs to perform those functions which the students of the Institute who study animal physiology—and I understand there are a large number—will perfectly understand. The effect of the air in the lungs—the function it performs—depends chiefly on the oxygen taken in. If the air has only three-quarters of the density it has in our ordinary atmosphere here, then one and one-third times as much must be inhaled, to produce the same oxidizing effect on the blood, and the same general effect in the animal economy; and in that way undoubtedly mountain air has a very different effect on living creatures from the air of the plains. This effect is distinctly perceptible in its relation to health.

But I am wandering from my subject, which is the consideration of the changes of pressure comparable with those that produce sound. A diving bell allows us to perceive a sudden increase of pressure, but not by the ordinary sense of touch. The hand does not perceive the difference between 15 lbs. per square inch pressing in all around, and 17 lbs., or 18 lbs., or 20 lbs., or even 30 lbs. per square inch, as it experienced when you go down in a diving bell. If you go down five and a half fathoms in a diving bell, your hand is pressed all round with a force of 30 lbs. to the square inch; but yet you do not perceive any difference in the sense of force, any perception of pressure. What you do perceive is this: behind the tympanum is a certain cavity filled with air, and a greater pressure on one side of the tympanum than on the other gives rise to a painful sensation and sometimes produces rupture of it in a person going down in a diving bell suddenly. The remedy for the painful sensation thus experienced, or rather I should say its prevention, is to keep chewing a piece of hard biscuit, or making believe to do so. If you are chewing a hard biscuit, the operation keeps open a certain passage, by which the air pressure gets access to the inside of the tympanum, and balances the outside pressure and thus prevents the painful effect. This painful effect on the ear experienced by going down in a diving bell is simply because a certain piece of tissue is being pressed more on one side than on the other; and when we get such a tremendous force on a delicate thing like the tympanum, we may experience a great deal of pain, and it may be dangerous; indeed it is dangerous, and produces rupture or damage to the tympanum unless means be adopted for obviating the difference in the pressures; but the simple means I have indicated are, I believe, with all ordinarily healthy persons, perfectly successful.

I am afraid we are no nearer, however, to understanding what it is we perceive when we hear. To be short it is simply this: it is exceedingly sudden changes of pressure acting on the tympanum of the ear, through such a short time and with such moderate force as not to hurt it; but to give rise to a very distinct sensation, which is communicated through a train of bones to the auditory nerve. I must merely pass over this; the details are full of interest, but they would occupy us far more than an hour if I entered upon them at all. As soon as we get to the nerves and the bones, we have gone beyond the subject I proposed to speak upon. My subject belongs to physical science—what is called in Scotland Natural Philosophy. Physical science refers to dead matter, and I have gone beyond the range whenever I speak of a living body; but we must speak of a living body in dealing with the senses as the means of perceiving—as the means by which, in John Bunyan's language, the soul in its citadel acquires a knowledge of external matter. The physicist has to think of the organs of sense, merely as he thinks of the microscope; he has nothing to do with physiology. He has a great deal to do with his own eyes and hands, however, and must think of them, if he would understand what he is doing, and wishes to get a reasonable view of the subject, whatever it may be, which is before him in his own department.

Now what is the external object of this internal action of hearing and perceiving sound? The external object is a change of pressure of air. Well, how are we to define a sound simply? It looks a little like a vicious circle, but indeed it is not so, to say it is sound if we call it a sound—if we perceive it is as sound, it *is* sound. Any change of pressure, which is so sudden as to let us perceive it is as sound is a sound. There [giving a sudden clap of the hands]—that is a sound. There is no question about it—nobody will ever ask, Is it a sound or not? It is sound if we hear it. If you do not hear it, it is not to you a sound. That is all I can say to define sound. To explain what it is, I can say, it is change of pressure, and it differs from a gradual change of pressure as seen on the barometer only in being more rapid, so rapid that we perceive it as a sound. If you could perceive by the ear that the barometer has fallen two-tenths of an inch to-day, that would be sound. But nobody hears by his ear that the barometer has fallen, and so he does not perceive the fall as a sound. But the same difference of pressure coming on us suddenly—a fall of the barometer, if by any means it could happen, amounting to a tenth of an inch, and taking place in a thousandth of a second—would affect us quite like sound. A sudden rise of the barometer would produce a sound analogous to what happened when I clapped my hands. What is the difference between a noise and a musical sound? Musical sound is a regular and periodic change of pressure. It is an alternate augmentation and diminution of air pressure, occurring rapidly enough to be perceived as a sound, and taking place with perfect regularity, period after period. Noises and musical sounds merge into one another. Musical sounds have a possibility at least of sometimes ending in a noise, or tending too much to a noise, to altogether please a fastidious musical ear. All roughness, irregularity, want of regular, smooth periodicity, has the effect of playing out of tune, or of music that is so complicated that it is impossible to say whether it is in tune or not.

But now, with reference to this sense of sound, there is something I should like to say as to the practical lesson to be drawn from the great mathematical treatises which were placed before the British Association, in the addresses of its president, Prof. Cayley, and of the president of the mathematical and physical section, Prof. Henrici. Both of these professors dwelt on the importance of graphical illustration, and one graphical illustration of Prof. Cayley's address may be adduced in respect of this very quality of sound. In the language of mathematics we have just "one independent variable" to deal with in sound, and that is air pressure. We have not a complication of motions in various directions. We have not the complication that we shall have to think of presently, in connection with the sense of force; complication as to the place of application, and the direction, of the force. We have not the infinite complications we have in some of the other senses, notably smell and taste. We have distinctly only one thing to consider, and that is air pressure or the variation of air pressure. Now when we have one thing that varies, that, in the language of mathematics, is "one independent variable." Do not imagine that mathematics is harsh, and crabbed, and repulsive to common sense. It is merely the etherealization of common sense. The function of one independent variable that you have here to deal with is the pressure of air on the tympanum. Well now in a thousand counting houses and business offices in Birmingham, and London, and Glasgow, and Manchester, a curve, as Prof. Cayley pointed out, is regularly used to show to the eye a function of one independent variable. The function of one independent variable most important in Liverpool perhaps may be the price of cotton. A curve showing the price of cotton, rising when the price of cotton is high, and sinking when the price of cotton is low, shows all the complicated changes of that independent variable to the eye. And so in the Registrar-General's tables of mortality, we have curves showing the number of deaths from day to day—the painful history of an epidemic, shown in a rising branch, and the long gradual talus in a falling branch of the curve, when the epidemic is overcome, and the normal state of health is again approached. All that is shown to the eye; and one of the most beautiful results of mathematics is the means of showing to the eye the law of variation, however complicated, of one independent variable. But now for what really to me seems a marvel of marvels: think what a complicated thing is the result of an orchestra playing—a hundred instruments and two hundred voices singing in chorus accompanied by the orchestra. Think of the condition of the air, how it is lacerated sometimes in a complicated effect. Think of the smooth gradual increase and diminution of pressure—smooth and gradual, though taking place several hundred times in a second—when a piece of beautiful harmony is heard! Whether, however, it be the single note of the most delicate sound of a flute, or the purest piece of harmony of two voices singing perfectly in tune; or whether it be the crash of an orchestra, and the high notes, sometimes even screechings and tearings of the air, which you may hear fluttering above the sound of the chorus—think of all that, and yet that is not too complicated to be represented by Prof. Cayley, with a piece of chalk in his hand, drawing on the black-board a single line. A single curve, drawn in the manner of the curve of prices of cotton, describes all that the ear can possibly hear, as the result of the most complicated musical performance. How is one sound more complicated than another? It is simply that in the complicated sound the variations of our one independent variable, pressure of air, are more abrupt, more sudden, less smooth, and less distinctly periodic, than they are in the softer, and purer, and simpler sound. But the superposition of the different effects is really a marvel of marvels; and to think that all the different effects of all the different instruments can be so represented! Think of it in this way. I suppose everybody present knows what a musical score is—you know, at all events, what the notes of a hymn tune look like, and can understand the like for a chorus of voices, and accompanying orchestra—a "score" of a whole page with a line for each instrument, and with perhaps four different lines for four voice parts. Think of how much you have to put down on a page of manuscript or print, to show what the different performers are to do. Think, too, how much more there is to be done than anything the composer can put on the page. Think of the expression which each player is able to give, and of the difference between a great player on the violin and a person who simply grinds successfully through his part; think, too, of the difference in singing, and of all the expression put into a note or a sequence of notes in singing that cannot be written down. There is, on the written or printed page, a little wedge showing a diminuendo, and a wedge turned the other way showing a crescendo, and that is all that the musician can put on paper to mark the difference of expression which is to be given. Well, now, all that can be represented by a whole page or two pages of orchestral score, as the specification of the sound to be produced in say ten seconds of time, is shown to the eye with perfect clearness by a single curve on a riband of paper a hundred inches long. That to my mind is a wonderful proof of the potency of mathematics. Do not let any student in this Institute be deterred for a moment from the pursuit of mathematical studies by thinking that the great mathematicians get into the realm of four dimensions, where you cannot follow them. Take what Prof. Cayley himself, in his admirable address, which I have already referred to, told us of the beautiful and splendid power of mathematics for etherealizing and illustrating common sense, and you need not be disheartened in your study of mathematics, but may rather be reinvigorated when you think of the power which mathematicians, devoting their whole lives to the study of mathematics, have succeeded in giving to that marvelous science.

The sense of sight may be compared to the sense of sound in this respect. I spoke of the sense of sound being caused by rapid variations of pressure. I had better particularize and say how rapid must be the alternations from greatest pressure to least, and back to greatest, and how frequently must that period occur, to give us the sound of a musical note. If the barometer varies once a minute you would not perceive that as a musical note. But suppose by any mechanical action in the air, you could cause the barometric pressure—the air pressure—to vary much more rapidly. That change of pressure which the barometer is not quick enough to show to the eye, the ear hears as a musical sound if the period recurs twenty times per second. If it recurs twenty, thirty, forty, or fifty times per second, you hear a low note. If the period is gradually accelerated, you hear the low note gradually rising, becoming higher and higher, more and more acute, and if it gets up to 256 periods per second, we have a certain note called C in the ordinary musical notation. I believe I describe it correctly as the low note C, of the tenor voice—the gravest C that can be made by a flute.—SIR WILLIAM THOMPSON in *Nature*.

(*To be continued.*)

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MAGNETISM AND ELECTRICITY.

By CHARLES F. CHANDLER, PH. D.

A magnet is either natural or artificial. A natural magnet is a piece of magnetic iron ore or magnetic oxide of iron (Fe_3O_4), also called loadstone, and it occurs in nature. An artificial magnet is one produced by artificial means. Artificial magnets are of two kinds—permanent and temporary. A permanent magnet is a piece of steel that has been magnetized by bringing it in contact with another magnet or piece of loadstone, or by passing a strong current of electricity around it. A temporary magnet is a piece of soft iron which has been made temporarily magnetic by being brought near to a permanent magnet, or by passing a current of electricity through a coil of wire surrounding it. The properties of a magnet are: 1. The power of attracting certain metals—iron, nickel, cobalt, and, to a slight degree, chromium, and a few others. 2. The property of tending to assume a certain position as regards north and south. A magnetic bar or needle, if allowed to hang by its center on a string, or to float free on a piece of wood in water, will assume a position approximating north and south, but not exactly so. 3. The property of polarity—that is to say, a magnet exhibits its peculiar attracting powers chiefly at the extremities. There is a center of attracting power near each end, but not absolutely at the end, and at this point or center the magnetic power is strongest. These two magnetic centers are called the poles of the magnet; the end which points towards the north is called the north pole, and the one pointing toward the south, the south pole of the magnet. When two magnets are brought near each other, the north pole of one will attract the south pole of the other, and repel the north pole. So it has been found to be a law with magnets that "like poles repel, and unlike poles attract each other."

With regard to the direction the magnetic needle takes when allowed to move freely, it does not point directly north and south, but it assumes a position pointing a little to the east or to the west of north and south, depending upon the locality at which the observation is made. This is because the magnetic poles in different parts of the north do not correspond exactly with the geographical poles, and the difference between them varies with the location at which the observation is made. This is why nautical almanacs are made to tell mariners the amount of variation from the true north and south made by the compass-needle in different parts of the world. This deviation of the compass-needle from the true north and south is called the "declination" of the needle. The term "declination" is very liable to be confounded with that of "inclination." When a bar of steel is hung by a thread at its center, it assumes an exactly horizontal position; but if this bar of steel is now magnetized it will assume a direction pointing north and south, but it will no longer hang exactly horizontal except at the equator of the earth.

At all points north of the equator the north pole of the bar will dip downward, and the further north you get the greater will be the dip, while at all points south of the equator the south pole of the bar will dip downward; and the degree to which the needle dips from the absolutely horizontal direction is called its "inclination." This is because the two magnetic poles of the earth do not correspond to the two geographical poles, but they appear to lie nearer the center of the earth. To overcome this tendency of the magnetic needle to dip at a varying angle according to the distance north or south of the equator, the needle of the mariner's compass is made by uniting two magnetic bars laid parallel, with the north pole of one adjacent to the south pole of the other, so that they lie with their opposite poles end to end. Such a needle is said to be "static." At a point on the surface of the earth corresponding with latitude 70° N. and longitude 96° 43′ W., the north magnetic pole seems to be located, and at this place the dipping needle assumes a vertical direction. The south magnetic pole is apparently located at latitude 75° 5′ S. and longitude 154° E.

The production of magnetism by induction is a curious phenomenon. If a permanent magnet is brought near a handful of iron nails it will attract them to it, and as soon as a nail becomes attached to the magnet it becomes a magnet itself and attracts another nail, which in turn becomes a magnet and attracts another, and so on, the magnetic power of each new nail attracted becoming constantly less than that of the preceding one. It is not even necessary that the nail should absolutely touch the magnet in order to assume this magnetic power, for it will be transmitted through short spaces from one to the other. This power which a body acquires by being brought near a magnet is called "magnetic induction." An important fact in this connection is that when a coil of iron wire is made to surround a permanent magnet it becomes magnetic itself by induction, and is capable of inducing magnetism in another bar of iron surrounded by it. This principle is made practical use of in the construction of the telephone and magnetic telegraph.

ELECTRICITY.

Electricity may be generated by means of friction, percusssion, heat, chemical action, cleavage, and by magnets. The effects of electricity in its different forms are manifested as attraction, repulsion, light, heat, violent commotions, and chemical decomposition.

To excite electricity we must always do something, and the first way of producing it, discovered in the earlier ages, was by rubbing amber, and so the term electricity was derived from a Greek word, signifying amber. It was afterward found that certain other substances when rubbed assumed electrical properties, and would attract or repel other materials. This electricity produced by rubbing or friction is called statical electricity. This can be held for a considerable length of time, and hence it has received the name of stationary or statical electricity. This is the only form of electricity that we can store up and keep for a time. What is known now as the storage battery does not really store up electricity, but only energy, which can be transformed into electricity at will.

We have a totally different kind of electricity, called dynamical electricity, or electricity in motion. This circulates only in a conductor or along a wire, and it cannot be held. It was first discovered by Galvani in experimenting on frogs' legs, and hence it is often called galvanic electricity. It is now ordinarily produced by means of galvanic batteries and dynamo machines. The third form of electricity is called magnetic electricity, or magnetism.

According to the generally accepted theory, there are two so-called electrical fluids, and these two are commingled in equal proportions in all bodies; and hence all the processes for getting electricity must result in pulling these two electrical fluids apart, and in taking a portion of one away from a body. These two fluids are called one positive and the other negative electricity. It is found that when two bodies are electrified with the same kind of electricity, as both with positive, or both with negative, they repel each other; but when the two bodies are charged with opposite kinds of electricity, as one with positive and the other with negative, or when one body is charged with either kind while the other is left in its normal condition, then the two bodies attract each other. Hence we derive the law which states that "bodies charged with like forms of electricity repel, and those with unlike attract." The gold-leaf and pith-ball electroscopes are constructed on this principle.

When a piece of sealing wax is rubbed it manifests electrical properties for some time, but certain other substances, like metals, for instance, after being rubbed in the same manner, show no electrical properties, and this is because the electricity easily gets away from them. Thus we find that while certain substances remain electrified for some time, others do not, and hence these bodies are named conductors and non-conductors. But these terms are not absolute, but only comparative. The metals, carbon, gypsum, and acids are called good conductors, while amber, glass, sulphur, and silk are poor conductors. If we want to insulate electricity and keep it from running off into surrounding objects, we surround the object containing it with a poor conductor. Thus, the glass insulators on telegraph poles prevent the electricity from leaving the wires and running off into the ground; and the non-conducting materials placed around the wires of the Atlantic cable so protect it that a small charge of electricity will carry a message from here to Europe.

Great difficulty is experienced in experimenting with statical electricity, because it so easily gets away. All substances are conductors to a greater or less degree, including the dust in the air and the moisture in the atmosphere. Perfect insulation, and a warm, dry air are, therefore, favorable conditions for holding statical electricity. The reason it was not used earlier for practical purposes was because it was so difficult to manage. The electricity which is produced on glass by friction is called vitreous or positive, while that produced in the same manner on shellac or sealing wax is called resinous or negative electricity.

All bodies are charged with an equal amount of the two electrical fluids called positive and negative, but when a body is electrified these two fluids are separated so that one remains in excess of the other. There is always a passage of the electrical fluid in two directions along a conductor, but, when the direction of the current is spoken of, it is the direction of the positive current that is always meant. Statical electricity can also be produced by pressure, as when certain crystals are firmly pressed together; by cleavage, as when two layers of mica are split apart; and by the heat as well as by friction. It may also be produced by torsion. It is found that the charge of electricity, if collected in a spherical body, is on the outside, and not within the body; and if it is not a spherical body, the electricity collects chiefly at the part most nearly pointed.—*Medical Journal.*

A New Fire Ladder Apparatus consists of a truck, on which is a bomb. A homœopathic charge of powder was put in the bomb beneath a ball of iron the size of a big marble, to which a linked ladder was attached. The powder was ignited, and the ball was shot to the top of the miniature model of a six-story building, causing the ladder to stretch from the top to the bottom. In an apparatus big enough for use the ball will weigh 120 pounds, so that it will penetrate the roof of a building, and in that way secure the ladder. The bomb is also intended to batter down dangerous walls.

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A New Electric Railway signal, which seems to possess valuable features, is thus described in the Boston *Herald:*

By the invention now under consideration, no matter how thick the snow-storm or how dense the fog, the engineer is told in his cab whether the track is clear or not. The apparatus consists of a generator of electricity placed on the engine, and connected with the rails by a suitable device to convey the electric current to the generator. In the cab overhead, is placed a gong and target, which works as follows: When a train is entering upon a section of road, if the tracks are all clear, the rails all in place, the switches and drawbridges all closed, the gong will ring a safety signal; but should there be any obstruction upon the track, or a switch or drawbridge open, the gong will strike, and the target will appear before the eyes of the engineer, upon which are the words "Danger! Stop!" and this target will remain at danger until the entrance is made on the next section, when it returns to safety, ready for the next signal. Another most important feature is that all switches and drawbridges are locked by the train immediately upon entering the section where such switches or drawbridges exist, and cannot be opened by the switchman or draw-tender until the train has passed, so that no train can be thrown from the track by a switch being opened after the safety signal has been given to the engineer before entering the section, and before he can reach the switch or drawbridge.

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IMPORTATION OF CONTRACT LABOR.

The bill reported from the House Committee on Labor to prohibit the importation and migration of foreigners and aliens under contract or agreement to perform labor in the United States, its Territories and the District of Columbia, having been made the special order for the 19th, was considered and passed by the decisive vote of ayes 102, nays 17. The bill as passed makes it unlawful for any person, company, partnership or corporation to enter into an agreement or contract with any foreigner or foreigners, alien or aliens, to perform labor of any kind in the United States, or to prepay the transportation or in any way assist or encourage the importation or migration of any aliens or foreigners into the United States under contract or agreement, paid or special, expressed or implied, made previous to the importation or migration of such aliens or foreigners; all contracts so made are declared null and void. Any violations of the act are fineable, $1,000 for each offense, one-half payable to the informer. Masters of vessels are also fineable $500 for violation. An important and necessary amendment to the bill exempts certain skilled persons, as follows:

"Nor shall this act be so construed as to prevent any person or persons, partnership or corporation from engaging under contract or agreement, skilled workmen in foreign countries to perform labor in the United States in or upon any new industry not at present established in the United States; *Provided,* That skilled labor for that purpose cannot be otherwise obtained; nor shall the provisions of this act apply to professional actors, lecturers or singers."

The discussion of this bill brought out a large fund of information bearing upon the subject of imported labor. In the anthracite coal regions it was stated that most of the mines were running on half time, which not only produced great poverty, but if the men refused to work their places were filled by the laborers imported from Europe in pursuance of contracts entered into between them and their employers. These are the lowest types of Italians and Hungarians. What is asked is legislation in favor of American labor as well as manufactures.—*Iron Age.*

TRADE TOPICS FROM EVERYWHERE.

It is probable that the Keystone Iron Works, of Reading, will resume operations shortly and give employment to their usual force of 50 or 60 men.

The Risdon Iron Works, San Francisco, are building an addition in the shape of a new boiler shop. The building will be 275 feet long, 45 feet wide and two stories high.

Fifty molders in the Penn Hardware Company's No. 2 Foundry, at Reading, Pa., quit work last Thursday on account of a new pattern not being of a certain size. The company have locked up the shop, and will not start it again before August 1 or later. Their No. 1 Foundry, with a complement of 40 moulders, is running full time.

The works of the Chicago Scale Company are to be enlarged by an addition 25×100 feet in size and four stories high, together with a smaller building for office purposes, 25 feet square and two stories high. When completed the new structures will increase the manufacturing and storage capacity of the company fully 100 per cent.—*Iron Age.*

George A. Rollins & Co., Nashua, have their new shops nearly completed, and are setting up the tools for engine work. These shops are very conveniently arranged, and when completed will be much more convenient than the former shops. Many new tools will be put in, and it is intended to have them complete in every department.—*Cotton, Wool and Iron.*

The Rohan Bros. Boiler Manufacturing Company have about completed a 40×46 foot brick addition to their establishment, by which the latter is extended to the corner of Carr and Collins streets. The new addition will be used for office room and other purposes; the present office will be abandoned to make room for new machinery, including a pipe cutter, a lathe and a bolt machine.

◆

If You Are Scraping Surfaces in a bad light get a new sheet of tin, and hang it so it will throw reflected light on the job; finest thing in the world!

◆

Do Not Omit to read "*The Six Gateways of Knowledge.*" It is by no means dry reading, and aside from its instruction, is a model of simplicity, elegance, and force in style.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

AS BOILER-SHOP FOREMAN.—The writer of the articles on Steam Boilers in this paper is open to an engagement to take charge of works. Has had long experience on all kinds of work, and understands it in detail. Is now employed, but wishes to change. Address, Button-Set, care Egbert P. Watson & Son, 150 Nassau St., N. Y.

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BLUE PRINTS OF WORKING DRAWINGS neatly executed with the utmost dispatch.
Mrs. A. V. Mantle, 34 Park Row, Room 43, N. Y.

STEEL NAME STAMPS 15 cents per letter. Steel figures, $1 per set. W. G. Sackmann, 59 Vine St, Cleveland, O.

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THE MECHANICAL ENGINEER.

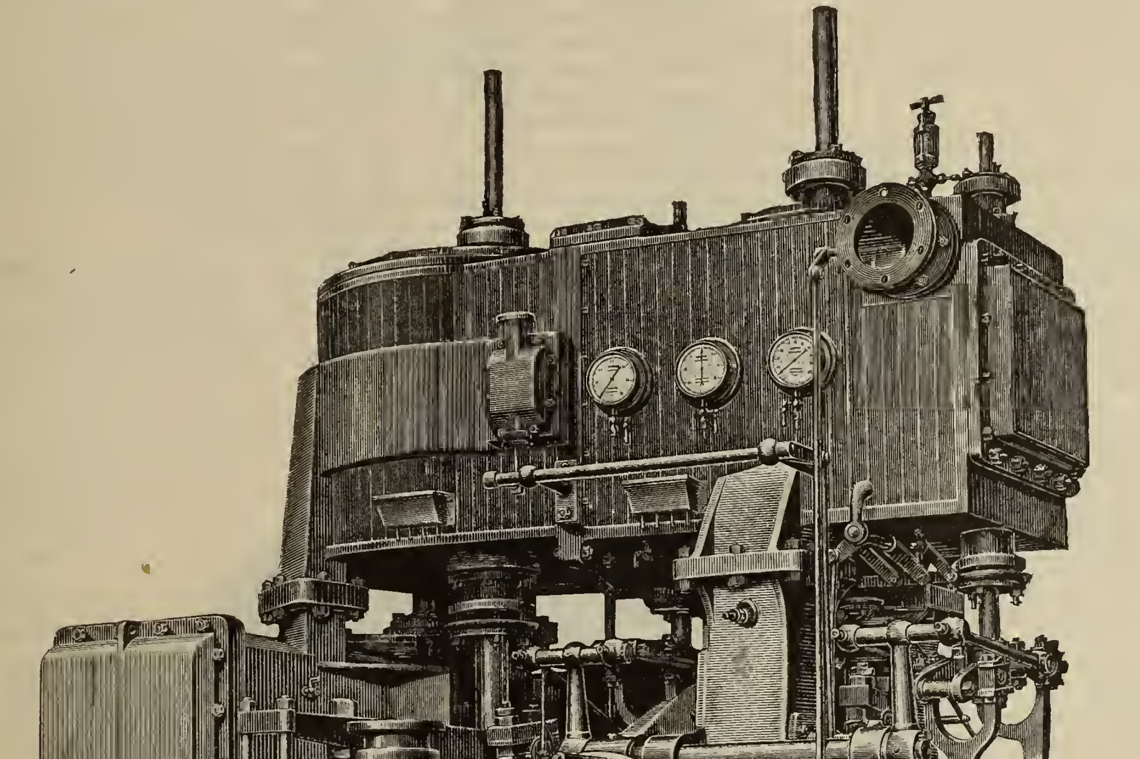
New Series. Vol. VIII.—No. 2.
Enlarged 1883.

New York, July 26, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

COMPOUND ENGINES OF AN ENGLISH GUN-BOAT.

Our engraving represents the engines of an English gun-boat which have one marked peculiarity, and that is the manner in which the air and circulating pumps are worked. These, it will be observed, are connected directly with the piston rod, so that the usual beam is dispensed with. It is true that the engines and pumps are small, and the resistance of the pumps correspondingly light, but the great projection of the arm which works the pumps leads engineers to speculate upon what would happen if the pumps were packed too tight, or the through-cocks closed by accident. It would seem that there would be a general bending of plungers, and fetching away of things. The cylinders are 24″ and 38″ by 24 inches stroke.



Compound Engines Of An English Gun-Boat.

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Mirrors made of black glass, without any amalgam backing, are to be made in Pittsburgh.

NOVEL CANAL BOAT.

A model of a novel canal boat has been placed on exhibition by a Cleveland inventor. The boat is to be propelled by a screw, so geared that it can be made to turn by horses traveling in a circle in a stable on the boat. The inventor claims that abundant power can be had in this manner, and that a large saving can be effected, particularly in river towing bills and by the reduction of help; that it would be cheaper than the present method of towing, even though no better time were made, but he is confident that four or five miles an hour can be accomplished. We hope that the boat may prove a success, as speedier transportation is one of the most desirable things for the shipping over the Erie canal.—*Trade Review.*

The horse will do more work straight ahead, on fewer oats, in front of the boat, than he will by dividing his strength traveling in a circle and wasting it in friction by turning a screw.—Eds.

"All The Tribes that wander on the earth are but a handful to those that slumber in its bosom," said Bryant, and a recent paragraph in a magazine states that the entire population of the globe could stand on a small Swiss lake. We quote:

"A German square mile contains 668½ million square feet. The superficial area of the Lake of Constance being 8½ German square miles, therefore contains 5,682 million square feet. There are living on the surface of the globe at this moment, in round numbers, about 1,430 million human beings. Let every man have 4 square feet allotted to him, and if it were frozen over the whole human family might find standing room upon the surface of the lake."

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Huge Siphon.—Contractors are now in Milwaukee, engaged in laying a siphon across the river for sewerage purposes. It is of wrought iron 50 inches in diameter, 520 feet long, with a shaft on each end 9 inches diameter. The east shaft is 33 feet deep and the west one 26 feet. The siphon is to lie 26 feet under water.

BRACING STEAM BOILERS.

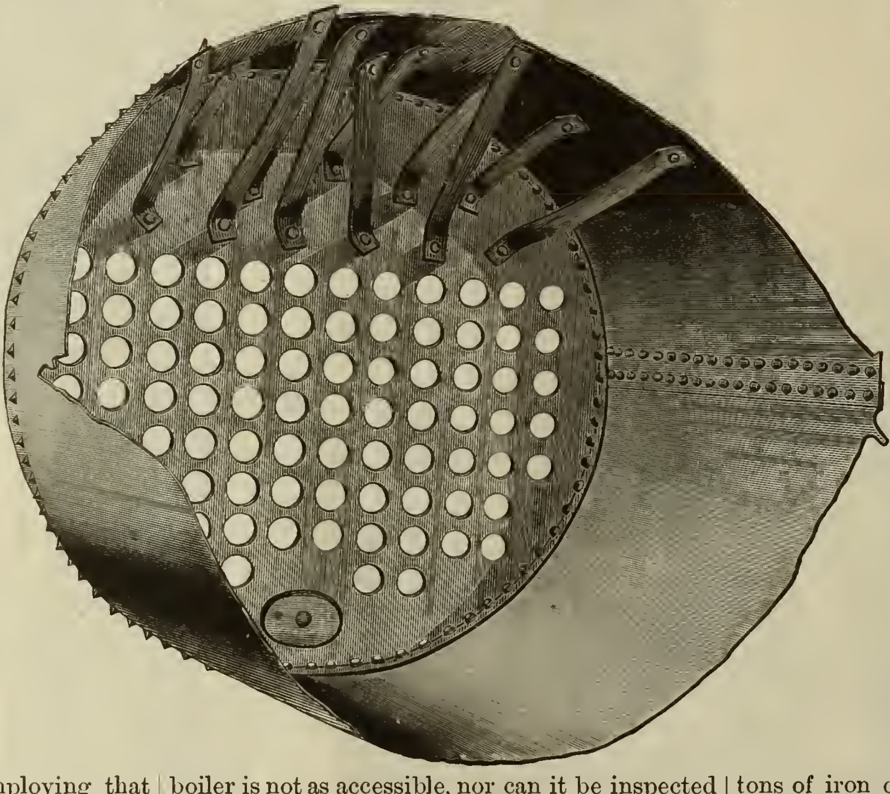
The illustration shows a very cheap and inefficient manner for bracing the heads of a stationary tubular boiler. It was photographed from the wreck of a boiler which recently exploded with disastrous effects.

If we should construct an elastic model of an ordinary cylindrical boiler, apply pressure to it and carefully watch the effect, we should speedily observe the weakness of the heads by deflection or bulging. In some experiments made near Leeds, England, in 1876, described in "Nicholls' Practical Boiler-maker," upon an unstayed wrought-iron boiler head, 30 inches in diameter, and $\frac{3}{8}$ of an inch thick, the deflection carefully measured and recorded was as follows:

10	pounds	pressure	deflection,	$\frac{1}{16}$	of	an	inch.
50	"	"	"	$\frac{1}{4}$	"	"	"
100	"	"	"	$\frac{9}{16}$	"	"	"
150	"	"	"	$\frac{13}{16}$	"	"	"
200	"	"	"	$1\frac{1}{4}$	inches.		
250	"	"	"	$1\frac{3}{8}$	"		
300	"	"	"	$1\frac{1}{2}$	"		

At this latter pressure a loud report was heard and rupture occurred in several places about the flange.

Referring to the illustration, we assume that portion of the head which is tubed to be sufficiently stayed by the holding power of the tubes, and we have practical demonstration of its ability to do so every day when the work is properly done. We need then only provide sufficient reinforcement for the part remaining above the tubes, to make it as strong as any other part of like area. For the purposes of this calculation we may disregard the strength imparted to the head by a properly-turned flange, and compute, by well known rules, the area of the segment above the tubes, which we find to be in this case 813 square inches.



The shell of the exploded boiler was 60 inches in diameter—$\frac{3}{10}$ of an inch thick—double riveted. As no stamps were found upon the plate we will assume its tensile strength to have been 45,000 lbs per square inch of section. Under the rules of the United States Steamboat Inspection Service, this would allow a safe pressure of 90 lbs. per square inch. To that pressure we must brace the head to make it equally strong with the shell.

The practice is to assume the whole load to be upon the braces, not taking into consideration the thickness of the head, nor the strength of the rivet-seam which joins the head to the shell. Employing that method of calculation here, the area of the segment above tubes being 815 square inches and the pressure 90 lbs., this part of the head will have to sustain a load of 815 × 90 = 73,350 lbs. Our next step will be to ascertain the number of braces required to sustain this load. Braces when made of inch-round iron of selected quality, with no welds, may safely be allowed a maximum strain of 10,000 lbs. per square inch of section. This would give us 10,000 × ·7854 = 7,854 lbs. as a safe load for a brace of this sectional area (one inch in diam.) 73,350 divided by 7,854 would give 9 for the number of braces required in the example we have chosen. These braces should not all attach to the first course of shell-plates, as they did in the exploded boiler, but be distributed so that at least three of the number should attach to the second course from each head. No brace should be less than three feet in length, and each should be properly fastened to the *head* of the boiler with good, solid crow-feet, or by pieces of T iron secured radially thereon—and on the shell by two suitably-sized rivets well driven, so as to realize the full strength of the braces. Counting the number of braces upon the head of the boiler shown in the illustration, it will be found that they are eleven in number. Six were 28 inches long, and the remaining five 20 inches long, all of flat iron, $\frac{3}{}$ × 2 inches with one rivet in each end. The objection to this form of brace is that under a heavy strain it would gradually straighten out at the hinged part on each end. The boiler-head would bulge and shear off the heads of the brace-rivets, and the ends would be blown out, probably with fatal results. That this boiler did not fail in the manner described, was, I think, because it was even weaker and more defective in another part.

An excellent plan in staying boiler-heads, and one that is growing in favor among the trade, is to rivet pieces of T iron radially upon the heads and attach the braces to the web of the T iron. Dependence should not be placed upon T or angle iron alone unless the surface is comparatively small, for their office is but to stiffen and prevent buckling. If reinforcement of the head is required, it must be obtained by bracing it to some stronger part.

The crow-foot appears to be the most popular brace among boiler-makers. There are several modifications, but when properly made and attached in a workmanlike manner, it is a very efficient brace. The quarter twist brace as a rule cannot be recommended except in short lengths between surfaces where no other brace is admissible or is as convenient. Horizontal braces or rods tying the heads of the boiler together are another excellent form of brace. Under like conditions a horizontal brace is more effective than a diagonal one, the efficiency lessening as the angularity of the brace is increased. A disadvantage in the use of this form of brace is that in many cases the interior of a boiler is not as accessible, nor can it be inspected or cleaned with the same facility as one having diagonal braces, without disconnecting the braces, and that is a very hazardous business, should it be forgotten to replace them again, as is sometimes the case. It is but a few years since that, in looking over a battery of exploded boilers, I found that a number of the braces were disconnected. Upon careful inquiry it was learned that a few months previous, a gang of boiler-makers had been at work upon these boilers putting in some new tubes, and they had undoubtedly loosened the braces to do their work, and forgotten to replace them again when they got through. The writer had a singular experience related to him of a boiler braced with horizontal rods lying along the water-line. They were about 26 feet long, without supports. While under inspection, one of the braces was struck a light blow with the hammer, as is customary, and it snapped off like a pipe stem. The remaining braces, when struck, acted in a like manner. The fractures were said to have been crystalline, showing scarcely any fiber. While of course I do not know what the quality of the brace iron was, I do know the builders of the boiler to have been a firm of good repute, who had the reputation of using the best materials in their construction. My informant attributed the crystallization of the iron to the vibration of the braces, which was not improbable, owing to the omission of supports which are necessary in braces of considerable length, and there may have been other causes which he did not notice.

Many feed-waters contain ingredients which are very destructive to the braces, and they are often found by the inspectors dangerously corroded, sometimes reduced to a skeleton. It is essential that they should be periodically examined and repaired or renewed as they may require it. In short, if I may be allowed to paraphrase a popular and patriotic expression, and apply it to this case, I should say "Eternal vigilance is the price of safety."—F. B. ALLEN, *in "Locomotive."*

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"UNLUCKY."

The new Cunard steamer *Aurania* is what may be called an unlucky ship, if there ever was one. Her engines experienced almost every ill that could befall them on the first voyage over. She is now running between this city and Liverpool, and on her last voyage out found a rock off the Irish coast, but got off, for something worse in future. Coming back to this port she walked into Uncle Sam's ship "*Swatara,*" lying at anchor in the lower bay. Her owners probably await her next achievement with some anxiety.

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THE HARTFORD ENGINEERING COMPANY, Hartford, have entirely suspended operations. Notices were posted in the shops on June 14th, stating the help would be paid in full at the receiver's office. This company occupied the old Woodruff & Beach property, which is one of the finest in the New England States. It is understood that the property, including all the tools and patterns, are to be sold by the receiver.—*Boston Journal of Commerce.*

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A MECHANIC'S ARCADIA.

Cornwall is only a few miles from Lebanon, Pa. One of its principal owners is Robert Coleman, one of the richest young iron kings in the world. He is an unassuming, unpretentious young man, and, notwithstanding his great wealth, is devoted to his business, lending all his energy to making good iron, and constantly striving to make his employees happy. The people who have proprietary interests here live like princes. Their domestic surroundings are baronial. Great stone mansions are located in magnificent parks. They have kennels, studs, herds, hunting grounds, and everything that wealth and refinement can suggest. They take at least 1,000,000 tons of iron ore from these hills every year (?). At this rate it will require hundreds of years to level the hills to the plane of the surrounding surface, and then the mining will only have begun. The depth of the deposit will require generations to remove. Iron ore is worth say $3 on the cars. If they only sold the ore it would give them a gross income of three millions a year, but the gigantic iron furnaces eat up most of the ore and bring in handsome returns. Mr. Robert Coleman's two furnaces cost about $800,000. They are said to be the most complete in the world. Yet they earned money enough to pay for themselves in fourteen months.

About 1,250 men are employed. They are as nearly contented as any set of persons to be found anywhere. Their work never ceases. Neither panics, shut-downs, over-production, nor any other causes ever interfere with labor at Cornwall. Strikes here are never known. Wages are of the very best, and the workmen are respected and cared for. Years ago a man named Grubb paid the original owner of the mines a certain sum to furnish enough iron ore for one furnace. The amount was paid in cash, and the agreement was that enough ore should be provided to him or his heirs or assigns for one furnace "as long as grass grows and water runs." That agreement has never been violated. The furnace in question was built at Robesonia, near by, and for years and years it has received all the ore it could smelt. Recently the capacity of the furnace has been greatly increased. The very best and latest patents have been added. The agreement calls for one stack or furnace, and no matter if the capacity of that one furnace can be quadrupled or sextupled, the ore will have to be furnished free all the same, because the agreement calls for one furnace. The Grubb heirs are becoming enormously wealthy, and bless the day the elder Grubb was shrewd enough to make so good a bargain.

Young Mr. Coleman has built a new railroad, giving the merchants a competing line and an independent outlet to the rest of the world. He put up a bank, a depot, large buildings, fixed up a fine park, built a Presbyterian church for $150,000 and a Methodist church for $10,000, and made many other valuable and attractive improvements of a substantial character. His wealth is enormous.—*The Sun.*

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RAILWAY LIBRARIES.

Mr. W. F. Smith, M.M., of the Humboldt division, C.P.R R., writes to the *American Machinist* an account of the establishment of a library of current literature at Carlin, Nev., where Mr. Smith is stationed. This library embraces all the principal technical and trade papers of the day, besides others, such as *Harper's Weekly*, etc., which are not technical. Mr. Smith says, in our contemporary :

> "The Central Pacific Employees' Railroad Library was a conception of Mr. A. J. Stevens, general master mechanic of the road, and was first instituted in 1873, and up to January, 1880. continued to flourish in a remarkable manner, when by some accident the building took fire, and with its contents, was totally consumed. A few hours after the fire had occurred, steps were taken by employees to found another library, and which now contains the books, etc., as per catalogue, which I send you. I also send you a copy of our constitution and by-laws, which, if given publicity, may induce and aid other railroad employees in founding similar institutions to ours.
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> "And, in addition to the papers, etc., mentioned, we subscibe for and receive twenty-one daily and weekly papers, and I may state that at the end of each week all the papers that have been read (except those treating on mechanical subjects) are taken from the tables of the reading-room and are made up into parcels, put in neat wrappers, and distributed free of cost to the various section houses on the division, which is 201 miles in length, and where the section men are married. Illustrated papers are also sent for the use of their wives and families, and it is not necessary that they should be members of the library in order to receive the papers. The institution is supported by a monthly subscription of fifty cents from each member, and the Central Pacific Company very generously supply, free of cost, the fuel and oil used in the institution, and, in fact, give us encouragement in every possible way."

The influence which such enterprise as this has upon future generations is simply incalculable, and all who participate in its benefits will, sooner or later, realize it. We are apt to fancy that education begins and ends in schools; it does begin there, but it never ends, to those who have a sincere desire to advance themselves, intellectually. Railway libraries, such as those mentioned by Mr. Smith, have been established at many other points, by other roads, and we hope they will increase.

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A New Motor has been invented by a jeweler of Toronto. The mechanism consists of two large metallic pans, one inside the other, with a tube in the center of both; the lower pan is partially filled with water, and the upper one revolves about the tube, floating in the water. The upper pan is moved by means of a spindle passing down the tube, at the lower end of which is hung a weight, and the principle of the invention is in destroying the ordinary friction in machinery by the floating process.—*Lumberman's Gazette.*

This seems to be a mechanical appliance, instead of a new motor, and its essential principle was invented by Thomas Shaw, of Philadelphia, and is patented by him.

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Ocean Steamship Fares are astonishingly cheap. Fifteen dollars in the steerage, and thirty-five dollars second cabin, is very low indeed for nearly 3,000 miles transportation, with board for eight days. It is much less in price than the same distance overland.

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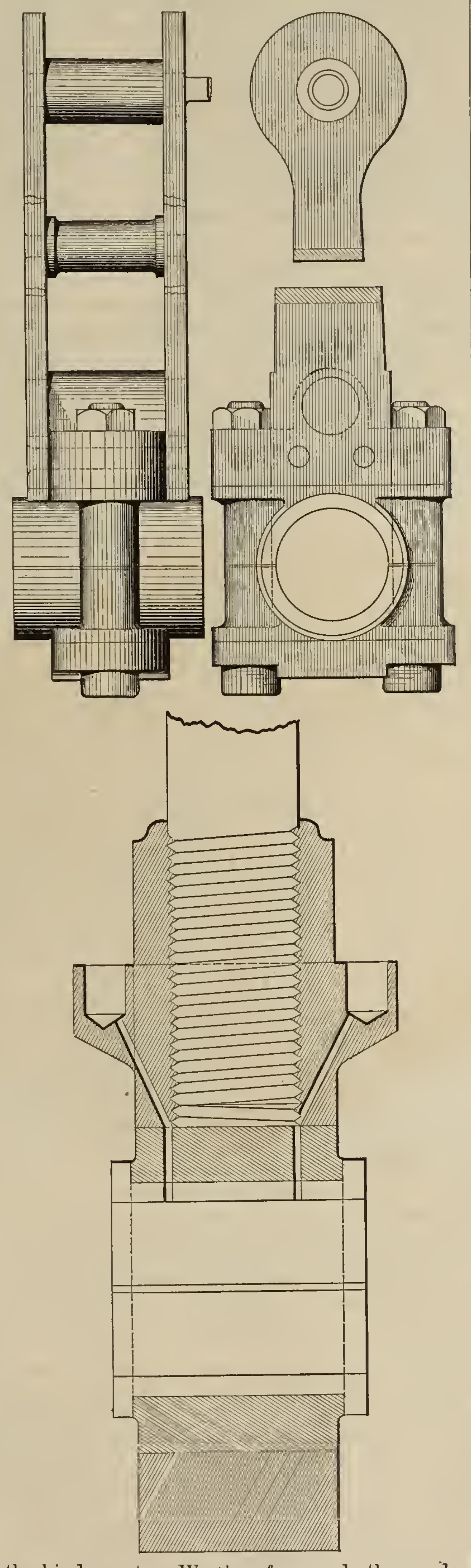
Iron Shutters, says the *Insurance Critic*, strongly fastened inside, have in some instances seriously interfered with the efforts of firemen. How to arrange these useful articles in such a way that, while a defense against burglars, they can, in case of need, be readily opened without the loss of time, is a difficult problem.

EYE-BAR CONNECTING RODS.

By Norman W. Wheeler.

We made some connecting rods like the drawing shown herewith, and we like them. The primary object in the design was to get a crosshead-pin much larger and longer than common, and to avoid forked ends with double bearings, which nobody likes but many use. Also to accommodate a cap crosshead and get wrench-room enough for the binder-nuts. We therefore made the spade-handle the whole length of the rod, so to speak. This was done by making the rod of two flat eye-bars, a crosshead-pin, and a lug-piece to carry the cap-end for the crank-pin.



The bars were planed up, clamped together, and the holes for the trunnions of the lug-piece and the crosshead-pin bored. Then the bars were put on with press fits, and the trunnions riveted over at the ends. As a steadiment to the lug-piece, two body-bound rivets were put through the lower end of the bars and the lug-piece, to prevent its turning on the trunnions; the lower ends of the bars coming down square to the boxes and affording room for them. Beyond this there is nothing different from common practice in the make of these rods. They are light for their strength, and very strong, inasmuch as the bars resist edgewise the bending strains arising from the grip of the boxes on the crank-pin; and, as for the usual strains of compression, the metal is in the right place, for the bars always straddle the stress. By the way, I have adopted as a standing rule with the draughtsman, "Straddle all lines of stress with metal, and use little of it." Now that they have that notion well in their minds, they don't get things so chunky as they did.

As to the cost of these eye-bar rods, we find it about the same as for common spade-handle round rods; that we can get them up on smaller tools, and several parts may be going on at once if we are in a hurry. Besides, we feel more sure of the metal of the flat bars than we do of that in round rods with the welds, which are often in bad places.

The section shows a method I adopted for readily oiling the crosshead-pin, which may be new to some.

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LICENSING ENGINEERS IN MICHIGAN.

Bay City has passed an ordinance which creates the office of boiler inspector, and requires every person using steam boilers to employ competent persons to take charge of the same. Boiler explosions have resulted in great loss of life in Bay City on several occasions, and in too many instances it has been demonstrated to the satisfaction of the public generally, that the sacrifice of life has been the direct result of the incompetency of the man in charge of the boiler at the time of the accident. In many places the boiler which furnishes steam and the engine using the same in pumping brine for salt works, are located at a considerable distance apart, and the engineer does not see the boiler for weeks, perhaps, it being left in charge of men without sufficient capacity or intelligence to run anything requiring even ordinary judgment. Events transpiring since the appointment of the boiler inspector referred to should convince any person of the necessity of the ordinance, as well as the inspector appointed under it.

We are reliably informed that one man was found in charge of a boiler who was unable to name the figures on the steam gauge. Other cases displaying equal ignorance were met with. These men held the lives of their fellow workmen, and every person in the immediate vicinity in their hands. Out of the men making application to run these boilers, only a very small percentage have been awarded certificates, most of them being unable to answer the simplest questions propounded, and yet some of them have been for years endangering the lives of perhaps scores of people. Bay City is not alone in this regard, but the mills at East Saginaw and other points along the river, and in fact all over the State, will show an equal indifference among the employers. This city has shown a commendable spirit in setting the example of enforcing a demand for greater intelligence among the men occupying such positions, and the State legislature should, at its first session, adopt measures for extending such a beneficent movement until it covers every steam boiler in Michigan.—*Lumberman's Gazette.*

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Leroy Bartlett, a Master Mechanic at St. Louis, says the *Railroad Gazette*, gets power for trueing crank-pins, reboring cylinders in place, and drilling any odd holes required by an engine under repairs, by means of small portable three-cylinder engines. The engine has three $3\frac{1}{2}$ in. cylinders, and is mounted on wheels, so that it can be readily moved about the shop. It is driven by compressed air, furnished by three old Westinghouse air pumps that are past regular service on the road. They deliver into old engine reservoirs from which air mains are laid through the shops.

◆

Manufacturers desiring trade catalogues in superior style can obtain estimates of probable cost by addressing us. Engravings of machinery furnished at low rates for good work.

◆

Newspapers require only one cent postage upon them now.

Letters to the Editor.

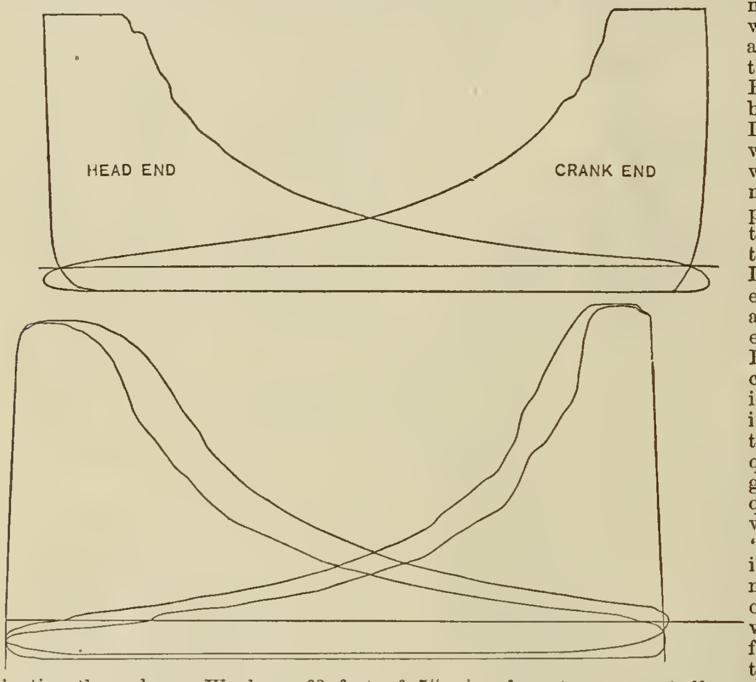
To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

AN EXPERT "NOVICE."

Editors Mechanical Engineer:

I am a reader of your precious paper, and a new beginner with the Indicator Will you, or some of your readers, please help me out. I inclose a pair of cards taken with a Crosby indicator, 50 lbs. spring, from an engine 14″×42″; no regular fly-wheel. but a band-wheel 10′ diam., running 77 revolutions per minute. The load varies about 16 h. p. The cards I send herewith were taken with the lightest load. When the additional load is put on, the head end has 362 lbs. mean pressure, and the crank end 262 lbs. I think if we had a fly-wheel it would help.

I have Wheelock's injector condenser. The engine runs noiseless with the heavy load, but with the load that the card was taken it thumps a little on the head end. The greatest trouble I find is the brasses wearing so fast on the crosshead-pins. When they are tight it runs noiseless. I must say many thanks for the binder you sent me. I will send you one of the cards taken when I first took charge. All the changes made were reducing the speed from 90 to 77 revs. per minute, and adjusting the valves. We have 63 feet of 5″ pipe from boiler to engine. We have never made a test, but from every-day work we can see a difference of a ton of coal in 12 hours.



H. F. M.

Abilene, Kas.

[For a novice with the indicator our correspondent is remarkably expert, the cards sent in evidence being unsurpassed He is evidently no novice with a steam engine. We do not follow our correspondent's figures, however, as regards mean effective pressure. The mean effective of the first cards is about 30 lbs., plus the vacuum, which is equal to nearly 9 lbs. (18 inches). the total mean effective being say 40 lbs. per square inch. What is referred to by—"the head end has 362 lbs. mean pressure, and the crank end 262 lbs." we do not know. There may be 100 lbs. difference between the two ends, for we have hastily measured only one end. In any event we advise our correspondent to let the engine carefully alone. It would be difficult to improve it, except, possibly, on the crank end, where the steam valve is a trifle late; perhaps opening it a little sooner would stop the thump spoken of. "Let well enough alone" is a good motto. Those who favor compression will observe how very slight the amount is here, that there is very little. Notwithstanding, the engine is noiseless in action, so our correspondent assures us Six tons of coal per week saved on so small an engine is enormous for a mere adjustment of valves. Is there not some mistake about this?—Eds.]

◆

RELATING TO STEAM PUMPS.

Editors Mechanical Engineer:

It is amusing as well as interesting, to notice some errors with pumping machines, located by whom you know not. In many cases there seems to be a decided want of knowledge on the part of some who go about the country putting in steam pumps and connecting them to boilers. In some cases the pipe will be much smaller than designed for the pump, and in other cases there will be several different sizes of pipe between the pump and boiler. In others yet there are check valves where there is no need of any. In places where they should be they are left out altogether. In no event should the delivery pipe be smaller than the pump is designed for. I know it costs a trifle less at the commencement, but we lose ground in the long run, as the rapid circulation through a small pipe soon wears it away, beside straining the pump more than a large pipe would.

I will cite an instance from my own experience. The pump in question was an old style single-acting plunger pump. driven by a half-stroke arm from the engine. I had noticed that the pump had not been in use for some time, and upon asking the reason was told that the former engineer had condemned it as being unfit for use. I made no reply to this, but when the time came I connected the pump to the engine. When I started up I carefully watched the working of the pump and soon discovered the reason why it had been idle; the connecting-rod from the half-stroke arm to the pump was very long and slim, and the pump being single-acting without any air chamber, had to start the water from a state of rest as quick as thought against a pressure of seventy pounds to the square inch. This caused the long connecting rod to vibrate badly. I slacked up the gland and let the water leak quite freely around the plunger, and found that it lessened the vibration of the rod very much. At night I made some changes in the piping so that I could connect a long piece of pipe, plugged at one end, to serve as an air chamber until I could get one. On starting up the next morning I screwed up the gland, and was not surprised to see a great change. I put an air chamber on, and for four long years the pump never refused duty, and I presume it is running now.

Bristol, R. I. F. S. Bradford.

◆

CONCRETE SPEECH.

Editors Mechanical Engineer:

I was pleased to see, in a recent issue, a protest against the idiotic phonetic orthography. Spelling by sound is essentially an ignorant practice: it is the resort of uneducated persons invariably. If all our language was spoken and the English had no visible form, as is, or was the case with the languages of savage peoples, then phonetic, or sound spelling is proper. So we notice the difference in the spelling of native American, native African, and native Polynesian words, by geographers and narrators, according to the phonetic idiom of their respective languages. But the English is not only a written language, but one that has a genesis—a history. It is not necessary that the sound of a word should be a positive guide to its writing; indeed, its sound would, in many instances, mislead as to its proper spelling. Most of our scientific words are from other languages; the Greek, Latin, the French, or the Latin through the French. It is necessary, frequently, to know the origin and the primal meaning of a word; especially in the sciences and the arts. But if they are misspelled—phonetically spelled—the clue to their origin is lost or greatly obscured. Take, for instance, the common word "disc"; this comes from the Latin *discus*, a quoit. This spelling and meaning give a definiteness to the word, for a quoit is a flat circular plate. But of what use is the emasculated abortion "disk"? It means absolutely nothing. So the word "gauge," which means a measure as a noun, or the act of measuring, or standard-testing, as a verb. It is evidently ridiculous to confound this word, by misspelling, with the old French word "gage," which means a challenge; and yet it is this sort of iodiocy to which we are invited by our spelling reformers.

You are just right in exposing the folly of this nonsense. If exactness in mechanical practice and in scientific investigation and teaching is desirable, it ought to comprehend the orthography used, as well as shop tools and methods, and the paraphernalia of the laboratory.

Connecticut. Old File.

◆

AS TO CAST GEARING.

Editors Mechanical Engineer:

In your issue of June 14th. 1884, there is an article on gearing, in which you say, "There is a thick and thin side to every cast gear." This we deny. We have had many gear patterns made in the past few years, and in all cases have had them all made *straight*, or one side as large as the other. All the reason there is for making draft on gearing patterns is to allow for imperfect pattern-making.

If gear patterns are made as they should be, and as true as we have them made, they will leave the sand without any draft. We think it is unwise to cover up bad workmanship at the expense of users of gearing. We use the odontograph in determining the form of the teeth of our gearing. consequently all wheels of same pitch work together smoothly, regardless of their diameter. William Tod & Co.

Youngstown, O.

[We should have said there was a thick and thin side to *many* cast gears instead of every cast gear. In the same article we also said:

> "Moreover, when trains are set up at work, it is not unusual with cast gears to find the draft sides opposed to each other, instead of being, as they should be, on the same side.
>
> "There is a thick and thin side to every cast gear, owing to the draft on the pattern, and these, it is obvious, must be identical when gears are meshed together."

As regards the draft sides this is exactly the reverse of what we intended to say. The draft sides should be opposed to each other, or else there will be a bearing on one corner of the face of the tooth only. This shows how careful one should be in writing on technical subjects.—Eds.]

◆

RESTORATION OF BURNED STEEL.

Editors Mechanical Engineer:

Inclosed you will find three pieces of steel, marked 1, 2 and 3. No. 3 is a piece that has been, what I call, burned, if there is such a thing as burned steel,

No. 2 is a piece that has been burned and worked over subsequently.

No. 1 is a piece that has not been burned.

Now what I claim is that steel cannot be burned so as to spoil it, if it is in such shape that it can be worked over again in the fire.

I suppose there are those who will not agree with me on this point. but all I ask is for such persons to send me a piece of steel that has been what they call burned, and I will make it as good as it was at first.

Do you know of anything to restore burned steel to its proper state?

I wish you to examine these pieces of steel and tell me what you think of them. If the preparation is good for anything I will give it to the public. If it is good for nothing let it remain as it is.

I would be happy to answer any question in relation to over-heating steel, from anyone.

Bristol, R. I. T. H. M.

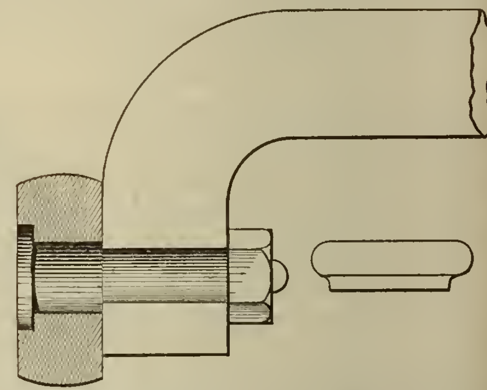
[The inclosures referred to were not burned, but were overheated. Steel that is burned has its crystalline structure changed in appearance; from a fine close grain it is turned into coarse irregular crystals, very much enlarged, as regards its structure. These samples, on being fractured, were almost uniform in texture; those said to be burned differing very little from those which were not burned. Steel can be burned very readily in the fire, and is sometimes subjected to such treatment through carelessness, but the occasions are so few that we do not think any preparation to restore burned steel would prove commercially valuable.—Eds.]

◆

TOOL FOR SPINNING COPPER LININGS IN CYLINDERS.

Editors Mechanical Engineer:

I find this a very useful tool for the purpose indicated—spinning or rolling copper liners into cylinders, for any desired work. The bar is 3½ square steel, with a steel roller mounted on a stud-bolt at the end, as shown; the bar itself being used in a lathe in an obvious manner. The construction is shown clearly by the drawing, and the rollers may be made of any special pattern desired. The same tool can be used in a boring bar, if the cylinder is too long to be "hung up" on the face-plate.



The method I employ is to bore out the cylinder casting to size desired, then insert the copper liner snugly, and with this tool in the tool-post and the feed on, roll the copper as tight as required If the liner is not intended for removal, turn a small groove in the casting at each end, and roll the copper into it.

Petersburgh, Va. R. J. Steel.

◆

FROSTED STEEL.

Editors Mechanical Engineer:

Can you, or will the "Professor" please tell me how to make a frosted surface on steel; a fine finish I mean, like dead polish or luster, as it is called?

Boston, Mass. Dead Finish.

[Frosted steel, so called, can be produced in several ways; by acid, by dead smooth files, and by oil-stone powder used with water, or kerosene. When dead smooth files are employed, the finisher must be careful and not allow them to "pin" up and scratch, for the surface is destroyed. All that gives the luster is an infinite number of fine abrasions. or graining, so that if the lines do not cross and recross, and curve in and out, there will be no effect; the surface will look like any smooth filed surface. The file can be used only on flat faced jobs and must be worked sideways, precisely as a woman scours with a scrubbing brush. The process is. actually, scouring the surface with files or oil-stone powder.

When acid is used the effect is not so good as with files, the surface is more or less blackened, and looks dull and dead. Moreover, it is apt to bite irregularly.—Eds.]

◆

LEAKY LOW PRESSURE ENGINES.

Editors Mechanical Engineer:

I noticed what you said in a recent issue, page 118, vol. VII., about engines leaking into the condenser, thereby giving many the idea that condensing engines cost more for fuel than high-pressure We have had such a case in this vicinity; but when I showed your article to the engineer, he seemed to see a great light, and went to work and ground the valves tight. Since which time there has been much less sweating (and swearing) in the fire-room. I would like to have about $5,000, so as to be able to put a copy of The Mechanical Engineer in the hands of every engineer on these lakes. I think it would do them good. Upper Lakes.

Ontonagon.

[Our friend's aspirations are creditable to him and to us, but he sets his figure too high; much less than the sum named would accomplish the purpose.—Eds.]

◆

WATER MOTORS.

Editors Mechanical Engineer:

Will you please explain why there is no small water motor in general use—or if there is such a machine why is it not generally known and used? The —— water motor is a fair machine, but it is made so large and clumsy, that it is not available for small powers—say one-quarter to one-half horse-power. If such a one was made, to be attached back of a sink, so that the waste water would run into the sewer, I should think there would be a large sale for them. D. B. K.

Providence, R. I.

[An obstacle to the use of water motors in many places is the want of head in the city water, and clauses in the licenses which forbid the employment of such machines. There are many places, however, where they could be used.—Eds.]

◆

FROM STATIONARY ENGINEERS ASSOCIATION, No. 4, OF MISSOURI.

Editors Mechanical Engineer:

At our last regular meeting the following officers were elected for the ensuing year: Pres., W. A. Cowan, Vice-Pres., G. Moore; Recording. Sec, J. Crabtree; Fin. Sec., F. B. Crary; Cor. Sec., N. M. Fife; Treas., G. Sortwell; Conductor, L. McCormack; Doorkeeper, C. Chapman; Past Pres., G. Pinkham; Trustees, C. T. Sortwell, A. McCloud, and J. Kern. Our delegate and alternate to the National Convention were selected, and will be elected at our next meeting. These are Messrs. George Trindle, delegate, and R. J. Kilpatrick, alternate. We took in five new members at the last meeting, and have more applications in. The boys are just getting down to business. We shall have a new Indicator in a short time.

Kansas City, Mo. Henry M. Fife, *Cor. Sec.*

◆

FROM OWOSSO, MICH., ASSOCIATION OF STATIONARY ENGINEERS, NUMBER 2.

Editors Mechanical Engineer:

Inclosed please find list of officers elect for ensuing year. As some mechanical journals have sent circulars asking for such list, I thought perhaps it might be desirable to you.

At the regular meeting of the Stationary Engineers Association, No. 2, of Owosso, June 24, officers for the term of one year were elected, to wit: C. A. Byerly, Past Pres.; M. Crandall, Pres.; H. Walker Merrill, Vice Pres.; M. Gaylord, Rec. Sec.; D. Sullivan, Treas.; W. R. Smith, Finance Sec.; Wm. Rowley, Conductor; A. Jackson, Doorkeeper. Delegate to Nat'l Convention, W. R. Smith; Alternate, John A. Trit. W. K. Smith, *Cor. Sec.*

◆

A QUERY.

Editors Mechanical Engineer:

There is a passage in Article IX. by George Slocum, which reads thus:

"Now 1 pound at the lever's end will balance 1,508 pounds at the point of the screw."

I would be obliged if he would try and make it a little clearer in reference to balancing. Clement.

Philadelphia.

[The expression "balance" is used in the sense of pressure; what follows in the same article shows this very clearly.—Eds.]

◆

FROM TWIN CITY ASSOCIATION NUMBER 3, STATIONARY ENGINEERS.

Editors Mechanical Engineer:

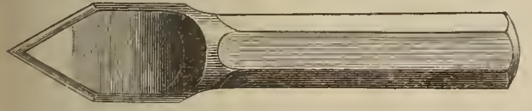
The following named persons have been elected to serve during the coming year:

Pres., S. D. Gresham; Vice, Ernest Welchley; Treas. and Fin. Sec., C. E. Hollister; Cor. Sec., E. S. Claybourne; Cond., A. F. Bradford; Doorkeeper, E. C. Bronson; Past Pres., Theodore S. Kinner.

Urbana, Ills. E. S. Claybourne, Sec.

Chippings and Filings.

Make Yourself A Marking Chisel and keep it handy. If you are setting up engines, it is indispensable; if you are in charge of machinery it never comes amiss. The cutting end should not be a right angle, but as shown in the sketch. The point strikes first then, and makes a true mark.



◆

An Unknown Correspondent has sent a tracing of a new plan for marine boiler furnaces to Norman W. Wheeler, addressed in our care. Mr. Wheeler is at present making the tour of the Great Lakes, and has no permanent address. When he returns the drawing will be handed to him.

◆

Sponge Rubber, used by draughtsmen for cleaning drawings, hardens by time so that it becomes worthless. This is well known, and our suggestion is that those who have the opportunity might try what virtue lies in high pressure steam, as a restorer of its elasticity. We apprehend that it might be useful.

◆

The *Builder* says:

"A smoking fireplace may often be cured without any change of flue or chimney, by a piece of metal fitted in between the jambs. And this cure is effected not because the fireplace was originally too large or too shallow to "draw," but because the proper provision had not been made for entrapping the smoke and turning it into the rising stream of warm air."

◆

A French Chemist makes alcohol out of watermelons by this process: He took the juice of six pounds of watermelon pulp, and having added a certain quantity of free sulphuric acid, warmed the mixture; the sugar became transformed into a mixture of glucose and levulose. This product, which ferments directly, yielded ten quarts of perfectly normal alcohol.

If this is correct it seems a cheap way of making alcohol.

◆

We Have Often Thought that there was money to be made in large cities by collecting cinders from ashes and selling them for fuel at a small price. The waste in this line is enormous. Servants throw good coal away, not to mention that which is only half burned and still valuable. Our conviction above expressed is strengthened by the fact that a company just started to utilize house refuse in this city finds 400 lbs. of cinders and coal in 1,800 pounds of waste. By the aid of simple machines all this could be made marketable.

◆

A Contemporary says:

> A New York inventor has patented an electric device that is claimed will give an alarm when the water in a boiler gets below the danger line. If so, it is a triumph of genius that should command the warmest praise and substantial support.

There may be a difference of opinion on this point. Bunyan's Pilgrim's Progress mentions a first-rate low water alarm, or detector, that should always be found in every engine-room. This is Mr. Facing Bothways. When he is about the water never gets low.

◆

It Is In Evidence that a dog, trotting over an iron bridge in Western Massachusetts, caused the bridge to fall. The latter was already weakened, and the jarring pulsations induced by the dog's trot brought the bridge down.

Bands of music are forbidden to play on most of the large iron bridges of the world. This is due to the well-known phenomenon that a constant succession of sound waves, especially such as come from the playing of a good band, will excite the vibrations; at first, these vibrations are very slight, but they increase as the sound waves continue to come.

◆

What seems to us a singular proceeding is that mentioned in press dispatches of the 10th instant: "A fireman removed the plate from the manhole of a boiler, and placed a lighted lamp on the inside to aid him in finding a leak. Benzine had already been poured into the boiler for the same purpose. An explosion immediately followed, and for a while the boat seemed enveloped in flames. The fireman, the mate, engineer and assistant fireman were all burned about the arms, face and head, the burns of the fireman being considered serious."

This was a marine boiler, and the method employed for discovering a leak seems extraordinary; the results do not.

◆

A Curious Second-Hand Boiler Experience, in which many individuals took part, is related in *Engineering.* A bought a second-hand boiler on speculation and stored it with B; not being able to "stick" any one on it in a year and a half, A gave the boiler to B for the storage charged. B sold the boiler to C for $50; C ran it for a while and sold it to D for $90, which was altogether too much profit. D seems to have had a little decency in him, for after working the boiler a little while he sold it to E for only $10 advance on what he paid for it. There is no knowing what price E would have got for it, because, fortunately, it burst "on him." Moral: do not go and do likewise.

◆

The Efforts Of A Train-Boy to sell a fine-print book suggested the thought that people who make books might score an increased sale if they would pay more attention to the type they use. There is something inviting about a book printed in large type to a traveler, but fine print has nothing to recommend it. It tires one to glance at it; although a few foolish individuals risk their eyesight on this sort of literature, the majority would prefer a more legible kind.

The St. Albans (Vt.) *Messenger* says this, and it applies equally as well to newspapers. The Mechanical Engineer, as regards its body type, is a most legible paper.

◆

The *American Miller* requests us to state what we think of western journalism, as displayed in a paragraph it quotes from a contemporary. We have read the quotation, and express the opinion that it is packed too tight, and is, also, somewhat out of line.

We have, however, no bashfulness in saying that we have a very sincere admiration for western trade journalism as exhibited in the *American Miller.*

We could say fine things of it, but don't like to. We read it all through, and think we have got it all; then we read it again, and find there is more of it. It is to milling interests what *Harper's Monthly* is to general literature.

◆

A Contemporary, unknown, says:

> "If a man persistently battles against a great moral wrong, he is thought to be a 'crank.' The person who has force of character and manhood sufficient to break out of the rut that all unthinking individuals trundle along in, he or she is at once set down as a 'crank.' When one looks around and thinks over the names of the 'cranks' who have given us religious and political liberty, we thank heaven for giving us so many 'cranks,' and trust our future may always be guided by a noble band of 'cranks.'

Our friend seems to have an erroneous view of the cranky man. He is not as depicted above—one with convictions and objects, but a person who has neither; he is hot after the last sensation or hobby, but he purses them without either method or consistency. Of such is the crank.

◆

A Peculiar Case is that of the French yacht *Nubienne* now lying in this port. Just before starting for Newport a young man came on board who spoke French perfectly and requested the berth of pilot for the trip. He presented forged letters of recommendation from yacht owners, and also a letter from the Harbor Master, giving him "leave of absence." The young man was engaged, but on leaving the dock he hailed a passing tug and demanded to know whether the tide was "coming in or going out." This curious inquiry from a pilot aroused the suspicion of the French crew, and they kept only just steerage way on the ship. This was enough for our amateur friend, who had no sooner got into Hell Gate than he promptly put the yacht ashore. The audacity of the proceeding has never been equaled.

◆

Respecting The Adoption of independent cut-off valves on locomotives, Charles E. Emery says:

"A well-known builder of stationary engines at the East held the same views as Mr. Le Van about the locomotive, and after I had advised him to abandon the subject, he acknowledged that he had some time previously got permission to apply independent cut-off valves in upper separate chests to a passenger engine (though he was not allowed to meddle with the main valves), and had found to his great surprise that he could do no better with his attachments in use than when a cut-off was produced with the link motion."

Exactly; for the reason, probably, that the link motion was also used as a cut-off, in connection with the independent attachment.

◆

The Guarantee given by one maker of machine tools in this country embraces these points:

"We will, in every case, guarantee the accuracy of alignment of the 'live' and 'dead' spindles. If the large face-plate cannot be faced up so that a straight edge shows it to be practically a true plane, send the lathe back to us. If a piece held in a chuck, or otherwise, securely fastened to the face-plate, cannot be bored out so that the hole is practically true from end to end, send the lathe back to us. If the scraping and fits of all parts intended to fit are not first-class, send the lathe back to us. If a proof-bar fastened in the center of the 'live' spindle throws out more than 1½ thousandths of an inch, twelve inches from the face-plate, send the lathe back to us. Finally, if the lathe will not do a strictly first-class job on anything within its capacity, send it back to us."

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

150 Nassau Street, New York.

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No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

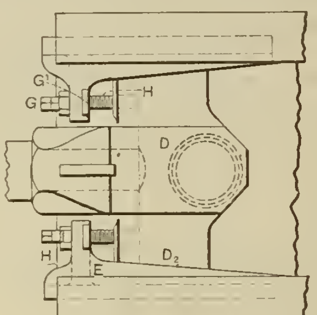
☞ *No matter will be entitled to payment unless the price is stated at the time.*

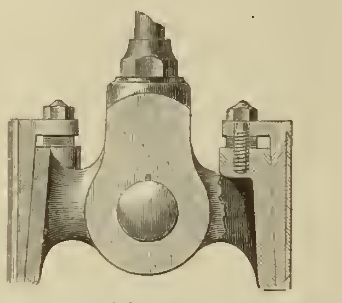
TAPER GIBS ON CROSS-HEADS.

On page 154 of the last volume, under head of *"Patenting Old Devices,"* we cited the carrying-jack, commonly used on railways, as a case in point. Since that time we have observed another example of patenting old devices, which seems worthy of comment.

Taper gibs used on the cross-heads of steam engines are very old devices—so old that we cannot recall where we saw the first one, or when, and we can cover thirty-five years of active service in this line.

The objects of the gib and its construction are obvious without comment, and we shall therefore offer none. What is remarkable, however, is the fact that anyone should deem the device worth patenting, in view of its antiquity, or if convinced that some special construction of the taper gib is worth securing, how it is possible to cover it in a patent which shall be valid.





We present herewith two engravings of taper gibs, as applied to cross-heads. The first engraving shows an arrangement patented February 4th, 1884, by a well-known engineer, who is the originator of the automatic system of working steam engines. The second engraving shows a cross-head used by the *New York Safety Steam-power Company* for nearly twenty years last past.

The claim herewith published is that made for the first engraving, to wit:

1. The combination with the crosshead D, having inclined faces D^2, of gibs E, having inclined faces E^2, and two or more independent adjusting bolts G G^1 and H H^1, exerting forces in opposite directions, all arranged for joint operation, to move and to resist the movement of the gibs relatively to the crosshead, substantially as herein specified.
2. The combination of a crosshead D, having inclined faces D^2, with adjustable gibs E, having inclined faces E^2, and adapted to be operated in the direction of their length relatively to the crosshead by means of one or more adjusting bolts, substantially as herein described.

In the second engraving the reader will observe that there are a number of washers on the crosshead, between it and the gib-head. These are very thin and are intended to act as stops to screw down upon, and prevent the gib from being held merely by the friction of the screw-thread in the crosshead. These washers are not shown in the first engraving, but what seems to be a collar (screw collar?) countersunk into the under side of the gib is shown. If this is a patentable device, or feature, it is not covered in the claim above set up—for it is not mentioned. Nothing, in fact, is to be found in the claim which is not also found in the construction of the crosshead shown in the second engraving.

The reader can see for himself whether our comments are just or not. We have made them for the reason that this instance, and the one noted in a previous article, seem to us incomprehensible. They are marked examples of covering old devices by patents which bear very late dates.

We have consulted many engineers of long experience, and persons whose interests lie in patents, and have asked them if they could discover in this device anything new or patentable. The universal answer has been in the negative. Whether issuing patents upon such devices is for the best interest of all concerned, we leave every one to determine for himself.

ENCOURAGING TO ENGINEERS.

Whether it is owing to the persistent appeals of the technical press, the efforts of the Societies of Engineers springing up all over the country, or to the natural instinct for self-preservation which dwells in mankind, we cannot say, but it is certain that serious attention is being given to the status of engineers, and their personal fitness for the posts they occupy. We rejoice at this, for it can result only in good to a class in this country who have never yet had justice done them. We mean, of course, men who follow the management of steam engines for a living.

Engineers have not had justice done them for the simple reason that all have been lumped together; the good and the bad have been classed alike, and the shortcomings of the poorest have been charged upon those better informed. Men who have a realizing sense of the responsibility of their charges have been classed with those who do not know the figures upon a steam gauge.

Popular indifference to the status of engineers is not by any means confined to small consumers and steam users, but it extends to very high places. Men are to be found occupying positions of trust and responsibility who can scarcely read or write. We have plenty of proof of this, and would, if we saw any end to be gained by it, mention instances, but we have no desire to impale individuals for the fault of a system.

They exist because of the indifference of employers, or ignorance of employers, as to what an engineer should be, but the time is rapidly coming when a man professing to be an engineer will have to show that he is such actually. What would be thought of a steamship company that would allow one of their vessels to go to sea with a captain who could only write his name because he had practiced that graphic method of identifying himself on paper? How much more responsible a post has the captain of a ship than the chief engineer? We answer none at all; a fact so palpable that it needs no argument to sustain it.

We said at the beginning of our article that a better state of things is approaching, and we see this in the popular demand for the examination and classing of engineers. Not alone among the men, but from the public. This sentiment is shown in an article which we publish elsewhere from the *Lumberman's Gazette*, Bay City, Mich. It is also shown by the comments of our contemporaries in other parts of the country. They begin to realize that an engineer is a man of some importance in the community, or should be, and that the safety of every one in his vicinity depends upon how much he knows, not upon what he pretends to know.

THE MECHANICAL ENGINEER has always taken the boldest ground upon this question, from no other motive than simple justice to a class who are not always appreciated as they should be, because their places are usurped by pretenders who do not comprehend the rudiments of the power they profess to manage.

The day will come, sooner or later, when every city and town in this country will have its license system and its inspector of boilers, and it behooves all who can in any way expedite its coming to do so.

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SOME EXCEPTIONS.

To all rules there are some exceptions. A recent writer says:

> "There is no such thing as a journal friction, as a friction of rest in distinction from a friction of motion. The fact that friction of rest appears to exist is due solely to the fact that no journal or other solid body can be instantly set into rapid motion by any force, however great."

How about a rifle bullet?

A pickerel lies sunning himself in a quiet stream, and is as inert and motionless as the stones at the bottom. Something startles him, and, like a flash, he is hundreds of feet away. He moves so swiftly that the eye cannot follow him, even though his motion is in a direct line before us. He was here, he is there; an electric flash is not swifter. If the pickerel is a solid body (we have known some that were), he starts instantly from a state of rest, and stops instantly. There is merely a vague streak, to the keenest vision, during his flight.

The only question that can arise is what instantly means. If it covers an inappreciable period of time we think we have made out a case.

PUBLIC TESTS FOR STEAM ECONOMY.

Public tests for economy in steam engines, between rival manufacturers, do not appear popular. They do not seem conclusive of anything, either. Some one must be second, and that some one finds such a position disagreeable. Then wrangles ensue. All concerned are impeached. Many inconsistencies, which did not appear during the trial, when the result was unknown, are discovered when the judges announce the winner. For half a year thereafter the trade papers are full of long communications, bristling with figures, showing just where the errors occurred which placed the best engine in the worst place. This was the result at the Millers' Exposition in Cincinnati about four years ago. In view of these facts, we hear with some apprehension that at the coming International Electrical Exhibition, to be held at Philadelphia, September, 1884, it is proposed to make a most thorough series of tests for all engine builders who may make application for them.

It is of course desirable to know what advance we are making in steam economy. To this end experiments, carefully carried out by competent persons, are indispensable. We do not exclaim against them, but what seems unfortunate—and possibly inevitable—is the differences which arise when the decisions of the judges are made public. Neither do we see how it is possible to avoid contention if public experimental tests are made. If the authorities announce that no firm names will be given, in connection with the trials for economy, good manufacturers would not care to compete, for the commercial benefit to be gained in case of taking the first place is very great, and perhaps the only inducement for manufacturers to enter their machines.

Exactly how engine tests for economy should be conducted is a question; the solution of it cannot be had ready made. If it could be so managed in the interests of steam users that the naked facts could be had, such tests would be of the greatest value; but if they are to be repetitions of similar tests where all fare ill alike—manufacturers, experts, judges, *et al*, we fail to see their importance.

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A MISTAKE.

Engineers generally have an idea that where brick walls have been laid over steam boilers, directly touching the iron, so that the mortar came in contact with the shell, injury was sustained by the same. It was supposed that the lime corroded the iron, under the combined action of its causticity aided by moisture and heat alternately. If we read the experiments of the late Mr. Trautwine correctly, upon this subject, we are mistaken in the idea above mentioned. Lime mortar in direct contact with boiler shells is preservative, rather than destructive.

The experiments alluded to were these:

> "The cements used were English, Portland and Louisville; in addition to which he tried plaster of Paris nure, and also mixed with equal measures of the cement. All were of the consistency of common mortar, and all were kept in an upper room during ten years, unexposed to moisture other than that of the indoor atmosphere. The metals were partly embedded in the pastes, and partly projected from them. They consisted of cut iron pails, some of which were galvanized; smooth iron wire nails; brass in both sheet and wire; zinc in sheet; copper wire; and solid cylinders of lead $\frac{3}{8}$ inch diameter. The result at the end of the ten years was that all the metals in both the pure cements were absolutely unchanged; and this was also the case with the plaster of Paris, with the exception of the ungalvanized nails, which had become covered with a thin coating of rust, as were also those in the mixtures of plaster and cement, but to a less degree. Mr. Trautwine concludes from his experiments that if dampness be excluded, both cement *and lime mortar* will protect from injury all the metals employed in ordinary constructions for an indefinite time."

The italicized words are ours, for they contain the only reference to lime mortar, pure and simple. Nevertheless, unless it is absolutely necessary, it does not seem exactly the thing to expose iron to the chance of corrosion by contact with mortar.

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HARD COAL vs. SOFT COAL.

In relation to the smoke ordinance, so called, in force in some cities, notably Chicago, a Western contemporary says:

> "It has transpired that it will be very expensive for tugs and propellers to use hard coal as fuel, as the intense heat directly under the fire will soon burn through the shell of the boiler. It would be beneficial to all concerned if the great American law-makers would devote a little common sense to the results of its working before they frame an ordinance. The enforcement of this smoke ordinance will put vessel owners to great expense, without the slightest suspicion of any good to result therefrom, as the fumes arising from the burning of hard coal will be tenfold more injurious to health than would be volumes of smoke from soft coal."

Our friends are in error as to the action of hard coal on steam boilers. Thousands of tons of it are used annually under steam boilers without injurious effect. It is claimed that soft coal is very much more injurious, as regards repairs, to boilers than anthracite. Engineers who have used both in the same boilers say that such has been their experience.

As regards burning smoke, consuming it after once made, that is impossible physically. Smoke does not burn any more than water does. It cannot be ignited. Any ordinance that requires it—smoke burning—is a dead letter on its face, for it requires impossibilities. The only remedy for smoke is not to make it.

Soft coal is troublesome to fire, in that it requires to be fed to the furnace a little at a time and often. Part of the fire must be bright, so that the gases of combustion will ignite, but the difficulty with many who use soft coal is that they smother the fire with it. Smoke is inevitable under such circumstances.

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AN IMPENDING FIZZLE.

The steamer *Meteor*, which made such a fuss about going to Europe in five days some three years since, but never went anywhere with her own power, is now having new engines put in her in Maine, and, if our information is correct, is destined to be the cause of more trouble and loss in the near future. The concern which is putting the new engines in her has guaranteed a speed of 29 (?) miles per hour; upon learning which fact the chief constructor of the works—a man of wide experience—immediately resigned his position, and the works are now going it alone, so to speak. If the *Meteor* is ever driven through the water at sixteen statute miles per hour by her own power, those who do it need not be ashamed of their job.

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AS TO CRITICISM.

A latter-day humorist stated to a friend that he had recently adopted a method of moral culture in his family which promised the happiest results; this was unsparing criticism upon such personal weaknesses and failings as came to the surface. He was obliged, however, to pass General Order No 2, revoking this method, for the reason that it cost him too much in crockery and court-plaster to keep it up.

This is undoubtedly the view generally entertained upon critics and criticism, and, in some instances, the feeling is not unnatural, for some criticism is merely a medium for the utterance of harsh sentiments, due to a bilious and heavy laden stomach, which longs for something to vent its spleen upon. This is criticism in its illegitimate form. A person of sluggish digestion, in thrall and bond to dyspeptic pangs, is apt to say black and bitter things about that which is, to others, lovely and of good report. Respecting critics and criticism, and the responsibility of journals therefor, our contemporary, the *American Engineer*, has this to say, in substance:

> "Editors of independent technical journals of standing have to contend with some serious difficulties arising from their very independence. The fact that this leads them to point out without fear or hesitation whatever they consider an error from an engineering standpoint, seems to give some the impression that they open their columns to anonymous belligerent attacks. This is a serious mistake, for no independent journal will knowingly permit itself to be used in this way, and be degraded to the level of a partisan or scurrilous sheet. For that matter criticisms of engineering devices, or projects, should always be signed by the author. This appears to be the more manly course, for if the points are well taken, and presented in good faith, there is no reason why the party scoring the same should be ashamed of them. The moment an independent technical journal of standing really errs, it will be made to feel its error by a decreased financial return. But the editors, acting for themselves and the publishers, must be the judges, and can refuse or admit into their journal whatever they think proper."

"We concur in the above."

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Manufacturers desiring trade catalogues in superior style can obtain estimates of probable cost by addressing us. Engravings of machinery furnished at low rates for good work.

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LXIX.

Jacob Hess has not figured much in these simple annals of the shop for the past few months, and this is due to the fact that he is averse to notoriety, or to the celebration of his doings, in the columns of The Mechanical Engineer. He said as much as this to me, some time ago, and in deference to his wishes I have forborne to mention many things which transpired that might possibly, by the narration, have helped others. When I pointed this out to him and instanced some little thing he had told the men, or the boys, about the business he would answer:—"Why, good gracious! everybody knows that. What's the use of making a fuss over a little thing like that?"

"Everybody don't know it; the man to whom you gave the information for one person; if he had you wouldn't have had to tell him. You forget that every man has a different experience from his fellows in this world, and though he may have had good opportunities he did not make use of them. Here is a chance now for you to show us how much your men know about everything, as you call it. I brought this lamp over from the house this morning, because the tin bottom sweats oil. There isn't a five-eighth hole in the bottom, but it leaks all the same. Take it out to the first man you meet in the shop out of a job, and tell him to solder it. I don't bet, but I will venture to say your man will take water on the job; or if he undertakes it he will make a botch of it. More than that, I venture to say there are not three men in the whole thirty-five that can make a good job of soldering."

Jacob entered into the spirit of the thing, but he said it was scarcely a fair test of general ability, for soldering wasn't a machinist's business, strictly, though, he added, every man ought to know how to do it. Jacob picked up the lamp, which had a tin fountain on it, and went out into the shop. As good or ill luck would have it, the first man he ran across was Bill Paul, an old machinist of many years' experience.

"Bill," said Jacob, "what are you doing now?"

"Ain't doing anything," said Bill, "was just coming after a job."

"Jobs are scarce," said Jacob looking around carelessly; then his eye lighted, casually, on the lamp in his hand, and he said, indifferently, "Here, take this; there's a hole in the bottom of it somewhere; just solder it tight while I look you up another job."

Bill took the lamp and turned fairly green. "Fact is," said he, "I suppose I might plug up a hole in a tin can with a chunk of lead, Mr. Hess, but a thing like this, that wants to be done neatly, I ain't up to, and that's a fact."

"You mean to tell me you can't solder a straight seam," said Jake, looking at him.

"I do," said Bill, rather sheepishly. "Oh, I can stop the holes, give me time and lead enough, but I am afraid the work will look rather 'curdly' when it is done; a little mite 'ridgy like,'" said honest William apologetically.

"That won't do," said Jacob; "if I were you I would take a lesson in soldering first chance I got." Then he went over to Lamb, a young man of whom I have made mention before. Lamb is a person who has full faith that he can do anything he undertakes to, no matter whether he has ever had experience with it or not. This is a most valuable trait, particularly if one undertakes to jump a ditch. In such a case a man needs to be dead sure that he is not going to stop half way. Lamb answered at once:—"All right," and stretched out his hand for the lamp.

"Can you make a neat job of it?" said Jacob.

"Why, certainly," said Lamb, amazed that any one should argue about a little thing like that. Jacob gave him the lamp and then disappeared; he didn't go far, however, but remained in the vicinity where he could watch Lamb's operations. This latter personage took the lamp in hand and began by holding it up to the light, expecting by that to find where the leak was. Not succeeding very well in seeing around a corner—the leak was in the seam on one side, and Lamb was looking through the wick-hole—he felt the bottom all over with the end of his forefinger. This didn't locate the leaky place either, so he went to the hydrant and filled the lamp full of water. This time he did better and found a place where the water oozed out slowly. He chalked the spot and then went for the soldering iron, and heated it at the portable forge where we dress tools. Then he got the solder and melted some on the leaky spot, having first rubbed it off with a piece of waste. The solder didn't like the place very well and rolled off, and Lamb dabbed at it, again and again, with the iron, but after five or ten minutes' fuss was no better off than when he started. Finally, when he was quite red in the face, Jacob went over "accidentally" and asked him how he was making out.

"First rate," says Lamb, "I'll soon have it done now." Meanwhile he was pegging away with the iron.

"Hold on," said Jacob; "that's enough of that. I was sure you didn't know how to solder, and now I am dead certain you don't."

"Anybody can solder," said Lamb, rubbing away with his iron.

"Well, then, you're nobody, for you can't solder worth a cent, and I know it. I saw that as soon as you took hold of the iron. How did you expect the solder to take on a dirty surface?"

"It ain't dirty," said Lamb; "I wiped it off clean."

"You wiped it with a piece of dirty waste, but that didn't clean it any. If you knew it should be clean why didn't you clean it? Give me that iron."

Lamb handed it over, and Jacob looked at it. "You've burnt it," said he; "it's no good for a soldering iron for regular work, but we can file it up for present use, and then dress it properly afterward. The iron is as dirty as the job you were at work on. Jacob took the iron, put it in the vise and filed it up square and true on the point; then he tinned it. He did this by heating it moderately hot and rubbing the end of it on a bar of tin, which he had strewed with a little powdered rosin. After this he took some fine sandpaper and ran all around the seam Lamb had fussed over, and cleaned it all off; then he took his knife and scraped close in on the seam where the sandpaper would not reach, after which, with the iron perfectly clean, and a little rosin, he ran the seam all around with solder just as easy as molasses runs out of a pitcher. "There," said Jacob, "it's the simplest thing in the world, if you only know how. The solder follows the iron every time, if everything is in good order, but if there is the least bit of dirt anywhere, if the surfaces are not *absolutely* clean, the solder will crawl off, or if it appears to stick will not hold long. Rosin acts as a flux and prevents the metal from oxydizing, or being attacked by the air, which acts on it instantly, as soon as it is cleaned. This oxydation is not visible to the naked eye, perhaps, but its influence is there. Soldering fluids act in the same way—as fluxes. The fluid used for this purpose is muriatic of zinc. It is made by dissolving sheet zinc in muriatic acid until it will cut no more zinc; turn off the clear liquid and dilute it with water until it is mildly sour to the taste. You needn't drink any of it, however, to find out, for it is poisonous. Some add a little sal-ammoniac, but I never found that it made any great difference. All that I have told you, Lamb, relates to common soft soldering, which can be used either for brass or iron. For the latter you must tin the surfaces, however, before you undertake to unite them by soft solder. Strong muriatic acid will sometimes bite an iron surface clean so that soft solder will take on it without tinning, but I have known this to fail a good many times. You can tin cast iron so that solder will adhere to it by filing it clean of scale and sand, dipping it in soldering fluid, and then sprinkling it with powdered sal-ammoniac. Hold the work over a clear fire until the sal-ammoniac vaporizes and then dip the piece in melted tin, jarring off all but the film which adheres. You will have success every time, if you only observe cleanliness in all that you do."

"Well," said Lamb, "I own up, Mr. Hess, that I thought soldering was only holding a hot iron on melted lead, but I see it is something different."

"You ain't the only man," said Jacob, as he went away with the lamp in his hand.

All the proceedings above narrated had been observed by me, for being interested in seeing how my prediction would come out, I had followed every stage. When we both returned to the office I asked Jacob what he thought about universal information now, and whether knowledge of that which seems obvious, or known to all, is worth relating in print.

It is worth telling, I suppose, to the man who wants to know it, and there must be a good many of that kind, judging by what we have just seen.

"Have you stopped learning, Jacob?"

"Not at all; I learn every day. I have found out something to-day I didn't know before."

"Have you any objection to parting with the information you obtain?"

"Not a bit; I am glad indeed, if I can help any one along."

"Then don't you say a word, after this, if I put you in the paper sometimes. You know what you have verified by experience. The other man wants to know also. It is no loss to you to impart it, and it is a gain to him to learn it. When you see something in print that you know all about, just think that there are thousands of others who will see it for the first time."

OPTICAL ILLUSIONS—Number IV.

By Egbert P. Watson, Jr.

My last article left the reader contemplating a goblet full of cigar smoke at the end of a ribbon ten feet long, which smoke, it is assumed, was condensed from the cigar we consumed on the stage in presence of the audience. Of course this is wholly illusory; but it is a very effective deception, and, when performed with skill and dash, never fails to excite the admiration of all, simple as it is.

Here let me remark, in passing, that the success of all optical illusions depends greatly upon the probabilities and possibilities involved. Anything which appears to violate these two contingencies is, morally speaking, a failure, even when it is superficially a success. The trick is performed and the audience accept it, with mental reservations. They acknowledge the skill of the performer, but they shake their heads all the same and say "it couldn't be."

This little illusion which I am about to explain violates none of the probabilities. "It is quite possible," says the man in the audience who knows how all the tricks are performed, and explains them audibly to those in his vicinity, "that he has some kind of a 'porous ribbon;' then he magnetizes (?) the glass, and the smoke is drawn right into it." Silly as this is (magnetizing a non-conductor), it is not more so than many alleged explanations of tricks which I have heard.

As a matter of fact, there is no smoke, the vapor which stands for it being wholly chemical.

In using the chemicals necessary for this, be careful not to drop or spatter any on clothes, furniture, fingers, or anything else, for the effect will be disastrous. Provide two glass goblets, not tumblers. It isn't necessary to have fine ones, as the only requisite is clearness. At the same time obtain two common saucers. From the druggist purchase five cents' worth of pure muriatic acid in a glass-stoppered bottle.

Into one of the goblets put a small quantity of muriatic acid, and in the other put a little saturated solution of common table salt. A *saturated* solution is made by dissolving the salt in water till no more can be absorbed. You will only need as much of the solution as you have of the acid. Wet the sides of each of the glasses by stirring the liquid around with a clean stick. When this is done empty the acid into one saucer and the salt solution into the other. Now place the goblet which was wet with acid mouth down in the saucer containing the same, and put the other in the same way (mouth down) in the salt saucer. This being done, we are ready to put both on our table. It is needless to say that the saucers, etc., must be put on the table before the performance begins. The ribbon may be anything your fancy dictates, as it is only a trick to deceive the spectators. As the description of the action has been given in the previous issue, it is unnecessary to repeat it here. The whole secret lies in the chemical combination which ensues at the moment the two glasses are put together, mouth to mouth; smoke (vapor) will be formed by the action of the acid on the solution of salt.

A seemingly marvelous transformation of ink into water is a pleasing illusion, and one that never fails to elicit applause. It is effected in this way:

The performer calls attention to a glass globe or bowl which is filled with ink, and which stands out in the front center of the stage on a light uncovered table. To show beyond a doubt that it is ink he dips out a small spoonful, and, emptying the same on a white plate, passes it around for inspection. Before coming back he borrows a large handkerchief, which he carries to the stage and uses as a cover for the globe. He allows it to remain there for a few moments, meanwhile keeping up a harangue on some subject. After finishing, he goes to the stand and raises the handkerchief; in the place of ink he reveals—water, pure and simple.

This is very easily managed. All that is needed is a black cloth bag without a bottom, so made as to fit the inside of the globe, with a small piece projecting, or rather hanging from the back, outside. If any difficulty is found by reason of the cloth floating when the globe is filled with water, a few buckshot sewn in the bottom edge will remedy the matter. The water presses the bag against the side of the globe, and gives to it the appearance of being filled with ink. To show ink to the audience, get a small tin dipper from the tinsmith, and ask him to make a hole in it through into the handle. Pour a little ink into the handle through the hole, and place the dipper on your table, handle down. When you use it, you need only to pretend to dip, and the lowering of the body will allow the ink to run through the hole into the dipper. The rest is plain; simply pour it on a plate, and the deed is done. You need a large handkerchief, because when you raise it you also raise out the bag, by taking hold of both at the same time. If the handkerchief be too small the bag will show, and then—woe be unto you. "Shame and confusion will seize upon thee, and follow thee all the days of thy life."

This illusion may be varied by using two globes—one showing "ink," and the other water. The water globe may be sent out bodily for examination. When this is used, the ink is turned to water and the water to ink. The only difference between this and the one explained is that the water is changed to ink in the second globe. To do this you need a small druggist's phial filled with ink, which you carry in a small pocket for convenient use.

After turning the "ink" to water you go to the second globe (which has also been covered with a handkerchief), and raise that one off by taking one corner in each hand. This is necessary, because you must carry the phial in the right hand and at the moment of raising pour its contents into the water, of course doing this unostentatiously and while raising the cover. If poured on the front side it will tinge the water jet black there and extend backward on each side, growing a little faint at the back. A uniform color can be obtained by quietly agitating the globe while taking it to be examined. This is a thing which never fails to please, and does not need much practice.

(*To be continued.*)

MORE ABOUT FLYING MACHINES.

The $100,000 left by Mr. William Maxwell, of Wisconsin, to be used by Prof. C. F. Ritchel, of Bridgeport, to perfect his system of aerial navigation, will not reach Prof. Ritchel for eight or nine months. As soon as it is received some extremely interesting experiments are to be made. Prof. Ritchel proposes to construct a flying machine to be raised in the air and moved by revolving of fans. There is no balloon attachment.

"Flying machine men insist," Prof. Ritchel said, "that, if they only had power enough, they could make a balloon go anywhere. Now, I think that the only way to propel a balloon would be to attach it to a good locomotive on a good track. In this instance, owing to the pressure of the air, the balloon would be turned inside out and flapped to pieces. Some French inventors claim that when they get a powerful enough electric engine in a balloon they can travel anywhere they like, even against the wind. I will show you the falsity of their position. I will show you that if you had a 1,000-horse-power engine no larger than your hat, and as light, in order to lift you and the machine the balloon would have so much surface to present to the wind that you would be dashed here and there and collapsed. There must be at least 4,000 feet of hydrogen gas in the balloon to lift the machine and the man. You never saw a balloon with less than 12,000 feet of gas in it, but I will say 4,000. Hydrogen gas, being the most compressible body known, would be compressed, and by less displacement of the air allow the balloon to drop or be flattened and flapped to pieces."

To show the principles on which he based his claim for a flying machine, Prof. Ritchel originally used a gas cylinder. Suspended from it was his flying machine, with the place for the operator. The gas cylinder reduced the weight of the machine and operator to one pound or less, but never was able to raise them from the ground. By turning a crank connected with geared wheels a propeller wheel at the bottom of the machine revolved very rapidly and the apparatus arose. By means of other propellers, or fans, the apparatus was moved backward and forward. The machine lifted fourteen pounds of shot, placed alongside of the operator.

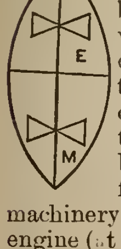
"There is no limit," Prof. Ritchel said, "to the lifting power in the air, by means of a fan, shaped like a screw propeller. The faster you go, the greater is the lifting power. The lifting power is gauged by the speed, which in turn is gauged by the power behind it. In the air there is no limit to the supply at the back of the wheel. In the water there is a limit, for if a propeller wheel is run too rapidly in the water, air space is formed and power is lost. The stumbling-block has been that the air propeller has been compared with the water propeller.

"Now, the strength of a man is about one-eighth of a horse-power. In the apparatus mentioned, one man weighing 96 pounds lifted 14 pounds in the air. Now, a two-horse-power engine would do as much as sixteen men, and would furnish power enough to raise 224 pounds. It is within the possibilities to lift this 96-pound man up if I can introduce the power. In the old machine my largest fan was 16 inches in diameter, and made 2,200 revolutions a minute. The great thing is a small fan and immense speed. Napoleon III. once furnished an inventor with a vast amount of money to construct a flying machine with fans. The inventor built one with fans twelve feet in diameter, to be rotated at a speed as rapid as the frame-work would stand. It had to be very large and strong to stand the rack of the revolutions of such big fans. The Emperor and his friends gathered around to see it fly. The machinery was set in motion, and the big fans traveled around like windmills. There was a great cloud of dust raised, but the machine would not fly. It showed plainly that big wheels were not the thing.

"I claim that it is a mistake to look to nature for models. There is no model in nature equal to the rotary motion. A bird's wings work very nicely, but a bird cannot fly except in a wave-like line, no matter how straight we think it flies. The recovery motion of a bird is a retarding motion. It is not near as perfect as the rotary motion. With the rotary motion of the fan we have the continuous lifting motion of the wing and no retarding motion whatever."

The experimental flying machine which Prof. Ritchel intends to construct is like this:

It is to have two lifting fans working on parallel planes and on the same shaft, one of the wheels revolving from right to left, and the other from left to right. The wheels are to be worked by independent gearings, but from the same center. If both fans are revolved in the same direction the effect is to turn the machine in the air, its natural tendency being to rotate in the direction in which the fans move. That would be decidedly disastrous, and to prevent it the fans are to revolve in different directions. This machine is intended to simply demonstrate that a man can be lifted free in the air by mechanical force, and in it there is to be simply the machinery necessary to raise. It consists of an engine (at E in diagram) operated by compressed air for moving the two fans. It is to be under the control of a man in the bottom of machine (at M in diagram). The machine is to be skeleton, and of light brass tubing.



The engine is to be operated by compressed air passed up from the ground by a rubber hose, in the way that compressed air is transmitted to rock drills in mines from compressors. For the trial experiment the hose pipe is to be long enough to allow the machine to rise 200 feet.

The second experiment is to be with a machine having propelling fans in addition to the lifting fans, and it will describe a gigantic circle in the air. The next machine is to be more elaborate, with all the improvements added that experience suggests. In that the air compressors are to be carried. The fans are to have four blades with a slant of about 30° projecting from a metal hub with steel shafts $\frac{3}{16}$ of an inch in diameter. The blades are to be of white holly with the grain crossed.

"Of course, it is visionary to expect to make a perfect air navigator at the first attempt," Prof. Ritchel said, "and I propose to creep before I walk. The science of mechanics, unlike the science of theology, is a positive science, and every fraction of material entering into the construction of the apparatus may be so tested that all accidents caused by imperfections of material may be avoided. A simple engine of two-horse power will be necessary for this experiment."—*The New York Sun.*

ZINC AS A PREVENTIVE OF CORROSION IN STEAM BOILERS.

Among the many inquiries directed upon the general subject, some of the most exhaustive and minute have been those instituted by the Admiralty, extending from 1874 to 1880. They were carried out by committees appointed to inquire into the causes of decay in the boilers of H. M. ships.

1. With regard to a prevailing belief that the presence of particles of copper in a boiler was a source of injury, they state, first, that the quantity carried into the boiler is extremely small; and, second, that no injurious effect of importance can be produced by it.

2. That the fatty acids resulting from the use of vegetable and animal oils for lubrication were a source of injury, and they recommend the use of mineral oils.

3. Moist air, or water containing air, are powerful corrosive agents. They recommend increased density in the water, especially in boilers fed from surface condensers, and that the boiler should be emptied as seldom as possible.

The main conclusion, however, at which the committee arrived—the great principle that they asserted and demonstrated—was that galvanic action, induced by the contact of zinc with the iron of the boiler, was the best and only trustworthy remedy for corrosion; and that, so long as the metallic contact was maintained, little or no corrosion would go on.

They adopted a plan of hanging slabs or plates of zinc by iron straps from the stays or rods within the boiler, the zinc being held in a clamp to which it was tightly bolted. The theory was perfect, but the weak point in practice was found to be in keeping up electric contact between the two metals. The zinc and the iron not being metallically connected, but only mechanically pressed together, were liable to be so far separated—by the corroding of the surface of the zinc—that the galvanic current was soon weakened and destroyed.

The committee endeavored to circumvent this difficulty, first, by fixing in each boiler an excessive number of plates, so that (apparently) if electric contact should cease even in many plates, it might chance to be maintained in some; and, secondly, they directed a frequent examination with a view of renewing the contact, and putting in fresh plates in lieu of those destroyed by corrosion.

This system was the best they were able to arrive at, but it could be maintained only at such a cost that, to use the words of the report: "The expense of the zinc necessary for efficient protection is undoubtedly an important element in determining how far it should be adopted." For, besides the expense of fitting, examining, and renewing the excessive number of plates already referred to, the committee go on to say that "the actual waste of zinc is much greater than that due to the protection of the boiler; and it becomes important to ascertain whether that waste cannot be avoided."

With great care, however, this system was found to prevail against the inroads of corrosion; and herein was a distinct advance, although it still left the question of incrustation by lime-scale comparatively untouched. Indeed, it is stated that the scale which formed in some of the boilers in which slabs or plates were used became "harder and more adherent," and it was therefore suggested that the zinc should be periodically removed altogether, for a limited time, in order that a slight corrosion forming under the scale might enable it to be separated more readily from the iron.

Under the Admiralty system, then, it must be presumed that the bad effects arising from scale, such as the burning of the iron, the waste of coal, and the injury caused by severe chipping, are still a source of trouble and expense; and such I believe is the case.

The committee's report attributed this hard scale to the action of the excessive quantity of zinc which was found necessary for protection when used in the form of slabs or plates. × ×

The mercantile marine has in a great measure followed in the wake of the navy; and zinc is now very largely employed in the fleets of all large companies. Every possible method of fixing it in the boilers has been adopted, with more or less success. Engineers who understood the principle of its action in forming with the iron a galvanic battery, have sought to secure metallic connection by many mechanical devices, while others, convinced of its efficacy, but not understanding its methods, have even thrown it loose into the boilers, to waste and crumble away to no purpose.

Zinc, indeed, had long been used with the object of depositing any minute particles of copper that might find their way into the boiler. It was useless for this purpose, as the Admiralty inquiry fully proved; but wherever it happened to be connected with the iron, it became protective, by setting up electric action, which would continue for a short time, until oxidization of the zinc had broken the electric contact.

A superintendent engineer who was using zinc in his boilers, fixed to the iron, told me he did not believe in the galvanic theory, while in practice he was profiting by it; and when I pointed out this fact, and asked him to explain on what other principle the zinc could be protective, he was unable to answer me.

Among the numerous methods adopted for fixing the plates in boilers, the plan patented by Mr. Phillips (formerly a member of the Admiralty Committee), was considered one of the best. It consists in attaching a plate of zinc to a stud or peg, 3 or 4 inches long, projecting from the shell of the boiler, the plate being screwed on tightly by a nut, to insure close contact with the iron. × × × ×

The common theory held at that time was that free oxygen and carbonic acid in the water were the active causes of corrosion, and Mr. Hannay's first experiments were directed to absorb the oxygen by the ordinary methods known to chemists, with the result, however, that corrosion continued. When an alkali was added to absorb the carbonic acid, priming was caused to such an extent as to be dangerous to the safety of the machinery. He exhausted chemistry in his endeavor to find a means of stopping the decay; but, although he succeeded in removing every trace of free oxygen and carbonic acid, the corrosion still continued after six months of patient trial. He concluded, therefore, that, while free oxygen and carbonic acid might help to corrode the boilers, they were certainly not the chief causes.

It next occurred to him that certain parts of the boiler more highly heated might, for reasons familiar to science, have their surfaces so altered as to cause them to become electro-negative to the colder parts. This view was particularly impressed upon him from the fact that corrosion so often took place along certain well-defined lines, as, for instance, along the sides of the fire-box. Sometimes the corrosion was so deep that there was reason to apprehend collapse of the furnace. The cold blast going to feed the fire kept the part where the corrosion was quite cool, while the flames kept the top very hot.

Starting from these facts, he deduced the theory that thermo-electric currents were set up between the colder and hotter parts of the boiler, and that the colder part, forming the positive pole, corroded by the natural law of galvanic action.

To test this theory, experiments were made with a boiler specially constructed to allow it to be heated in sections, and to stand a pressure of 200 lbs. to the square inch. Two iron plates were fixed in the boiler, one near the top, and the other near the bottom, and both were connected with a galvanometer, so that a current of electricity passing from one plate to the other could be detected and measured. The boiler was heated alternately more strongly at the top or the bottom, with the constant result that whenever the temperature rose above the boiling point, as in a steam-boiler, the cooler plate became positive, and wasted away. Thus the theory was lifted into the region of ascertained fact.

Attempts were made to keep the boilers in actual use more uniformly heated, but if corrosion were stopped in some places, it was sure to break out in others.

It appeared, therefore, that the only way to prevent this corrosion was by making the iron all negative by a current stronger than that set up in the iron itself by differences in temperature. The current was estimated and found to be very small; a weak battery was fitted up, and the positive electrode, or wire, passed into the water of the boiler, the negative electrode being soldered to the outside of the boiler.

After six months' trial with this arrangement, it was found that corrosion had entirely ceased. —*Journal Soc. of Arts.*

NOTES FROM THE MASTER MECHANICS' MEETING.

The use of mild steel for all parts of shell and inside fire-box.

Mr. Lauder took it for a fact that the reason the English had discontinued the use of steel was the difficulty of obtaining the right kind of steel. This had driven them back to copper. For Americans steel was the best thing to use.

Mr. Sprague had removed a foreign fire-box from a locomotive and it was so hard that it broke his chisel.

Mr. Forney had been told that the London & Northwestern Railway had tried American steel for fire-boxes and that it had failed. The Grand Trunk Railway, on the other hand, had used English steel for fire-boxes and found it to work well. Copper was in use for this purpose all over the continent.

Mr. Berry stated that engines on his road worked clear with no mud in them, kept their steel fire-boxes in good condition. He had bad water on his road and some inexperienced firemen, and with such iron fire-boxes were the best.

Mr. Johann thought that different systems of firing had something to do with the wear of fire-boxes. That was why some steel worked well at some points and not at others. He thought that an 18 or 20 inch deep fire hurt fire-boxes of steel, but that with only 8 inches of fire they would work well. He had so instructed his firemen.

Mr. Twombly had no trouble with steel on 300 engines. He thought that we had not the right grade of steel.

Mr. Hewitt (Missouri Pacific) said: On some of his engines the fire-boxes had cracked, but on many they had worn 15 years. About 20 per cent. of them had cracked.

Mr. B. Warren (St. Louis, Alton & Terre Haute), said that he had 46 engines which used hard water and the fire-box steel had not lasted over 2 years. Low grade steel lasted much longer than high grade. Water affected the steel question a good deal. Iron fire-boxes would blister.

Mr. Lauder said that there was one detail of construction that he would like to urge on the convention, and that was putting a mud ring at the bottom of the furnace. It is now 2 inches deep. If made 3 or 4 inches, 2 rows of rivets could be used and there would be no leakage at corners as there now was.

Mr. Setchel said he would guarantee an iron fire-box to last if used with either Ohio, White or Mississippi river waters. Fire-boxes on his road (Ohio & Mississippi) lasted 12 years. It all depended on the water.

Mr. Hovey thought that both coal and water affected the fire-box. In 1852 he had bought 15 locomotives having fire-boxes of Sligo iron. In three or four years some of these gave out. He had cut out a piece and found it to be carbonized by the coal so as to be as hard as glass.

Mr. Blackwell, Norfolk & Western, had very hard water on part of his road, had much trouble with both iron and steel on that division, some engines showed cracks in 4 months and some in 12 months. He thought the amount of sulphur in the fuel had something to do with it. He had found two or three times as much sulphur near the cracks as at the foundation rings.

Mr. Johann said he had given up annealing sheets, also no hammer should be used to flatten them. Uneven blows and with a hammer would cause a fracture at the place the blow was struck. He also believed in punching holes instead of drilling them. The better the water the better the boilers lasted and the less expense of maintaining them. Care should be taken to purify hard water. On certain parts of his road boiler flues lasted but six months without taking out and cleaning. He made his engineers blow off their boilers several times during each trip through the front.

Mr. B. Warren said that the water caused all the trouble. Put an engine on a different division and it will be found to wear as long as any.

Mr. Britton, Rome, Watertown & Ogdensburg, thought lime-water the most serious objection that there was to overcome. He was in the West where that kind prevailed. He had seen the top of the crown-sheet very hard from its effect.

Mr. Fuller, New York, Pennsylvania & Ohio, replied that some of the water used on his road was surface water and some from wells. His steel fire-boxes had lasted an average of 5 years each. He thought the amount of sulphur in coal had much to do with it. They were trying to get all suface water to use if possible.

Mr. Wilder did not think that sulphur had any effect on the wear of fire-boxes. The coal on the Buffalo division of his (New York, Lake Erie & Western) road had 3 to 4 per cent. of sulphur in it and yet the boxes lasted 12 to 14 years.

Mr. Eastman, of the Eastern Railroad of Canada, said that he used wholly iron flues, and asked for information about flue setting. Had used galvanized iron. Where he had done this the tubes had not been swedged.

Mr. Johann said he used copper ferrules in setting flues and did not swedge flues down. A variety of uses of the engine changed the results of flue setting.

Dome openings to be reinforced by strengthening plates or double flanges.

Mr. Forney said that abroad some strengthening was made at the dome. This joint was a weak place. Mr. Hain, of the New York Elevated Railroad, had told him that the plates on his engines had cracked about the dome opening, making a leak.

Mr. Wilder said he had 350 all-steel boilers. Took great pains in staying the dome to the crown part. Used many stays, had them every six inches down to crown part. Had only two instances of seam cracking, and those longitudinal ones.

Mr. Johann had no trouble on Wabash engines. He secured his domes by flanging up the wagon-top sheet to fit on the reinforcing sheet.

At this point, Mr. Austin, of the Baldwin Locomotive Works, arose and explained the trouble with the elevated road engines as follows: The root of it was that these engines had not been made right to start with. The boilers were of too thin iron, being only ¼ inch thick, in order to save all the weight possible. He had seen some that in the flange were only $\frac{5}{32}$ inch thick. His works now insisted on their being made thicker and there was no trouble with those.

Not attempting to get rid of mud by mud pockets or mud drums, but by blowing the boiler off under pressure.

Mr. Johann did not believe in mud drums. He used blow-off cocks.

Mr. Setchel did not believe in blowing off engines under full pressure. It would create scale. He would use water for cleaning. A boiler blown off under pressure would have a film left inside that would not wash out.

Mr. Wilder indorsed the idea. He used cold water at hydrant pressure with some steam left in the boiler.

An increase of initial pressure of 20 to 30 pounds to square inch, and that this will increase.

The Secretary added that we use steam fast and moist and must provide for greater pressure.

Mr. Lauder thought we must increase our pressure. He had got his mind up to 175 pounds as our ordinary pressure for the future. We use heavy engines and heavy ash pans. Some even have their fire-boxes weighted down. We should put more weight into the boilers. It is economical to run under high pressure.

The report of the committee on those points upon which they did not agree was read and discussed in sections, viz.:

The proper diameter of flues for a given class of coal.

Secretary Setchel called upon Mr. Austin, of the Baldwin Works, for the varieties of flues ordered at his works.

Mr. Austin replied that this was a point upon which men differed much. Some would use a certain flue successfully 20 years and yet another could do nothing with it.

Mr. Lauder thought that this question had been settled long ago and that all sizes had been tried. A two-inch flue was now virtually the standard. In England and on the continent they used very small flues and he had never been able to account for it. The Pennsylvania Railroad, which used the best of everything, used 2-inch flues altogether. He supposed the fuel attainable might govern it to some degree, also the metal of which the flues were made.

Mr. Austin said that it was the practice of the Baldwin Works to make the diameter of the flues larger as the length increased, to give them strength and good draught.

Mr. Johann said that his road operated a little narrow gauge road and some of these engines had flues 8 feet long and 1½ inches in diameter. These had troubled him by choking and he had been obliged to replace them with 2-inch flues, after which he had no trouble.

Mr. Sprague stated that he had used 1½ and 1¾ and 2-inch flues, the latter chiefly on 8 to 9½ feet flues.

Mr. Blackwell used 2 inch flues on a 10-wheel engine with a 12 foot 6-inch boiler.

Is the increase of first cost and inherent weakness of wagon-top boiler justified by the results?

Mr. Wilder thought that a long fire-box with big surface produced the best results.

Mr. Blackwell endorsed large fire-boxes. With one he had evaporated 9 to 10 pounds of water to a pound of coal.

The economical value of fire-brick arches. Keeping in mind the increased cost of fuel and the legislation in cities against the smoke nuisance.

Mr. Wilder thought that the use of a brick arch lessened the amount of smoke. He used heavy fire brick 6 inches thick with a water tube in the crown sheet. Since he had introduced fire-boxes for burning hard coal he had good results.

The relative merits of fire-brick arches compared with flat bricks carried and suspended on water tubes.

Mr. Setchel did not think water tubes good with impure water. If it created a circulation, as claimed, it brought up the dirtiest water to the top. Wherever these were used and the water hard, they gave out soon.

Mr. Hatswell, Flint & Pere Marquette, said that some of his engines wore out their tubes in 6 months. He advocated the circulating tubes.

Mr. Flynn thought that there was no benefit in the brick arch. Firemen should fire the same with a brick arch and open fire-box, but they would not. His engineers and firemen asked to have them kept out. With the coal in use on his (Western & Atlantic) road a brick arch would last from 4 to 6 months. He had fired a brick arch engine for 7 years. With this arch and the extension front he thought there was a little economy. A fire should not be too deep.

Mr. Hatswell thought that the brick arch saved leaky flues.

Good Lead Pencils cost the maker about half a cent each.

THE SIX GATEWAYS OF KNOWLEDGE.—No. IV.

The note of a two-foot organ pipe open at both ends has 256 periods per second. Go on higher and higher to 512 periods per second, and you have the C above that—the chief C of the soprano voice. Go above that to 1,024, you get an octave higher. You get an octave higher always by doubling the number of vibrations per second, and if you go on till you get up to about 5,000 or 6,000 or 10,000 periods per second, the note becomes so shrill that it ceases to excite the human ear and you do not hear it any longer. The highest note that can be perceived by the human ear seems to be something like 10,000 periods per second. I say "something like," because there is no very definite limit. Some ears cease to hear a note becoming shriller and shriller before other ears cease to hear it; and therefore I can only say in a very general way, that something like 10,000 periods per second is about the shrillest note the human ear is adapted to hear. We may define musical notes, therefore, as changes of pressure of the air, regularly alternating in periods which lie between 20 and 10,000 per second.

Well now, are there vibrations of thirty or forty or fifty or a hundred thousand or a million of periods per second in air, in elastic solids, or in any matter affecting our sense? We have no evidence of the existence in matter of vibrations of very much greater frequency than 10,000 or 20,000 or 30,000 per second, but we have no reason to deny the possibility of such vibrations existing, and having a large function to perform in nature. But when we get to some degree of frequency that I cannot put figures upon, to something that may be measured in millions, if not in hundred thousands of vibrations per second, we have not merely passed the limits of the human ear to hear, but we have passed the limits of matter, as known to us, to vibrate. Vibrations transmitted as waves through steel, or air, or water, cannot be more frequent than a certain number, which I cannot now put a figure to, but which, I say, may be reckoned in hundred-thousands or a few millions per second.

But now let us think of light. Light we know to be an influence on the retina of the eye, and through the retina on the optic nerve; an influence dependent on vibrations whose frequency is something between 400 million millions per second and 800 million millions per second. Now we have a vast gap between 400 per second, the sound of a rather high tenor voice, and 400 million millions per second, the number of vibrations corresponding to dull red light—the gravest red light of the prismatic spectrum. Take the middle of the spectrum—yellow light—the period of the vibrations there is in round numbers 500 million millions per second. In violet light we have 800 million millions per second. Beyond that we have something that the eye scarcely perceives—does not perceive at all perhaps—but which I believe it does perceive, though not vividly: we have the ultra violet rays, known to us chiefly by their photographic effect, but known also by many other wonderful experiments, that within the last thirty years have enlarged our knowledge of light to a most marvelous degree. We have invisible rays of light made visible by letting them fall on a certain kind of glass, glass tinged with uranium—that yellowish green glass, sometimes called canary glass or chameleon glass. Uranium glass has a property rendering visible to us invisible rays. You may hold a piece of uranium glass in your hand, illuminated by this electric light, or by a candle, or by gas light, or hold it in the prismatic spectrum of white light, and you see it glowing according to the color of the light which falls upon it; but place it in the spectrum beyond the visible violet end, where without it you see nothing, where a piece of chalk held up seems quite dark, and the uranium glass glows with a mysterious altered color of a beautiful tint, revealing the presence of invisible rays, by converting them into rays of lower period, and so rendering them visible to the eye. The discovery of this property of uranium glass was made by Prof. Stokes, and the name of fluorescence from fluor spar, which he found to have the same property, was given to it. It has since been discovered that fluorescence and phosphorescence are continuous, being extremes of the same phenomenon. I suppose most persons here present know the luminous paint made from sulphides of calcium and other materials, which, after being steeped in light for a certain time, keep on for hours giving out light in the darkness. Persistence in emission of light after the removal of the source, which is the characteristic of those phosphorescent objects, is manifested also, as Edmund Becquerel has proved, by the uranium glass, and thus Stoke's discovery of fluorescence comes to be continuous with the old known phenomenon of phosphorescence, to which attention seems to have been first called scientifically by Robert Boyle about 200 years ago.

There are other rays, that we do not perceive in any of these ways, but that we do perceive by our sense of heat: heat rays as they are commonly called. But in truth all rays that we call light have heating effect. Radiant heat and light are one and indivisible There are not two things, radiant heat and light: radiant heat is identical with light. Take a black hot kettle into a dark room, and look at it. You do not see it. Hold your face or your hand near it, and you perceive it by what Bunyan would have called Feel Gate; only now we apply the word feeling to other senses as well as Touch. You perceive it before you touch it. You perceive it with the back of your hand, or the front of your hand; you perceive it with your face, yes, and with your eye, but you do not see it. Well, now, must I justify the assertion that it is not light? You say it is not light, and it is not so to you, if you do not see it. There has been a good deal of logic chopping about the words here; we seem to define in a vicious circle. We may begin by defining light—"It is light if you see it as light; it is not light if you do not see it." To save circumlocution, we shall take things in that way. Radiant heat is light if we see it, it is not light if we do not see it. It is not that there are two things; it is that radiant heat has differences of quality. There are qualities of radiant heat that we can see, and if we see them we call them light; there are qualities of radiant heat we cannot see, and if we cannot see them we do not call them light, but still call them radiant heat: and that on the whole seems to be the best logic for this subject.

Logic is to language and grammar what mathematics is to common sense; logic is etherealized grammar. I hope the advanced student in grammar and Latin and Greek, who needs logic perhaps as much as, perhaps more than, most students of science and modern languages, will advance to logic, and consider logic as the science of using words, to lead him to know exactly what he means by them when he uses them. More ships have been wrecked through bad logic than by bad seamanship. When the captain writes down in his log—I don't mean a pun here, log has nothing to do with logic—the ship's place is so-and-so, he means that it is the most probable position—the position which, according to previous observations, he thinks is the most probable. After that, supposing no sights of sun or stars or land to be had, careful observation of speed and direction shows, by a simple reckoning (called technically the dead reckoning), where the ship is next day. But sailors too often forget that what they put down in the log was not the ship's place, but what to their then knowledge was the most probable position of the ship, and they keep running on as if it was the true position. They forget the meaning of the very words in which they have made their entry in the log, and through that bad logic more ships have been run on the rocks than by any other carelessness or bad seamanship. It is bad logic that leads to trusting to the dead reckoning, in running a course at sea; and it is that bad logic which is the cause of those terribly frequent wrecks; of steamers, otherwise well conducted, in cloudy but perfectly fine weather, running on rocks at the end of a long voyage. To enable you to understand precisely the meaning of your result when you make a note of anything about your own experience or experiments, and to understand precisely the meaning of what you write down, is the province of logic. To arrange your record in such a manner that if you look at it afterwards it will tell you what it is worth, and neither more nor less, is practical logic; and if you exercise that practical knowledge, you will find benefits that are too obvious if you only think of any scientific or practical subject with which you are familiar.

There is danger then of a bad use of words, and hence of bad reasoning upon them, in speaking of light and radiant heat; but if we distinctly define light as that which we consciously perceive as light—without attempting to define consciousness, because we cannot define consciousness any more than we can define free will—we shall be safe. There is no question that you see the thing; if you see it, it is light. Well now, when is radiant heat light? Radiant heat is light when its frequency of vibration is between 400 million millions per second and 800 million millions per second. When its frequency is less than 400 million millions per second it is not light; it is invisible "infra-red" radiant heat. When its frequency is more than 800 million millions per second, it is not light if we cannot see it; it is invisible ultra-violet radiation, truly radiant heat, but it is not so commonly called radiant heat because its heating effect is known rather theoretically than by sensory perception, or thermometric or thermoscopic indications. Observations which have been actually made by Langley and by Abney on radiant heat take us down about three octaves below violet, and we may hope to be brought considerably lower still by future observations. We know at present in all about four octaves—that is from one to two, two to four, four to eight, eight to sixteen, hundred million millions—of radiant heat. One octave of radiant heat is perceptible to the eye as light, the octave from 400 million millions to 800 million millions. I borrow the word octave from music, not in any mystic sense, nor as indicating any relation between harmony of colors and harmony of sound. No relation exists between harmony of sound and harmony of colors. I merely use the word "octave" as a brief expression for any range of frequencies lying within the ratio of one to two. If you double the frequency of a musical note, you raise it an octave: in that sense I use the word for the moment in respect to light, and in no other sense. Well now, think what a tremendous chasm there is between the 100 million millions per second, which is about the gravest hitherto discovered note of invisible radiant heat, and the 10,000 per second, the greatest number of vibrations in sound. This is an unknown province of science: the investigation of vibrations between those two limits is perhaps one of the most promising provinces of science for the future investigator.

In conclusion, I wish to bring before you the idea that all the senses are related to force. The sense of sound, we have seen, is merely a sense of very rapid changes of air pressure (which is force) on the drum of the ear. I have passed merely by name over the senses of taste and smell. I may say they are chemical senses. Taste common salt and taste sugar—you tell in a moment the difference. The perception of that difference is a perception of chemical quality. Well, there is a subtle molecular influence here, due to the touch of the object, on the tongue or the palate, and producing a sensation which is a very different thing from the ordinarily reckoned sense of touch, in the case now considered, telling only of roughness and of temperature. The most subtle of our senses perhaps is sight; next comes smell and taste. Prof. Stokes recently told me that he would rather look upon taste and smell and sight as being continuous because they are all molecular—they all deal with properties of matter, not in the gross, but molecular actions of matter; he would rather group those three together than he would couple any of them with any of the other senses. It is not necessary, however, for us to reduce all the six senses to one, but I would just point out that they are all related to force. Chemical action is a force, tearing molecules apart, throwing or pushing them together: and our chemical sense or senses may therefore so far at least be regarded as concerned with force. That the senses of smell and taste are related to one another seems obvious; and if physiologists would pardon me, I would suggest that they may, without impropriety, be regarded as extremes of one sense. This at all events can be said of them, they can be compared—which cannot be said of any other two senses. You cannot say that the shape of a cube, or the roughness of a piece of loaf sugar or sandstone, is comparable with the temperature of hot water, or is like the sound of a trumpet, or that the sound of a trumpet is like scarlet, or like a rocket, or like a blue-light signal. There is no comparability between any of these perceptions. But if any one says, "That a piece of cinnamon tastes like its smell," I think he will express something of general experience. The smell and the taste of pepper, nutmeg, cloves, cinnamon, vanilla, apples, strawberries, and other articles of food, particularly spices and fruits, have very marked qualities, in which the taste and the smell seem essentially comparable. It does seem to me, although anatomists distinguish between them, because the sensory organs concerned are different, and because they have not discovered a continuity between these organs, we should not be philosophically wrong in saying that smell and taste are extremes of one sense—one kind of perceptivity—a sense of chemical quality materially presented to us.

(*To be continued.*)

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A DEMAND FOR UNIFORMITY IN DETAILS OF WOOD-WORKING MACHINERY.

In these progressive times, when improved machinery and systems are the order of the day, and in view of the fact that standards are found to simplify labor as well as enable one to fill orders more easily, there seems to be no valid reason why a great many details and supplies for wood-working machines should not be brought to a universal standard of measurement. Then they might be duplicated without any special drawings or specifications. This would reduce the liability of making mistakes either in transmitting or filling orders.

As the trade goes now, no two manufacturers send out a machine whose knives or cutters are alike either in the number, location, width, or depth of slots for receiving bolts or screws. They will vary in the same length and width of knife from 5 to 7 slots, from $_{16}$ to ⅞ inch wide and from 1½ to 2¼ inches deep or long. The same is true of the bolts or screws for securing the knives on the head. They are of all diameters from ½ to ¾ inch, all lengths from 1¼ to 2¼ inches long; the heads any thickness from ¼ to ⅜ inch and to fit any wrench from ⅞ to 1¼ inch square. Matcher-heads are subject to the same objections. They are made to fit spindles all the way from one to two inches diameter and have slots to take knives from ¼ to ½ inch thick.

There are other parts and details of machines subject to the same criticism, but these few will suffice to illustrate my arguments.

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Cylinder bolts have objections enough. They wear and stretch out and finally pull apart, or at least are dangerous to use, because they sometimes get torn off or out in a smash-up, when no duplicates on hand. Mr. Operator hies to the nearest store or machine-shop, expecting to get one or more bolts if he needs them, the same as a pound of nails. He is disappointed. Such bolts are not in stock because there never was a standard for them. Threads are different; lengths and diameters do not agree; heads are too large or too small, and the consequence is that he has to be content and wait for the smith to forge the bolts, go to the machine shop and get them threaded and turned and the heads shaved to the proper thickness, and slabbed off on the sides, and then he starts for the planing mill on a run. If he is sharp enough he may turn back to the machine-shop and borrow the tap that the bolts were made to fit to, and then start for the mill once more; the operator tries the bolts in the cutter-head and they don't fit; they are either too tight or too loose. If too tight, Mr. Operator chuckles to himself over his foresight in bringing that tap along; if too loose, he spends his energy in considering what a machinist is good for, anyway. If the machine-shop is not convenient he lets the machine take a rest, and composes poetry, perhaps, until the new bolts arrive.

The same objections are in a great degree true of matcher or other side-cutters and cutter-heads. The knives are too thick or thin, too long or short; the new heads are either tight or loose on the spindle unless some careful man has filed a wire or gauge to make the fit by. Why can't it be changed to a more agreeable system for both the builder and the customer. There should be no objection to having all knives of a length and width, fitted with a standard number of slots all of the same width, depth and location just the same in every case. Different lengths and widths of knives would then all have their particular standard and be alike, no matter where made, bought, or sold; cylinder bolts should all be the same for their different diameters. Every ¾ or ⅝-inch diameter would have its own particular length under the head, thickness and width of head, same number of threads per inch, and would fit any machine. Standards could be adopted for all side-cutters; matcher-heads having four or more knives or wings could be bored a standard size, those of three wings another size, etc. Stocks of all these details could be kept on hand and sold readily; buyers would not hang on to the old pieces for fear that they would never get another to fit properly, neither would they have to send to China for them.—*Lumber World.*

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THE TREMENDOUS SEA.

"The forces of a wave are peculiar. It is well known that about the nastiest open ocean waves in the world are in the Gulf Stream, to the southward of the Banks, where the current opposes them when they come from the east. The current seems to make them narrower and steeper. The largest waves to be found are off the Cape of Good Hope, where there are not over half a dozen swells to the mile sometimes, but they are not dangerous as compared with such a sea, for instance, as was encountered by the steamer Glamorgan in her passage from Liverpool to Boston a year or more ago. That steamer got into history on account of her strength, but while crossing the Atlantic in a gale, she was boarded by a wave that tore her iron bulwarks off like cardboard, broke away the whole iron side of the house on deck, tore off hatches and filled the hold. Those who were not killed by that wave were taken off by the State of Pennsylvania.

"Perhaps the influence of the tides on the waves is nowhere more clearly shown than on the coasts of Scotland. In the long, narrow bays the tides have a very rapid current. No boat can live there in a gale that is running contrary to the tide. There is a theory that tides are the cause of a very striking peculiarity of the waves in a storm. Every one has noticed that after a series of moderately high waves have passed a ship, she will encounter three in succession which are conspicuously larger. Then there will be a longer or shorter period of comparatively moderate waves, followed by three more monsters, and so on. Some sailors believe that tides or currents tripping up the waves, bring them together until they unite in those enormous swells that carry havoc on their crests. In support of this is cited a case at Peterhead Harbor, on the English coast.

"Over thirty years ago there was a great crowd of people down near the beach one day, watching the swells come in from the severest storm on record at the time. About two hours before high water three tremendous waves rolled in, and, breaking on the beach, carried away 315 feet of a great bulwark founded 9½ feet above high water of the spring tides. One piece of the wall, weighing thirteen tons, was carried fifty feet. Two hours exactly after high tide three more waves came in of a similar character, but they did less damage.

"It is on record that the waves of the German Ocean once broke in two a solid column of freestone that was thirty-six feet high, and seventeen feet in diameter at the base. The shaft was standing in place at the time. The diameter at the place of fracture was eleven feet. But at the top of the Bound Skerry of Whalsey, in Zetland, the waves have broken out of their beds, blocks of stone weighing from eight to ten tons, which are eighty-five feet above the level of the sea."

"I believe some calculation has been made of the force exerted by waves."

"It is only partial. A marine dynamometer has been used. This machine is simply a known surface for the water to impinge on, the force of the impact being transferred to springs of known strength. The distance to which the springs are compressed is self-registering. In this way the force of the waves, under not extraordinary circumstances, has been found to be as high as three tons to the square foot. No doubt, under some exceptional cases, the pressure has been more than double that figure. Why, at Port Sonachan, in England, where the 'fetch' of the waves, or the breadth of the water over which they travel, is but fourteen miles, a block of stone weighing a fourth of a ton was torn out of a solid stone stairway leading from a landing. It was rolled over and over. If such effects are obtained under such circumstances, what must be the forces which transatlantic steamers have to encounter?"

"How do you account for the destructive effects of a substance like water, which seems to yield so readily to every impact?"

"It does not yield so easily as it seems to. Every one knows that it cannot be compressed. So when a volume of perhaps 500 tons boards a ship in the right way, it is as if 500 tons of iron has struck her."

"How does it happen, then, that any ship lives to cross the ocean?"

"Because the waves seldom strike a ship a fair blow, and because of the enormous strength of the modern ship. The force of three tons to the square foot is about forty-six pounds to the square inch."

"Perhaps you have measured the height as well as the weight of waves?"

"The Comte de Marsili, in his 'Physical History of the Sea,' says that the highest wave observed by him on the shores of Languedoc, where the fetch across the Mediterranean was 600 miles, was 13½ feet from crest to base. Dr. Scoresby found waves in the Atlantic from 30 to 43 feet high from crest to the bottom of the hollow."—*The Sun, N. Y.*

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In the Capitol at Washington is the machinery by which the rooms are warmed and ventilated. It is altogether a big apparatus, consisting of three immense fans, four engines and eight boilers, with the necessary appliances for regulating the temperature and moisture of the air. The instrument which tells whether the air is too moist or too dry, is operated by a single human hair. Perfectly dry air is put at 0; saturated air—that is, air carrying all the moisture it will hold—is put at 100. The human hair absorbs moisture like a rope, and, like a rope, it becomes shorter when wet. The difference in length between a hair 6 inches long when wet and the same hair when dry, is made to represent 100° of moisture on the dial, and the hand or pointer moves backward or forward as the moisture in the air varies. If it becomes too moist less steam is allowed to escape, and thus the atmosphere is kept at the healthful point—about 50°—*Unknown Source.*

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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Single Copies, 8 Cents
$2.00 per Annum.

AUTOMATIC SAFETY DEVICE FOR PASSENGER ELEVATORS.

By The Whittier Machine Company.

The universal adoption of passenger elevators in public buildings renders everything which insures their safety against accident of general interest, and we therefore present views of the automatic device employed by the Whittier Machine Company of Boston, Mass., for the purpose mentioned.

The chances of accident in elevators lie in the breaking of the hoisting rope in raising the car too high, so that it strikes the top of the elevator shaft, or by accidental stopping of the car in its descent. When this latter occurs, the rope is unwound from the drum, gets foul in the machinery and is liable to be cut off. In either of the contingencies named the car is left without support and may break loose at any moment and fall to the bottom.

In order to avoid all possible danger from these sources a self-acting arrangement which will insure the safety of passengers at all times beyond the possibility of doubt is indispensable, and we think that here illustrated attains the end.

It consists of a series of levers and safety blocks set under the car on opposite sides, connecting with the lever *L* at the top of the car, as shown in the first engraving; this lever *L* being connected with the safety blocks through the medium of the safety rod *S*.

The lower engraving shows the details clearly, and we refer to it in what follows: The wrought-iron guide-rail *G* is attached to the post *P* which runs the whole length of the hoistway; *B* is one of two steel safety blocks set under the floor of the car at opposite sides, supporting the car from beneath, instead of at the top as is generally the case. *R* is a corrugated, hardened steel roll, resting on the safety rod *S*. These are the principal details. Now if the hoisting rope breaks the weight of the car is at once transferred to the safety rod *S*; this raises the roll *R*, and forces it between the tapering sides of the safety block *B*, and guide-rail *G*, which is indented by the corrugations on the roll and holds the car firmly. The apparatus acts instantly, and the heavier the load the more promptly it holds. The action of this device is a straight up and down thrust, without wedging action sidewise, which tends to open the guide-rails.

As shown in the first engraving, the safety device is operated by the counter-balance of the car. The lever *L* is attached to the cross-head by a fulcrum-pin at the outer end. The inner ends of the lever *L*, and its fellow opposite, rest upon a block *B*, and are prevented from rising above the center by wrought-iron stops beneath the cross-head. On this block *B* is an eccentric sheave *S*. The rope is endless, and makes a turn about the sheave *S*, thus securing equal tension on all parts of the car, and the rope when hoisting. Should the rope break, the free end draws through and revolves the sheave *S*, gripping the rope instantly between the sheave and the block *B*, the car being held by the other unbroken side of the rope until repairs are made.

All of the details of this device are made of the best material, with special attention to the duty they have to perform, and the apparatus has been erected in a great many public buildings with entire satisfaction.

The device on the opposite page is connected with the car and indicates its position at a glance. Further information can be had by addressing the Whittier Machine Company, Boston, Mass., or 91 Liberty St., New York.

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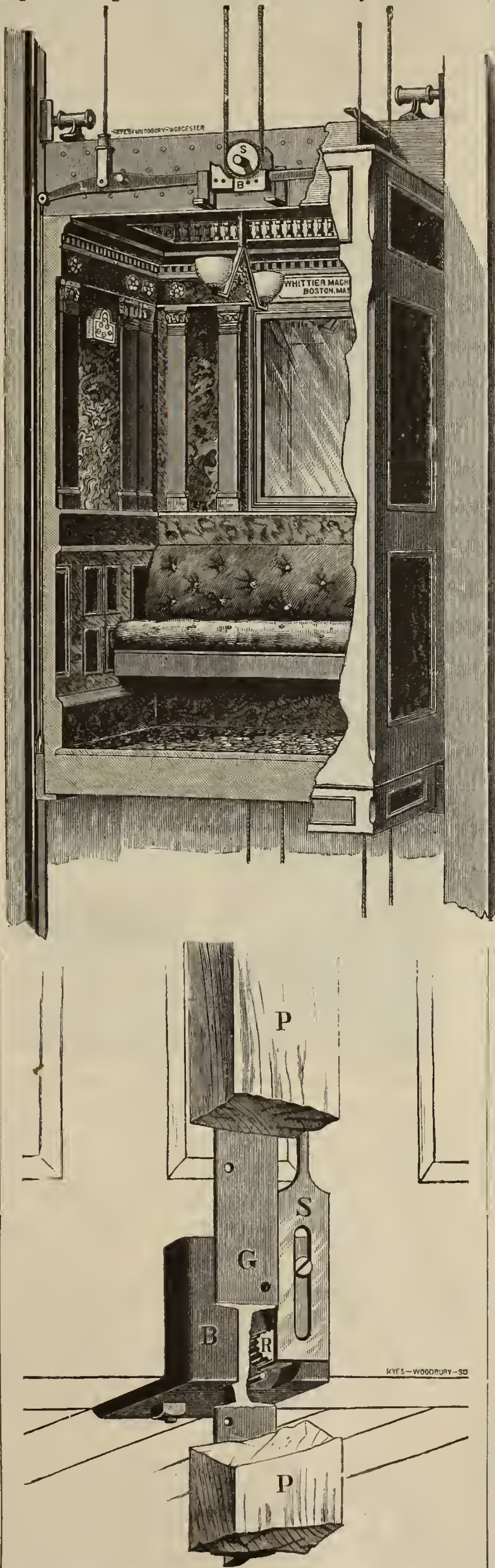
Railroads Which Run Dining Cars are pretty sure to be great losers, for there is no one that has any interest in making them profitable; if, indeed, any one could. Catering is a business requiring peculiar qualifications, and unless some individual's pocket is touched, the original investor is bound to lose. The Northern Pacific R. R. lost $17,000 last year by their traveling hotels, and it is contemplated to remove them wholly.

CLOSE WORK.

The following synopsis of the report of the mint at Philadelphia, shows how closely the operations are watched to prevent loss.

The total number of 5 and 1 cent pieces issued was 55,955,029, with a face value of $1,174,709. 73. In the settlement this account came out to a cent, there being no loss. The amount of gold bullion operated upon was 1,305,575·65 troy ounces, or over 44 tons, equal to $24,289,779.70, upon which there was a legal allowance for wastage in the various manipulations in converting it into coin of 1034·91 ounces, equal to $19,254.30. The actual wastage, as established by the settlement, was but 33·36 ounces, or $620.51—or a loss of less than $1 in every $31 allowed by law.



Automatic Safety Device For Passenger Elevators

The amount of silver bullion operated on was 51,874,423 57 ounces, or over 1,778 tons, worth $60,181,129.25—dollar value. Upon this there was a legal allowance for wastage of 65,059·83 ounces, or $75,524.17 if converted into standard dollars. The actual wastage in working this enormous amount of silver was but 4,625·67 ounces. It will thus be seen that upon a total of gold and silver operated upon amounting to 53,179,999·22 troy ounces, with a coin value of $84,470,098.95, there was a total loss of but 4,659·35 troy ounces, with a coin value of $5,912.20; while the wastage allowed by law for operating the same bullion was 66,094·74 troy ounces—equal to $94,778.47.

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CARELESS WRITING.

While it is a lamentable fact that many persons are bad writers from lack of skill and a knowledge of what constitutes good writing, it is also true that a very large proportion of all the annoyance and injury, resulting from illegible and bad writing, is due to sheer carelessness and nonsensical personal eccentricity. In the haste of business, letters are often so crudely made as to be of a very doubtful character, and frequently, apart from the context, are without intelligible form.

A serious example of careless and doubtful writing occurred lately in the vicinity of Wall street. A firm having occasion to dispose of 300 shares of stock, sent written directions to the recipient to sell the same.

The writer of the note intended to say "Please sell *quietly* 300 N. Y. Central," but the same was read "Please sell *quickly*," and, accordingly, the stock was quickly sold. As a consequence of so large and sudden a sale, the stock went down sufficiently to cause a considerable loss. In view of so unexpected, and to them unauthorized a sale, Blank & Co., whose estimated resources are over a million of dollars, at once suspended business.

It is a somewhat prevalent idea that good writing is a "special gift"; this idea is not only fallacious, but is exceedingly pernicious, inasmuch as it tends to discourage bad writers by leading them to believe that not having "the gift" they are debarred from becoming good writers. Good writing is no more a gift than good reading, spelling, grammar, or any other attainment, and in the same way it is and *can* be acquired, *viz.*, by patient and studious effort. Writing is no less a subject for study and thought than any other branch of education. The correct form and construction of writing must be learned by study, while practice must give the manual dexterity for its easy and graceful execution. The hand can never excel the conception of the mind that educates and directs its action. —*Penman's Gazette.*

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It Often Occurs in establishments supplied for the first time with electrical appliances that engineers and others are placed, after a short period of instruction, in charge of dynamos and electric motors. To these men, experienced as they may be in steam engineering, the introduction of electrical terms and the unfamiliar names given to machines and their parts are mystifying. In one of our large factories, after the dynamos had run only a few hours, the bearings of the commutators showed signs of heating. Following out the practice pertaining to similar difficulties in steam engines, the engineer tried the effect of plumbago mixed with lubricating oil. The result might have been expected; the plumbago applied to the commutator being an excellent conductor, a short circuit was formed, rendering it necessary to stop the dynamo until the difficulty was remedied.—*Electrical Review.*

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The Engravings On Another Page, of the boilers of the SS. *Morning Star*, will serve as a guide for stationary purposes, and they form a most useful example of an excellent form of setting for stationary boilers. Those who employ a firebrick regenerator will find it of great value.

◆

One Concern in Louisville, Ky., makes 2,000 plows daily, and sends them all over the world.

BOOK NOTICES.

A Treatise on Toothed Gearing. Containing complete instructions for designing, drawing and constructing spur wheels, bevel wheels, lantern gear, screw gear, worms, etc., and the proper formation of tooth profiles; for the use of pattern makers, draughtsmen, designers, scientific schools, etc., by J. Howard Cromwell, Ph.B. New York, John Wiley & Sons.

In his preface the author states that he has looked many years in vain for a work on gearing which is at once terse, compact and comprehensive, but not finding any, he has compiled such a work from the researches of others, aided and supplemented by his own experience.

We have carefully and conscientiously examined the book in question, and with every desire to do the author justice, are compelled to say that he has at least not simplified the subject any. The work in appearance is forbidding and discouraging to those who take it up as students. To others who have passed through preparatory courses in the construction of toothed wheels, it will be found of great service. The science of toothed wheels—gearing—is an abstract one, and though certain fundamental principles inform it, it is still involved in a maze of contradictory opinions and practices on some points. These, many writers attempt to solve by giving their personal opinions and convictions, concerning moot points, which is not so conclusive as it might be. We are bound to say, however, that the author of this work is not dogmatic upon any questions propounded, but states the benefits of both systems, or given systems, with great frankness and candor.

The mild censure indulged in by us as regards the popular character of the work is perhaps unjust, from the fact that the subject itself forbids any such treatment. It involves careful study and analysis to design gearing, which qualities, unfortunately, all who attempt such work do not possess; but we think that for the use of machinists and others, the mathematical portions of the work might have been expressed in rules, or forms, intelligible to them. Singular as the statement may appear to some, there are a great many worthy people in trade who are unable to soar to algebraic heights, to whom the solution of questions involving its use is incomprehensible, to whom also it remains sealed forever. Incapables like these persons should have some provision made for them if they are expected to purchase such works. This has been done in some examples in the present work, so that persons who are not mathematicians can avail themselves of arithmetical solutions. The author has given due credit to the labors of others, and his reading of authorities seems to have comprised reliable ones.

Modern Reproductive Graphic Processes. By James S. Pettit, First Lieut. First U. S. Infantry. New York, D. Van Nostrand.

This little work is a useful one to all who work by drawings. It describes in brief the various methods for reproducing works of art, or drawings of any class. The book was originally compiled for the students in the department of drawing at the United States Military Academy, and is therefore not so elaborate in detail as it might be, but the information contained in it is worth the price—50 cts.

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We Acknowledge The Receipt of catalogues from Heald & Sisco, Baldwinsville, N. Y., Whittier Mech. Co., Boston, and the Stevens Institute of Technology, Hoboken, N. J.

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NEW COLORS FROM MOTHS.

This statement is from Prof. C. F. Ritchel, the flying machine man: "The excrement from the moth worm is the exact color and shade of the material it has eaten. I gave some of the worms red flannel as the first test, and the product was a beautiful shiny substance, the exact color and shade of the flannel. A very smalll quantity of this substance colored a large quantity of white lead. Knowing that modern artists could not mix black and white perfectly, or nearly even, and the difficulty of reproducing the color of gray hair, I gave my worms gray hair to eat. The result was very astonishing. They gave me a perfect coloring, the exact shade of the gray hair given to them. I mixed some of the coloring with white lead and gave it to an artist, who was greatly pleased with it. I tested the coloring extract in many ways. I put some of it on a plate on the roof of my house, protecting it from the dust and rain with a glass. After an exposure of two months, I could not discover change in its appearance or shade."

We venture to say that it will be a good while before any moth manure color is in market.

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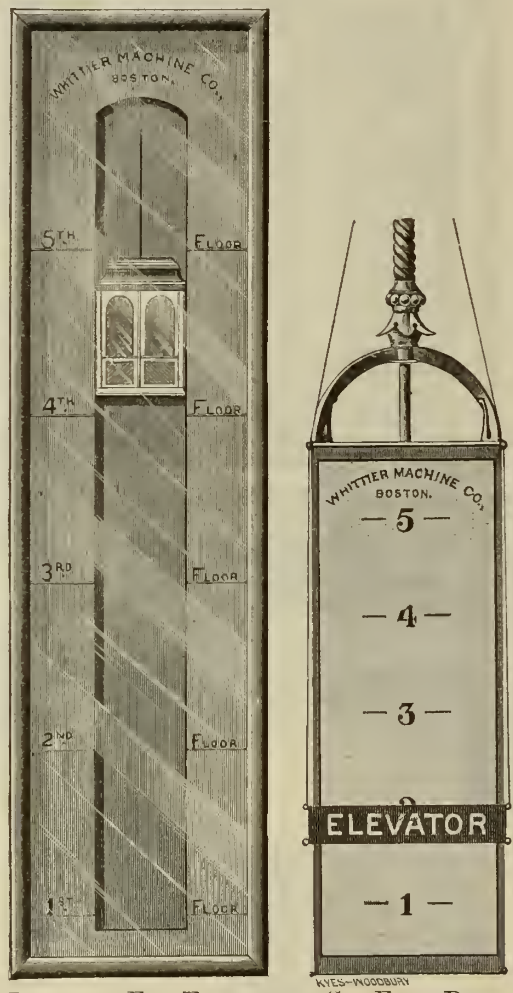
"Seersucker" is the name given to an East Indian fabric said to be made from silk and cotton. An entire suit of it weighs 19 ounces only. The Philadelphia *Times* says that it is the only dress material for men not bought by the yard, and has to be taken by the importer exclusively on faith. It has to be paid for a year in advance, when ordered, and it is never known what patterns or how much is coming. It is sold by the box, each box contains fifty pieces, which may be small or large. They may have blue, buff, or even red stripes. It is all chance, and whatever comes has to be kept. There is no sending it back. Sometimes in dressing it the material becomes discolored, and should that be the case it has to be taken just the same. There is no redress.



Indicator For Elevators.—See First Page.

The Machine For Testing Lubricating Oils at Altoona is of ingenious construction. A journal is made to revolve in a bearing at the same rate as when a car-wheel moves—15, 30 and 60 miles an hour. The amount of heat produced by the friction is accurately shown by a thermometer, while a pendulum moving upon a graduated arc shows the amount of friction or resistance, the wearing quality of the lubricant being determined by the length of time it will stand the test. About one pound of phosphor-bronze bearings is worn away under a car for every 25,000 miles run (or two ounces for each bearing), the journals being supplied with the standard lubricant.
—*Railroad Gazette.*

◆

A Passenger Train at Youngstown, O., was pulling away from a water-tank when a valve in the latter broke, sending an 8-in. stream of water against the train, breaking all the windows and deluging the coaches. Many of the passengers leaped from the train, rolling down an embankment, and some were bruised.

◆

It Costs Forty Cents to telegraph nine words from Philadelphia to West Philadelphia, and it takes five hours for the message to reach its destination. The people complain, but they should not do so. Forty cents for five hours of the company's time is cheap.—*Electrical Review.*

A WORD ABOUT ARTIFICIAL FLOWERS.

The fidelity and cheapness with which natural flowers are imitated by mechanical processes is wonderful. A brief account of them is here given from the N. Y. *Mail.*

"It used to be the custom to manufacture the floral designs from a material called chiflou, but that is too expensive, so ordinary Victoria lawn is substituted. This is first soaked in water to shrink it and then stretched on a frame to dry. When dry it is folded so as to make about 16 thicknesses and is ready for any flower we want to make.

"Now suppose we take the most popular decoration of the present day, the snowball," said the manufacturer, and he took a steel die and cut out of the muslin 16 pieces at each blow of the mallet. These were placed in alcohol and tinged in the center to give them the natural tint of the flower. After drying, each of the scallops is twisted and about 12 pieces strung together by passing a wire through the center. A little paste is added, and in less time than it takes to relate the snowball is ready to adorn some lady's bonnet.

"What are the most difficult flowers to manufacture?"

"The rose or the mignonette. All those that have fine petals cause more or less trouble. The manufacture of leaves is a little different. They are cut in a similar way out of green muslin and then put in a press to stamp on the veins. The color is put on with a stencil, and each leaf is dipped into wax and dried. Every leaf and petal is handled separately, so that will give you an idea of the work accomplished. Fashions are constantly changing and prices vary fron 20 cents to $2.50 a flower."

"Are not the dyes used very injurious?"

"Not at all. Paris green was used in the old times, but now it is dispensed with and ordinary aniline dyes substituted. Wages? Some people have an idea that girls barely earn a living. We pay three cents a gross for stamping leaves. That appears very little when you know every leaf is stamped separately, but an accomplished hand will stamp 15 or 20 gross in an hour.

◆

THE STATUS OF ENGINEERS.

We take occasion as opportunity serves to urge the claims of engineers for greater consideration and a fitting recognition of their responsibilities, and we find our reward in knowing that these utterances are not unheeded by those to whom they are addressed. But much remains to be done before engineers will stand where they should in public estimation. It is a curious commentary—and ludicrous in some lights—upon the intelligence of landlords and agents of buildings, and those who let power, that they fancy reducing the wages of engineers means lessening expenses. We were told of an instance not long since where a wiseacre of this class came upon, in the monthly reports of a large building, the item of "Engineer, $80;" he declared his ability to get the work done for $50, and he did. Before the old engineer left, however, the agent was simple enough to ask him to instruct the new man in his duties, "so that everything would go on all right." This is fact. This sapient agent will doubtless find a good many items charged to repairs which he will cheerfully pay.

Engineers will never be benefited by combinations of any sort which look toward regulating the wages of individuals. This is so well understood that the new Engineers Associations everywhere have this for their corner-stone. They build upon it, and their structure will stand. No interference with the liberty of the individual, in any way, shape or manner, is attempted, and anything looking to such interference is promptly voted down. This is as it should be, and so long as it is adhered to the associations will prosper. Engineers of to-day have to become scapegoats for many sins and omissions of the trade in the past, for we do not disguise that, until within a few years, engineers were not ambitious to improve their condition; but since they have learned that knowledge is power, and have sought the same sources that every one seeks who wishes to rise, they have, as a class, risen in public estimation. They will continue to do so, and future generations of the craft will be looked upon in their true light—important men in manufacturing circles.

BOILERS OF THE NEW MISSIONARY STEAMSHIP "MORNING STAR."

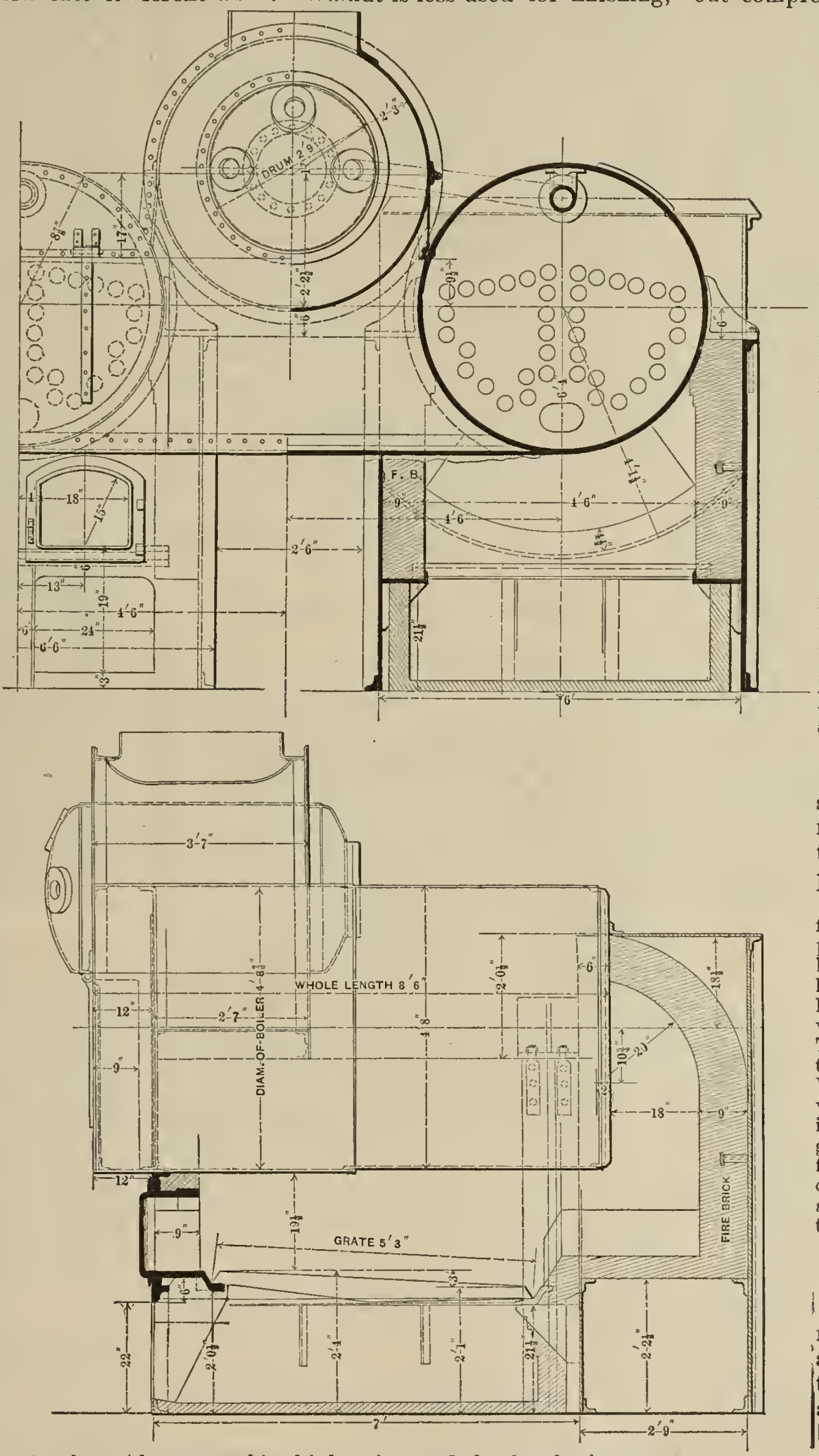
The accompanying sketch shows the dimensions and arrangements of these boilers, which are of the externally fired type, and resemble somewhat the celebrated cylinder boilers of the SS. *Louisiana*, designed by Miers Coryell, as they now are, with parts which were found to be superfluous, cut away.

The sketch is reduced from a shop drawing, and clearly shows the manner of constructing the brick-lined casings within which the boilers are secured.

The usual steam chimneys are replaced by a cylindrical steam dryer, supported in the uptake breeching; over, and between, the two boilers. The products of combustion will completely surround the dryer, and steam be led into it from each boiler by copper pipes bolted to the flanges shown on the heads of the boilers and the dryer. The main steam pipe leading to the engine connects to the middle flange upon the dryer-head. This arrangement allows the boilers to be kept wholly below the main deck, whereas, if steam chimneys were used upon the boilers they would come through the deck into the cabin.

The engine to be driven by these boilers is compound, with 12″ and 24″ diameter of cylinders, and 18″ stroke; steam pressure to be 120 lbs. per square inch.

It is thought by the builders—The N. E. Shipbuilding Co.—that the little vessel will easily steam eight knots per hour, which speed is deemed ample for all missionary purposes!



◆

SOME WORK OF THE HARTFORD BOILER INSURANCE COMPANY.

In the office of the *Hartford Steam Boiler Inspection and Insurance Company* are draughting rooms, a chemical laboratory, and apparatus for experimenting on iron and steel, in order to ascertain its fitness for boilers. The company is in daily receipt of letters from its patrons asking information as to the adaptability of this or that type of boiler to their wants, or asking for specifications for boilers, and plans for settings, also plans for chimneys. In many cases, when requested, the company lays out the entire plant, making full detail drawings of building, boilers, and all attachments, and pipe connections. If the parties insured have trouble with the water used in their boilers, or if it makes a hard deposit or corrodes the plates, they send a sufficient quantity to this office for a careful analysis, and a report is made advising them how to overcome the difficulty. Such work is done free for those who are insured. If we are called upon to lay out a boiler plant and superintend the work of setting and connecting the boilers, a reasonable charge is made, but for advice as to new boilers or repairs of old boilers, specifications, when called for, and analysis of water for our patrons, no extra charge is made. We have on file numerous letters from those who have been thus benefited, and who express much satisfaction that there is an institution where valuable and disinterested advice can be obtained. The ability to give this advice has required much expensive apparatus. But if we can aid those insured with us in attaining greater safety and economy in the use of steam, we are amply repaid.—*The Locomotive.*

◆

Number 2, Volume VII., is out of print; persons who wish to part with that issue can obtain 25c. for it at this office.

◆

The Enormous Quantity of 170,000 tons of raw sugar is now stored in this city. The price is very low, ($2\frac{3}{4}$c. per lb.); notwithstanding this fact, we do not observe that the consumer is benefited.

The Consumption Of Hard Woods for interior finish in buildings is a most important factor in the trade in such lumber, says the *Builder and Woodworker*. On account of the scarcity of cherry, other woods are sought after that will answer as a substitute, affording a similarly rich grain. Cherry is imitated with gum, and quarter-sawed beech is named as the lumber likely to take its place to some extent. Calico ash is obtained principally in Indiana and Michigan. White maple is a designation applied to the sap of the ordinary maple, which is sought after for finishing purposes. Mahogany has latterly been used to quite an extent in fancy buildings. Very often from six to a dozen different kinds of lumber are used in finishing an aristocratic residence—the plan being to have every room finished in a different wood. Walnut is less used for finishing, because of its high price, and the developing tendency is to employ light shades in wood, to produce a cheerful and refreshing effect.

◆

Blasting Paper has been made by J. Petry, of Vienna. It consists of unsized or ordinary blotting-paper coated with a hot mixture of 17 parts of yellow prussiate of potash, 17 of charcoal, 35 of refined saltpeter, 70 of potassium chlorate, 10 of wheat starch, and 1,500 of water. When it is dried it is cut into strips, which are rolled into cartridges.

◆

It Is To Be Hoped that for the remainder of this world's existence a fence will extend across Baffin's Bay, at, say, Uppernavik, to prevent any more attempts at discovering the North Pole. No one has yet ascertained what value the same would be if found.

NOT ALL ALIKE.

A writer in a contemporary says:

> "It has been found in high-speed stationary engines, where the clearance is reduced to a minimum, and compression commences late in the stroke, that the sudden arrest of the reciprocating parts in so small a distance by the compressed steam acts like a sledge-hammer blow, and has resulted, in many instances, in the practical destruction of the engine. On the other hand, the early compression of the link motion gives a soft cushion, gradually arresting the momentum of the working parts—an advantage to which may be attributed the remarkably satisfactory performance of many locomotives."

If our friend had qualified his remarks on the stationary engine by saying that some act so, when improperly adjusted, he would have been correct. We can show him an engine in this city working at 70 revolutions per minute without compression. The cylinder is 60 inches in diameter by 72 inches stroke worked at 90 lbs. pressure, cut off at $\frac{1}{16}$th. It is absolutely noiseless. This may not be high speed, in the opinion of the writer of the paragraph quoted, but it seems to us that it is; 840 feet per minute is not very slow for a 60″ cylinder.

◆

This Is Close Work.—An English paper says:

> "In the island of San Domingo there is a remarkable salt mountain, a mass of crystalline salt nearly four miles long, estimated to contain 89,337,600 tons, and said to be so clear that type can be read through a block a foot thick."

When a man can figure out a mountain four miles long and come within 662,400 tons of getting 90,000,000 in it he is doing finely!

◆

Forty-Two Inch Railway Wheels are said to have worked finely in a recent rapid run on the B. & O. R. R.—the car sailed at the rear of the train as gracefully as a swan, at a speed rarely less than 45 miles an hour, and from that up to a rate of 50, 60, 65, 77 and 90 miles.

◆

A Machine For Picking Cotton is spoken of, and as it does away with negro labor its social effects are looked to with interest. A South Carolina paper says:

> "The negro will probably be the first to feel the effects of the new methods impending. A more intelligent laborer than he is will be demanded, and the number of laborers will be vastly reduced. The farm laborer who has nothing but his muscle will have to acquire brains and skill or go. The farmer will be independent of him, and there will be little need of him anywhere. Where he will go we cannot tell. The world is becoming harder for a fool to live in every year, and muscle is steadily losing ground before brains. That is a problem for the future, but the effect of the system of farming by machinery will be to improve and elevate the remaining labor of the country, and increase its power and strength."

Yes, sir; quite so.

◆

Even The Humble Center Punch now has its allotted place in trade catalogues. The center punch of modern times has its body beautifully knurled and is provided with a lovely ogee head; quite esthetic in its line!

◆

Gould & Eberhardt, Newark, N. J., have recently shipped the Eberhardt patent universal automatic gear-cutter to Fay & Scott, Dexter, Maine; Mason Locomotive Works, Taunton, Mass.; Standard Machinery Co., Mystic, Conn.; Ball Bros., Madison, Wis.; Robert Tarrant, Chicago, Ill., and are building some for the Scott Printing Press Co., Plainfield, N. J.; also for foreign orders. Some of the above machines have the automatic rack-cutting attachment, a very useful addition.

◆

An Example Of Carelessness in making up a paper is found in a recent illustration of a journal box in a contemporary which is headed "A prehistoric human tooth," while the matter which belongs to the engraving is in another column remote from it.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

LIKE UNTO A CIRCUS.

Editors Mechanical Engineer:

I wish to relate an incident which occurred in this city within the last four months, and carries its own moral. A certain mill-furnishing establishment got the contract for a new mill of two hundred and fifty barrels in twenty-four hours, and they put in an engine made in Ohio and sent what is called "an expert" to set the engine up. He went to work and got his engine in place and all "brimstoned" down solid. Then he put the shaft in place and found her out of line; so he put a jack between the wall and the cylinder, and jacked her around until he got the coupling together. Then he took the jack out, and when he got ready to start, gave her steam. She would not move. He had left the cap off the pillow block. So when he got a full throttle on she *went*. The shaft did not turn, but she went straight ahead bodily, and shoved the front half of the box off!

Well, the manufacturers sent a new engine; the expert put it up and started it, and turned it over to the engineer, who thoroughly understood his business; but when he got the engine, it was eating a bushel of coal to the barrel of flour. The engineer got her down to sixty (60) lbs. to the bbl., but about this time the governor shaft broke, and it ran with nothing but the collars to hold it in place. The engineer informed the proprietors, but they let it run, and on the day the mill was to be accepted, it let go. A new one was sent, and also the same expert to put it in place and adjust the engine, which he did, to the tune of one hundred bushels of coal to ninety-six bbls. of flour, and let her go at that. Then the said expert, the head miller and the agent of the firm hired a man to take charge of the engine, whose only recommendation was that he had been blowing for the engine, but had never seen one until this came here. The excuse for hiring this party was that the first man would not do the engine justice. Well, the man they put on has done her justice; he said he only wanted one and a half hours to get the knock out of her. As to this, I may say that the engine has no foundation under it, but there are four or five hods of brick and common mortar instead; and a man has to chase the engine around the room to oil it up. Last Monday morning our friend started up. and after running about twenty minutes melted the babbit all out of the pillow block, and made one solid mass of the quarter-boxes and shaft. This will cause a delay of five or six days at the least, and at least six hundred dollars loss to the firm. The way they are fixing it they will have more bother with it for a long time, but I suppose it will *wear* in line, if the engine don't wear out first.

I will bring my letter to a close, or you will think I am writing a serial. Automatic.

Atchison, Kas.

[This is simply amazing.—Eds.]

◆

BOILERS THAT PULSATE.

Editors Mechanical Engineer:

Having been a constant reader of your paper for the past two years, and being in trouble, I write to ask if you can help me out. I am running a Corliss Engine 16″×36″ at 92 revolutions. The boilers are 44″ by 16,′ with thirty four-inch tubes in each. We work our engine for all there is in it. The boilers pulsate all the time when the engine is working hard, and I claim this causes them to leak. The steam dome is 18″ diameter by 9′ 6″; the steam pipe is 4 inches; we take steam for the engine from center of the dome on top. I claim that the boilers are too small for the work they are doing. They set on a cast-iron stand about 2 feet from the back end, have also on a mud-drum on the bottom. The seams leak back of the bridge wall, and at times all of them. Can you tell me how to stop the pulsation? if you can you can help one who is willing to learn. Corliss.

Wichita, Kan.

[We fear we cannot help our correspondent much, for the data he gives is not sufficient, as regards the boilers. He does not say whether they are return tubular, or how they are set, therefore it is impossible to tell whether the boilers are too small. The pulsation he speaks of may be caused by lack of steam room. If there is a constant demand on the boilers for steam, each opening and closing of the main valve would cause a surge or shock on the incoming steam.

We dislike very much to give advice in a case like this, because we are wholly in the dark as regards facts. If we were on the spot we should examine the steam dome and see if that pulsated first, and communicated the shock to the main boiler. If the greatest disturbance took place in the shell and the least at the dome, we should suspect the feed to be the cause of the trouble, and possibly change its point of entry. We infer that this has something to do with the leakage of seams behind the bridge wall. Just here is the hottest point in the boiler, and if the feed enters near it, or is directed over it, it is not wonderful that the seams leak, through expansion and contraction.

We do not know where our correspondent carries his water, but he can increase the steam room materially by keeping scant two gauges. Supposing him to carry three gauges of water now, by running down one gauge (carrying one gauge less) he can add 16 cubic feet of steam room to his space, which is no small increase. In finding this amount we assume the gauge cocks to be 4″ apart, the boiler to be 192″ long, and the width of space occupied by water between gauges to be 36″ only. Then 192″ × 36″ × 4″ = 6,912 cubic inches; divided by 1,728 cubic inches in a cubic foot gives 16′ (cubic feet) increase by dropping one gauge of water in one boiler, or 32 cubic feet increase for both boilers.—Eds.

◆

THE BOILER OR THE DITCH.

Editors Mechanical Engineer:

I have been a reader of your valuable paper some time, purchased through the news agent of this city, and feel thankful for the many things I have learned from it in regard to engines and boilers. As my hobby is boilers, I read everything pertaining to them, and would like to ask a question in regard to blowing them off.

I have just got a new boiler and my ambition is to keep it new as long as I can. The boiler is down in a hole, as usual, where the old one was, and always had to be blown off under pressure, as there was no way to get a straight outlet without digging a trench about three hundred feet by eight feet. My employers thought it would cost too much to do so. I contend that I can keep the boiler clean much better by letting it empty when cool, as the matter inside will be soft and easy to wash out; while on the other hand, should I blow off while the pressure is on, the brick work and grates being hot, the sediment will bake fast, and have to be scraped off, or if too hard for that, chiseled off. I think that is bad, for you are in danger of hacking and scarring the sheets. Upon your answer and advice depends the position of the blow-off. W. E. Hagerman.

Lambertville, N. J.

[All the evils our correspondent mentions would follow upon blowing the boiler off under pressure, and the only objection to running the water out seems to be the cost of the trench. There are probably urgent reasons, but we do not understand why the boiler is "down in a hole" only eight feet below the level. Not knowing why we shall not comment, but may be permitted to say that it is a bad location. The cost of digging a ditch, such as our correspondent mentions, has to be offset against the injury done to the boiler. When this is done it will be seen that the ditch is a good investment.

Fifty dollars would pay for digging such a ditch under ordinary circumstances, while it would take but a short time to coat the heating surfaces of the boiler and lose much more than fifty dollars in permanent injury and daily waste of fuel. This latter is a constant item, and one which increases. We should dig the ditch if there was no alternative.—Eds.]

◆

THE EXPERIENCE OF AN ENGINEER IN CALIFORNIA.

Editors Mechanical Engineer:

I wish to say a few words concerning a letter in your paper—page 152, Vol. 7, upon the care of boilers, by *Smoke Arch*. Some years ago I was asked to leave a good job and tackle a tough one, the only inducement to do so being more coin. I found at this place a battery of two 40″ cylinder boilers made out of ¼ inch iron, and having 40 tubes, 2¼″ diameter, 15′ long, carrying 125 lbs. per square inch. The old engineer had been discharged for carelessness and new tubes were being put in. I got under the boilers and found a "sag," or as *Smoke Arch* appropriately called it, a bulge, just forward of the bridge walls. As the only opening in the boilers was a hand-hole plate, 3″ × 4,″ there was no opportunity to learn the condition of the seam inside of the boiler between the rivets. The circular seam near the sag had been leaking, but the boiler-makers had caulked it. I cleaned out all the dirt I could through the hand-hole plate, and washed the boilers out. It is the custom to wash boilers out here, except when they are in charge of savages. I also reported the condition of things to the proprietor, who said I was to repair the trouble myself, as he objected to having boiler-makers called in so often.

After I had been running the boiler a little while I found the leak increasing, and I then told the proprietor that if the matter was not attended to I should quit. The result was that he gave me leave to do as I thought best. I then cut a manhole 10″ by 14,″ and got inside, when I found that the seam was ripped between the rivet heads up to the top row of tubes, and all that prevented the boiler from blowing apart endwise was the holding-power of the tubes.

I think it is obvious enough that all boilers should have manhole openings in the bottom, in front, so that the engineer can get inside to examine them.

San Francisco, Cal. John Mailer.

◆

HINT TO THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Editors Mechanical Engineer:

If not out of place, permit me to offer a suggestion to the authorities of the *National Association of Stationary Engineers* to act on at the approaching Convention. It is beyond my conception how any editor can be an active member of any of these associations. I can readily see how he could be an honorary member, but an active one, never.

Again, if he can be an active member is it policy for him to continually write abusive editorials? If by hook or crook dishonest men have sneaked in, this should not be made an article of public comment. The proper way one would think to remedy evils would be to go to the subordinate association of which such persons, if there are any, are members, and begin reforms there. Some editorials that I have read are enough to counteract the work of a dozen men in favor of any given organization. It is a wonder to me that there has been one association organized the past six months, when so much unscrupulous abuse is indulged in by some alleged engineer. I should not have intruded my opinion had I not read a contemptible slur in a paper published in this city.

In conclusion let me say to the delegates who will meet at Baltimore this fall: enact such laws that no one who is not actually engaged in building, designing or handling steam machinery can become an active member of any association, and that when any member of a subordinate association openly, in print, attacks any officer of the national body, that association is to be held responsible. Get rid of alleged engineers whose experience cannot be established in any other way than their say so.

Boston, Mass. R. S.

◆

WEIGHTS ON SAFETY-VALVES.

Editors Mechanical Engineer:

This same piece of information I asked of the —— ——. You can see by referring to the July 19th number how it was answered. I don't see how I could state it any better, and will be pleased to have you give me the rule. I wish to obtain 1,200,000 lbs. on a hydrostatic press, say 12″ diameter cylinder, with a lever 18″ long over all, a fulcrum 1½″ long, valve $\frac{5}{16}$″ diameter. What would be the required weight of ball to put on end of lever to attain the desired pressure? Thanks for all past favors and for this. R. J. Steel.

Petersburg, Va.

[1,200,000 pounds upon the ram of a 12″ press equals 1062 lbs. to the square inch, disregarding fractional amounts. The valve to resist this pressure is $\frac{5}{16}$ of an inch diameter. What weight shall we put on the end of a lever 18″ long, fulcrum 1½″ to balance it?

The rule is:

Multiply the pressure in pounds per square inch by the area of the valve in square inches, and by the distance from the fulcrum to the center of the valve in inches; divide the product by the length of the lever and the quotient is the weight of ball required.

Area of $\frac{5}{16}$th valve is ·0767; multiplied by pressure per square inch and distance of fulcrum from center of valve, equals 121·68, divided by length of lever equals 6 lbs. 10 oz.; which is the weight of ball required to resist the pressure named. This rule answers for a safety-valve on a steam boiler also.—Eds.]

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IN THE MATTER OF THE METEOR.

Editors Mechanical Engineer:

I assume that you do not wish to make in your valuable journal any misstatements in regard to any mechanical establishment, and that you have, therefore, been misinformed in regard to the connection of these Works with the steamer *Meteor*.

It is true that we are building engines for her, and we expect her to be fast.

Our management do not and *never did* "guarantee twenty-nine miles per hour" for her, and we believe that we are amply able to "go it alone," so to speak.

I ask you to publish this as a matter of justice to our Works. Chas. E. Hyde,

Bath, Me. *Supt. Goss Marine Iron Works.*

[Mr. Hyde is correct in his assumption, and in deference to his expressed wish we publish his letter, although the name of the Works he represents was not mentioned in The Mechanical Engineer. We have nothing but good wishes for the *Meteor*, and hope she may yet achieve fame for all connected with her.

In justice to a gentleman who writes for The Mechanical Engineer, and was formerly connected with the Goss Marine Iron Works, we desire to state that the paragraph headed "*An Impending Fizzle*," in our issue of July 26th, was not prompted by him. On the contrary he made a special visit to this office and protested against it as being incorrect.—Eds.

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FROM THE MINNEAPOLIS ASSOCIATION OF STATIONARY ENGINEERS.

Editors Mechanical Engineer:

At the annual election the "*Minneapolis Association of Stationary Engineers*" elected the following officers: Pres., E. S. Getchell; Vice-Pres., H. F. Pierce; Fin. Sec., W. M. Sage; Rec. Sec., W. M. Derby; Treas., John Norton; Cor. Sec., W. M. Millan; Cond., C. C. Hurd; Doorkeeper, F. R. Auger; Inspectors, A. R. Cole, A. L. Daniels, Robt. Williams.

We are not positive, but think we will be represented at the National Convention. At our meetings we have articles read from The Mechanical Engineer, which are very instructive. Some of the members get the paper through the News Company, but by the first of January we expect to send you a pretty good club.

Wishing success to The Mechanical Engineer, and all sister associations, we remain, etc.,

Minneapolis, No. 2.

◆

FROM ATCHISON ASSOCIATION NUMBER ONE.

Editors Mechanical Engineer:

At our last meeting, in June, we elected officers for the ensuing year, but when it came to installing them, our corresponding and recording secretary and conductor respectfully declined, and we had to elect others to fill their places. So this list will vary from the one sent Bro. Davy. The following officers were installed: President, George Fishwick; vice-president, J. H. Stanard; corresponding and recording secretary, R. G. Cheney; financial secretary, T. C. Logan; treasurer, R. R. Herd; conductor, Joseph Maxwell; doorkeeper, T. G. Sortor; trustees, R. G. Cheney, Jos. Maxwell, T. G. Sortor.

Our delegate and alternate to the national convention will be chosen at our next meeting. Our association is in good condition. T. C. L.

Atchison, Kas.

◆

ABSOLUTE PRESSURE.

Editors Mechanical Engineer:

Please inform me—a young engineer—the meaning of absolute pressure, which I sometimes see in your paper. Is there any other pressure about a steam engine than that shown on the steam gauge? J. D. C.

New York, N. Y.

[Absolute pressure means that reckoned from perfect vacuum. The steam gauge shows only the apparent pressure, above the atmosphere. A condensing engine has the pressure shown by the gauge, on it, and whatever advantage is gained by the vacuum; half a pound for every inch of vacuum shown on the vacuum gauge. —Eds.]

◆

THE "WINURNA."

Editors Mechanical Engineer:

Some weeks ago you published sketches of a boiler for a Kennebec River boat, and got the boat's name "*Winona.*" Now I don't know whether the copy was illegible, or wrongly written—but please say that, strange as it may appear, the boat is named "*Winurna.*" N. W. W.

◆

FROM SOUTH PUEBLO ASSOCIATION, COLORADO, NUMBER 3, NAT. ASSOC. STATIONARY ENGINEERS.

Editors Mechanical Engineer:

Having noticed the interest you take in the *National Association of Stationary Engineers* as a movement in the right direction, it is my duty to advise you that Pueblo engineers have also fallen into line with the rest of the craft who are desirous of elevating themselves.

Our Association organized here April 12th, with 13 charter members, and our last report to Grand Secretary Davy numbers 24. Our officers for the ensuing year are: President, M. H. Hilburn; vice-president, Archibald Stewart; past-president, Jas. Taylor; recording and financial secretary, B. C. Roos; corresponding secretary, J. E. Beaton; treasurer, James Dawdy; conductor, Thomas Redfern; doorkeeper, A. Steaton; trustees, George Lannon, Hugh Tully, J. L. Hickox.

We want every candidate to prove (before open lodge) that he is able to take charge of a boiler, give his knowledge of dangers, and how to prevent the same from disastrous results.

Our meeting nights are 1st and 3d Saturdays each month.

Our president, Mr. Hilburn, I think, has counted his threescore years; but he is full of life and interest for the National Association. He is firing up the younger members, and gives, at the close of each meeting, a good word to us about the duties of a good engineer. He is superintendent and chief engineer of the Pueblo Water Works.

Our Association started with the chief engineers and master mechanics in this place, and they are very strict and careful in keeping the National Association laws and regulations in full force. One of the Members.

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FROM CLEVELAND, OHIO, No. 5, N. A. S. E.

Editors Mechanical Engineer:

Cleveland Association No. 5, of Ohio, organized on the 27th with thirty members, and a more intelligent set of men I have not met before. They intend to have the banner association as far as numbers and intelligence are concerned, and that in the near future. The officers are as follows: pres., Joseph Frazier; vice-pres., J. S. Card; rec. sec., C. B. Jessup; treas., P. Buckman; fin. sec., J. S. Clark; cor. sec., D. Honeywell, 627 Clark avenue; conductor, N. Bickford; past pres., D. K. A. Lamont, J. L. McDonald.

They will elect a delegate at some future meeting, as they are determined to be represented at the annual meeting of the National Association.

Auburn No. 5, of New York, applied for charter on July 23d. We now have 57 associations, and more are coming. A. M. Davy, *Gen'l Sec.*

Detroit, Mich.

◆

THE KEY NOTE.

We have previously noted the friendly character and tone of our correspondence, and its familiar "between you and I" tenor, but while it is gossipy, it is never impertinent or rude. It never crosses the narrow line which separates concise speech and direct address from coarseness. It is perhaps brusque at times, after the manner of engineers with one another, but brusqueness breaks no bones, and engineers are not so thin skinned as to fancy slights where none are intended. They know how to distinguish plain speech from intentional insult. This leads us by an easy grade to the tone of the paper itself. "The tone of The Mechanical Engineer," said an editor on one of the great daily papers of this city to us recently, "is like nothing else under the sun. No one on earth ever saw the like before; the idea of going right into a man's shop and sitting down on his bench and talking to him is a novelty in journalism, but it is pleasant, and is doubtless understood by those whom the paper addresses."

This is a very clear exposition of what the editors aim at, and if they are permitted to judge, it has succeeded. But, we may say without egotism, it would not in the hands of all conductors. One must know his audience before he can handle them freely and familiarly, and long association, years of shoulder-to-shoulder companionship, have brought us to know ours. We believe that straightforward address simplifies and expedites business, and the adoption of it in the tone of The Mechanical Engineer is not a question of policy, but a conviction that it is better for all concerned.

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Number 2, Volume VII., is out of print; persons who wish to part with that issue can obtain 25c. for it at this office.

TRADE TOPICS FROM EVERYWHERE.

George W. Grimes, Bluffton, Ind., manufacturer of boilers and engines, etc., will put up two additions, 20 by 38 feet and 18 by 30 feet, and also put in a large drill press and another planer.

A company are issuing proposals to build the Uncompahgre Irrigating Canal, in Colorado, at a cost of $200,000. It will be about twenty-five miles long, and 36 feet wide in the bottom. It leaves the Uncompahgre river about six miles east of Montrose, in Montrose County, Colorado, and runs in a generally northwestern direction into Delta County. Walter H. Graves, of Denver, is chief engineer.—*Age of Steel.*

A. Garrison & Co. received an order from the Otis Iron and Steel Company, of Cleveland, O., for a chilled roll 122 inches long and 20 inches in diameter. This is undoubtedly the longest chilled roll ever made on this side of the Atlantic.—*American Manufacturer.*

The Tanite Co., Stroudsburg, Pa., is now arranging for a large extension of its factory. The new building will be of stone 45 by 32 feet, and three stories high. When the improvements are completed the company will have a steam engine and two large turbine wheels as motive power.

Chippings and Filings.

Engine Number 165, Philadelphia and Reading R. R., has made 130,300 miles, covering a period of three years, without being off of her wheels. The main bearings, of phosphor bronze, were worn down in that time about $\frac{1}{8}$ of an inch only.

◆

The *Industrial World* says:

"The Department of Mechanical Arts of the University of Wisconsin, at Madison, has just completed a 16-inch gap-lathe which has some peculiarities. One is that what is commonly known as the back gears are inside the cone. All the screw-cutting gears are in position, and so arranged as never to have to be changed. The head-stock swivels for boring tapers, and a device in the carriage automatically withdraws the tool from the work in screw-cutting."

◆

It Is Announced that there will be a rendezvous of the steam yachts of the American Yacht Club at the Larchmont club house on Wednesday afternoon, August 6. Next morning there will be a race around the lighthouse off Stratford to abreast the lighthouse at New London. Prizes will be given in two classes—yachts over 100 tons gross and yachts under 100 tons gross. A third prize will be awarded to the yacht making the least actual time over the course. Owners of steam yachts of any organized club are invited to enter and to compete for the prizes under time allowance.

◆

The *Railway Age* says:

"The ingenuity of scientific people in discovering dangerous qualities in things supposed to be perfectly harmless is illustrated by the announcement that Mr. Beach, of the *Scientific American*, has found that the elevated railways are filling the air with iron dust, which gets into the wide open eyes of rural visitors, and also into those of citizens. According to Mr. Beach, the hospitals of New York are receiving hundreds of victims of this new source of optical injury. ' If some still more daring scientist will now announce the discovery of bacteria in the noise of railway trains we can subside, unresistingly, into a chronic state of terror."

Mr. Beach sees a great many motes in other people's eyes, and sometimes writes anonymous letters about them.—Eds.]

◆

Government Experiments in the manufacture of sugar are to be continued this year. Among the appropriations for the Agricultural Department is one of $40,000 for erecting what is known as a diffusion machine, for the purpose of extracting saccharine matter from sorghum. It will be constructed at once at Wilmington, Del., whence it will be taken to Ottawa, Kansas, and thoroughly tested. The machine has been operated with success in France, in the manufacture of beet sugar, and great results are anticipated for this country from experiments with sugar cane, which will be made under the supervision of the Agricultural Department. The machine will have a capacity of 100 tons a day.—*Iron Age.*

A Recent Suit to recover value for an invention has interest. Henry C. Milligan sued the Lalance & Grosjean Manufacturing Company of this city. The plaintiff claimed that in 1876, while in the employ of the defendant, he invented and sold to it an improvement upon metal kitchen utensils, upon an agreement with his brother, the Vice-President of the company, that he should receive a royalty upon such of said utensils as embodied his invention. The defendant denied these claims, and also set up that an employee is bound to assign his inventions to his employer gratuitously. This view was declared by the Court to be unsound. A verdict was rendered for the plaintiff.

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This Is Curious Advice; we find it in a contemporary whose name we omit intentionally:

"The very first and most important step is the selection of a calling for the young man. What line of life is most appropriate for him? Which of the occupations suggested would be best suited to his mental and physical make-up? We would advise parents and guardians not to waste any time in guessing as to the proper beginning for a life. Let them go at once to a good phrenologist and get his opinion. If he says the boy should be a blacksmith, or a plumber, or a doctor, start him immediately in that particular line. If he does not succeed in it, be convinced that he would not have succeeded in any other."

Oliver Wendell Holmes said one might as well feel of the rivets on an iron safe (when there were rivets on them) to tell where the money was, as to divine the intellectual faculties by bumps on the skull. We concur with Oliver.

◆

TESTING BOILERS BY HYDROSTATIC PRESSURE.

By S. Lloyd Wiegand, M.E.

Read at the meeting of the Franklin Institute.

In the matter of applying hydrostatic pressure to steam boilers, the momentum of the fluid as forced into the vessel plays an important part, and sometimes, if not frequently, causes ruptures or leaks by concussion, in vessels at pressures far below those that they have resisted under slow and steady application of hydraulic force.

When force-pumps of large displacement are used, the shock of the fluid-column delivered at each stroke is very appreciable in producing a pulsation, or intermittent dilation of flat surfaces, and leakage and rupture occurs at a moment coincident with, or instantly following, the sudden injection of the fluid. The indices of the pressure-gauges jump to an indication of pressure far beyond that which they settle at. This is specially noticeable in what is known as maximum recording-gauges, the rising and returning motions of the index (to which motion from the pressure is first imparted), being often so sudden as to escape observation; the recording index may be seen standing considerably beyond the point to which the eye can follow the moving index.

When a pump with a smaller plunger is used, the pulsation of the flat parts of the vessel is much less appreciable, and oscillations of the gauge indices are proportionally reduced, whilst at the same time the pressures reached before leakage and rupture are greatly increased.

These differences in performance under different proportions of apparatus are so well understood by the makers of machines for testing the properties of metals by weighing-beams combined with a hydraulic jack or press, that they employ a series of very small reciprocating force-pumps, worked by cams or cranks from a revolving shaft, to effect an almost uniform delivery of fluid to the ram of the jack, and their experience shows results not procurable by intermittently acting pumps. Pressure produced by the use of an injector produces like results.

The steady or more uniform application of pressure has sometimes been accomplished by charging an accumulator, similar to those used for hydraulic elevators and cranes, with fluid under a pressure equal to the intended test, and then cautiously admitting the fluid to the vessel under test. The cost and want of portability in this apparatus, as well as the risk of accident from sudden liberation of pressure by rupture, form an objection to this mode of working, and limits its application to situations where frequent tests are to be made of small vessels.

In such apparatus, a valve operating so as to automatically shut the flow from the accumulator as quickly as any rapid flow or fall of pressure occurs in the delivery pipe, is a useful adjunct.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in The Mechanical Engineer. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of The Mechanical Engineer will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

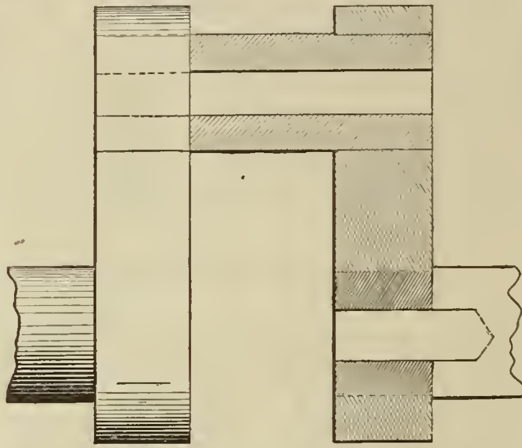
Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

HOLLOW CRANK-PINS.

The tremendous pressures dealt with in modern marine engineering are increasing evils which were sufficiently great before, one of which is heating of the principal bearings. We got on passably well at 75 to 90 lbs. boiler pressure per square inch, but now that 120 to 150 pounds per square inch are not uncommon, the difficulty of keeping the main bearings cool is greatly augmented. The bearings themselves are as large as they can well be made, and increasing the surface of them is hardly possible; we have, therefore, to inquire whether every means at command has been taken advantage of to keep the present bearings in working order. So far as lubrication is concerned there seems to be no improvement upon present methods which will prevent heating, for bearings get hot even when washed with oil.



We have thought, however, that if the crank-pins, as the main agents for transmitting power, were constructed as shown in the sketch herewith, some benefit would be derived therefrom. Not the least is the cooling effect of the air circulation through the central hole. The stroke of modern high-powered screw engines is often six feet, and the crank-pin, therefore, moves in a path of say 18 feet at each revolution, repeated 60 times in a minute; this amounts to a little over ten miles per hour for the crank-pin, and equals an artificial blast at the same velocity. We think that this current could, by a simple device, be carried positively through the hollow pin, where its refrigerating effect would doubtless be felt.

If this is too much to assert, a hollow crank-pin certainly removes weight, where it is injurious to have it remain, and, moreover, affords the greatest facility for artificial cooling in case the air circulation amounts to nothing. By stopping one end of the hole through the pin and inserting a hose, the hot pin can be cooled directly from the center in a much shorter space of time than it could be by throwing water on it externally. When this is done the heat is still conserved or stored up in the body of the pin, and it is a long time before it is actually cooled. The pin may appear in good condition outwardly, but so soon as the engine is started again the friction, added to the central heat, makes matters as bad as ever.

As regards the main bearing, where the shafts are solid we would drill a large hole into the center, for the purpose mentioned in the case of the crank-pin.

In themselves, hollow crank-pins are not novel. We have seen them in use many years ago, but the suggestion here made—to enlarge the hole, so that it shall serve as an air conduit in the case of large marine engine pins—is, we think, novel, and may be useful.

Many engineers of long experience claim that there is no occasion for hot crank-pins or bearings at any time, that a proper adjustment of the valves would materially relieve the load. This, certainly, is sound from one aspect, for any relief on a bearing already heavily loaded is the one thing needful, and taking off the compression affords such relief.

However this may be, 150 pounds per square inch, and 75 pounds per square inch, are very different matters, and mere valve adjustment may not wholly meet the trouble mentioned.

It would also seem quite within the province of modern metallurgy and engineering ability to provide a box-lining which shall not heat under any attainable pressure or velocity of surface.

We think, also, a measure of relief might be attained, as to the crank-pin at any rate, by making the boxes so that a current of air would pass through them at all times when in motion. This could be accomplished by coring out passages that would not interfere either with the strength or the adjustment. The air would circulate very rapidly through these passages, and would surely do much to carry away the heat engendered by friction, so that it would never rise above a certain degree.

WE DISSENT.

It seems to us that the author of the paragraph quoted herewith is misinformed, and that he merely echoes the misstatements of others. During the many years in which we were personally connected with the machinists' trade we had opportunities for observation which we made use of; said observations do not accord with the remarks we quote. For example:

> "The foreigner who has thoroughly studied his work steps into the factory or shop, takes the remunerative places, and thrives, as industry and knowledge always thrive. A sorry day awaits the American boy unless he changes his attitude towards learning a trade—the first step towards successful manufacturing."—*Boston Commercial Bulletin.*

The foreigner does not thoroughly study his work, for he is, as a rule, a specialist, knowing only one branch of his business. If the *Bulletin* writer had ever worked in a shop he would know that this is so.

In support of our assertion we quote *The Mechanical World*, England, who may be supposed to know something of the matter:

> "The Englishman who wished to become an engineer used to bind himself as apprentice either without or with a premium. In the former case he was usually employed in the shops only. In former times, when there was less machine work and more hand-fitting, and the shops generally undertook a greater variety of work, he usually acquired a varied experience and became the good old millwright, who could turn his hand to any job. If gifted with mechanical talent and a studious turn, he would also acquire by private study a knowledge of the principles of mechanics and machinery and turn out a good mechanical engineer. Circumstances, however, have altered. Unless the manager has some special interest in him, the engineer's apprentice will generally be kept to one department in the works only, and if he shows an aptitude for a certain kind of work, will be kept at this job for years, as long as he likes to stay in the place. This undoubtedly makes him an excellent hand at that particular job, but will not qualify him for taking a more important position.
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> "We find that the Englishman, who has devoted himself exclusively to one branch, is thoroughly acquainted with it, but does not know much outside of it. If anything new is required of him, he works chiefly by the rule of thumb and sometimes hits the correct thing; sometimes only after incurring great expense. The German engineer has a more various knowledge, but not the same thorough knowledge of a special branch, unless he has been exclusively engaged in it like his English colleague."

The American boy is learning a trade, and not as a specialist.

The first step toward being a successful manufacturer is not learning a trade. A very large proportion of the successful manufacturers in this country never learned the rudiments of the trades they carry on. One of the most prominent machine firms in this country has a man at its head who does not know iron from brass, as a machinist knows them, and it is not necessary that he should. We can recall numerous others who never learned trades and know nothing of them, as workmen, but are successful.

Unfortunately for the ethics of the question discussed, industry and knowledge do not always thrive. Bitter as the truth is, many a man, the peer of his fellows, is struggling for the bread and water of life. Honest toil and merit do not always win—except in novels and namby-pamby paragraphs. All of us can put our hands on men who, through no visible faults of their own, without a vice or an idle hour, linger at the foot of the class. It is easy to say that they don't do this or do do that, and assign it as a cause for want of success, but the reasons are beyond cheap philosophizing and trite moralities. A man that succeeds succeeds, while his comrade who failed toiled earlier and later, is more prudent, and more energetic in every way. The brazen braggart with his morality—or what he parades in lieu of it—hanging in shreds and tatters about him, courts publicity, while the modest merit man is crushed into hopeless obscurity by an idle rumor.

As a rule, we may say that honest men are better than rogues, that workers are more profit to the world than idlers, but if we assert that good qualities *always* win we say what is not true.

◆

HINTS FOR INVENTORS.

Many persons who have peculiar faculties therefor, follow the invention of new machines or devices as a profession. Such persons are not machinists, necessarily, and certainly not mechanics in all cases, but their inventions are none the less valuable on that account. Inventors embrace men of all callings, and the faculty exhibited is a peculiar one. The inventive faculty will scarcely bear analysis, but it is akin to the inspiration of poets and painters. Ideas flash upon inventors, though the realization and elaboration of the details may take a long time to perfect.

We would like to suggest that it might be beneficial to persons who have inventive faculty to leave beaten paths which they may have followed more or less persistently, and go abroad into others. Observations in new fields and lines of trade will perhaps show them golden opportunities. How often, when we go into shops or mills, do we not see some portions of the work carried on under the greatest disadvantages. It is not a platitude to say that the order of the day in the arts and manufactures is to keep marching on. All inventions are not necessarily successful, even though they may be practically useful, but for all that there is a field for every useful improvement that can be made, if the inventor can find it.

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THE WOOTEN LOCOMOTIVES.

It seems impossible to obtain any facts in the case of the Wooten locomotives. It has been asserted that these locomotives burn "dirt"—that is, refuse coal, which cannot be used in any other way. Our personal observation is that the passenger engines burn the most expensive kind of clean anthracite, and we are assured that this is the case with all the passenger engines of that type. The reports of performance of these engines are not to be seen, but we are assured upon reliable authority that they are very expensive to maintain, being in the repair shops much more frequently than standard engines. These are the rumors; whether they are fact or not we do not say, but if the Wooten engines are the long-looked-for-come-at-last engines they are claimed to be, why are not the reports made public, and why are not the facts stated in regard to the use of steamboat coal on the passenger engines? We live on the line of the Philadelphia & Reading R. R., and see these engines daily.

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THE STEAM YACHT RACES.

Unfortunately our paper goes to press for this issue before the steam yacht races occur, but we shall endeavor to be present and obtain as full an account as possible for the next issue.

Exactly what will be settled by such races is not very clear, for the method of grading time allowances for differences of engine power and size of vessel are of no value.

Aside from the vessels of a certain builder, there are, strictly speaking, no high speed yachts in this country. There are many large vessels, steamships in point of sea-going ability and engine power, but they are so loaded down with weights in hull, boiler, engine, top hamper, furniture and traps generally, that they make no better record than steam vessels in trade, and are yachts only in the sense that they are private pleasure vessels.

The very term—yacht—implies a vessel of singular speed; it is a distinguishing name, but we regret to say that many steam yachts belie their names. The *Yosemite*, a vessel some 160 feet long, with an indicated horse-power of over 1,200, has, as the highest effort she is capable of, made 16 miles. This is her utmost, and her average velocity when not driven is probably not over 14 miles. By itself this is no mean effort for a vessel of her size, but it is not what might be called flying, or even what can be done with a hull of her dimensions.

Nothing is better settled than that weight is the arch foe of high speed on water, and owners who demand the conveniences and room of an aquatic hotel have only themselves to blame if they barely keep abreast of the average tugboat.

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Cast Iron Car Wheels range in price from $8.50 to $10.

SOMETHING ABOUT METALLURGY, WHAT GOES ON IN A BLAST FURNACE.—Number 1.

By Norman W. Wheeler.

The editor was complaisant enough to say in a foot note awhile ago, that I did myself an injustice by addressing especially the younger class of readers. I don't see how he makes that out. If I can make my meaning so plain that the boys can understand me, I will take my chances with the old men; and aside from that, I know that boys must begin at the beginning on all subjects, and that learned writers are very apt to begin upon a subject a story or two above the ground floor, where the boys mostly live, and so sail along on the wings of their technical knowledge, completely above the ken of a numerous and appreciative class of readers, with whom they would fain be on good and familiar terms.

I know all about that, as it is not more than forty years since I was a boy myself, striving vainly to get a grip upon some of the higher lines of knowledge.

If learned professors could be persuaded to adopt the method of the tale of "The House that Jack Built" once in a while, and lead up from the very basis at times not too infrequent, it would benefit multitudes who are perhaps not very quick at "catching on," but who cling with great tenacity when they have once got a good grip upon knowledge relating to their work.

Now with the intention of starting off some new minds upon the beginnings of metallurgy, I propose to talk about the ways of reducing metals from the ores—iron especially—and to begin at the very beginning; not, like all the works on metallurgy that I know of, assume that the reader understands the subject before he begins to read.

That is, to give warning to the learned that they will find nothing for themselves in my wanderings with the boys in the basement of the metallurgical edifice, but that perhaps they will find the boys all the better pupils by reason of their basement rambles, when they get into the professors' domain in the upper stories—where I could not lead them if I tried. . ..

Now let us begin on iron ore, which is iron oxide, with some impurities, such as silica interspersed among the crystals, or grains, and in most specimens minute quantities of sulphur, or phosphorus, or both.

But first of all, let us arrange to avoid writing out so many long words, as we would otherwise be obliged to do, by agreeing upon a set of symbol letters, or abbreviations, and we may as well adopt those in common use in chemical books, and write O for oxygen, C for carbon, Fe (ferrum) for iron, N for nitrogen, and so on through the list of elements which will be found in every class-book of chemistry. If we have a compound body or substance, we will write both the symbols; for instance, we will write FeO for iron oxide, CO for carbon monoxide (which is the gas given off by a thick fire with a poor draught through it), and from charcoal pits. By and by we will write our symbols to show how many parts of each element go to make up the substance we indicate by the symbols. For instance: we will write CO for carbon monoxide and for carbon dioxide, CO_2, because in this last there are two parts, or equivalents of O, to one of C. That is the gas which is given off from a clear fire, with a good draught through it. We shall get the use of these symbols best by using them as we go along, rather than by setting ourselves to memorizing the whole lot at once, in the fashion of the schools.

We are greatly interested in these gases CO and CO_2, for by the action of hot CO on iron ore the O of the ore, FeO, is burned away and the Fe left behind. In fact all or nearly all processes for the recovery of metals from the ores are based upon the action of CO upon the O of the ore. This comes about in this way.

Say we have a blast furnace—which is like a cupola filled with a mixture of coal and iron ore—the coal burning by reason of air blown in at the bottom. The O of the air burns with the C of the coal and makes CO gas, because there is not enough air blown in to make CO_2 gas in such a deep fire, and when the hot CO comes into contact with the FeO mixed with the coal, the CO takes up another part or equivalent of O from the FeO and leaves the Fe to come down with the ashes of the coal into the crucible or lower part of the furnace, where the heat is great enough to melt it. This is not all that goes on in a blast furnace, but it is enough to recite for the first lesson, and to show us that the conditions of reduction are these:

The contact of reducing gas [CO] with oxides of metals, the same being heated to the kindling temperature. The result is: The O of the ore burns with the C of the reducing gas and the metal is left behind as ashes.

If you lay that fact carefully away in your memories, and if besides that you look up again the matter of chemical affinities and combinations in the first part of your school-book on chemistry, we shall be able to keep together in our investigation of the oldest way of getting iron with the bloomery fire.—(*To be continued.*)

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THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LXX.

Editors Mechanical Engineer:

A friend has handed me a number of your paper containing a communication headed: "*The Professor in the Machine Shop*," which attacks, or animadverts unfavorably upon a matter I am deeply interested in, to wit: "Manual Training Schools." I should judge that the writer had never been in one of these institutions, for if he had he would not have so misrepresented them. Manual Training Schools do not aim to make mechanics, or to turn out machinists ready made, but they do endeavor to give intelligent and ambitious young men opportunities to perfect themselves in certain branches of the trades, and at the same time educate them in the theory and principles of the several handicrafts represented. I am surprised that a machinist, of all other men, and an employer of young men, should not see that it is directly to his (his trade's) benefit to encourage manual training schools by all means in his power, instead of misrepresenting them as he has done. Perhaps this latter was unintentional on his part, and arose solely from want of knowledge of the situation. The growing disinclination of American young men to learn trades, and the increasing number of foreign workmen in our machine shops should lead every one interested in material advancement to foster institutions which tend to that end.
Manual Training.

New York.

[Mr. Moulton has made his comments on the above, it having been forwarded to him for reply.—Eds.]

I supposed it would be hardly possible for me to express my views on the subject indicated without giving offense to some one, and those who have read my letter in the issue of July 12th will see that I predicted such an event. I am glad that the writer of the letter above has given the other side of the question, but it would afford many who are still doubtful of the advantages of training schools, more light if the writer had been specific. I wish he had stated in so many words the advantages which accrue to young men who use training schools, as regards their immediate future.

I know and appreciate as well as any one can the theoretical instruction given; but this, according to the understanding I have of the matter, is beside it. What we need, we are told, just now, is better mechanics, workmen, and the training school is going to furnish them. Does it furnish mechanics, or does it send forth a better class of apprentices who have the trade still to learn?

The gentleman who criticises my letter says in so many words that manual training schools do not furnish mechanics. In that case it seems to me that, barring his schooling, the manual training part is time thrown away. Half learning a trade is like half learning to swim—if a young man does not make an entire success of it he goes to the bottom. Following out this same line, I know of no way to learn a trade, except to work at it, from the bottom up. I do not think there is any easy way to do it. I do not believe a young man can work three or four hours daily, in a desultory way, and gain anything. I should think three years spent in active labor, ten hours per day, might give a young man an inkling of what lay before him, but amateur mechanics or school-room machinists will not stand the test of shop requirements.

I am loth to use these expressions, fearing that some may think that I deride every other acquirement save mere manual dexterity, but I must take the chances of such misinterpretation of my meaning. I make no such assertion.

We all, in a measure, argue by our own experience in any given case, and mine has been this: My trade, and as thorough a knowledge of it as my abilities will permit me to acquire, has been my chief ambition. As an aid to a better understanding of it, I have made the best of such opportunities as fell in my way, or as I could obtain by hunting for; but, first and last, and all the time, the trade was the chief, and all else subservient to it, or tributary to it. By that I had to earn my bread, and to keep pace with my fellows. To do the last I had to accomplish as much in the same time, of equal quality, as they did, otherwise I should have been sacked. It took me all my time to do what I have said, and I find, on reviewing my acquirements, that I am anything but satisfied with the result. I know enough to get along tolerably well; but, in comparison with others, and the thousand and one things yet to be learned, I find that I am a know-nothing. If this is the case with a man who is past middle age, of fair average intelligence, what is to be expected of a person who spends a few hours daily for, say three years, as regards proficiency? I should say, very little.

I should be glad to learn one thing from the gentleman who has written the above letter: This is in regard to the statement that American boys are disinclined to learn trades. If this is so I don't see the value of a training school. Certainly we cannot force them to learn trades against their inclinations; and here my friend's argument is weak. It is weaker still where he says the increasing number of foreigners in our shops should lead us to encourage training schools. I do not see the connection. How can any number of training schools keep foreigners from coming to this country, or our people from hiring them?

I think both the above positions absurd. They sound to me like echoes from the penny-a-liners of the daily press, who strike false notes when they take up industrial matters. They sound to me like the utterances of some pedagogue who knows nothing of the situation as it is. My world is not large, but I am sometimes, in the course of trade, outside of it. Also, I am in very frequent communication with those who employ large numbers of men. Their universal testimony is that they cannot begin to employ all the apprentices who apply for places. It may be in other trades than ours that there is a scarcity, but I think this is not so from what I see in daily advertisements.

As to foreigners crowding out native workmen, that is equally incorrect; I hardly think I need enlarge upon it.

If there was any short cut to learning trades, I for one would encourage it by all means in my power; but, for causes previously pointed out, I do not think there ever will be.

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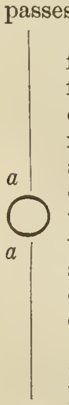
OPTICAL ILLUSIONS.—Number V.

By Egbert P. Watson, Jr.

The illusion which I will explain in this article is simple, but simple as it is it has baffled many who prided themselves upon their penetration.

A gayly-colored ball is shown and passed around among the audience. The closest examination will show nothing more than that it is pierced with a hole through the center, from one side to the other. Through this hole a cord, knotted at each end to prevent its coming out, passes freely; it looks like this:



Standing among the audience, the performer throws one end of the cord on the floor, and puts his foot on it to hold it down. The other end he keeps in his right hand, drawing the cord fairly tight, and vertical. The cord should be long enough to allow him to extend his hand a trifle higher than the shoulder. Taking the ball in his left hand he raises it as far as he can and lets go. Of course it drops down the cord to the foot, from the action of gravitation.

"Now, with this simple ball and cord I intend to show you that the greatest of Nature's laws, gravitation, can be overcome," says the performer, as he again raises the ball to the top, where he lets go as before. Instead of falling as it did, the ball remains perfectly stationary, although it has been shown that it slides freely on the cord.

"If some one will kindly command the ball to start it will begin to travel," he continues. Some one says "Start," and instantly the ball begins to travel slowly down the cord as though it were alive.

"Stop," says some other person to the ball. The ball stops short wherever it may be, and so it goes on down, stopping and starting at the word of command, until it gets to the floor, when it is raised, only to repeat the performance until the audience tires of it.

The diagrams explain this trick clearly.

For the cord, any small one, like a carpenter's chalk-line, will answer. The only requisite is that it be not elastic; it should stretch very little when held and pulled. The reason for this will be given later on.

We must not forget, however, that the larger, or, rather, the *heavier* the ball is, the stouter the cord should be. Get a gimlet from the tool-chest, and make a hole through the ball. There is but one hole, but to make it we will have to drill from both sides. Make a small spot on the ball, anywhere. Then make another, exactly opposite to it, on the other side. These are for guides in making the hole, and their position is shown by letters *a a* in Fig. 6. Now take a gimlet and make a hole a little more than half way through the ball—not entirely through. If it *did* go straight through, there would be no need to drill it from both sides. Incline the gimlet as in Fig. 7; this makes an obtuse angle. Now make the other hole, beginning where the second spot was made for your guidance, and incline it so as to meet the first hole in the center of the ball. It will make no difference if the holes pass beyond each other in the ball. The completed hole should be as in Fig. 8.

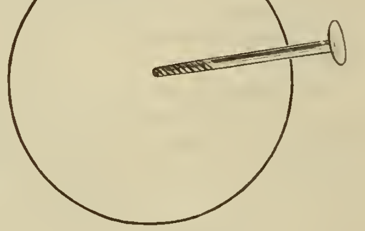


Fig. 7.

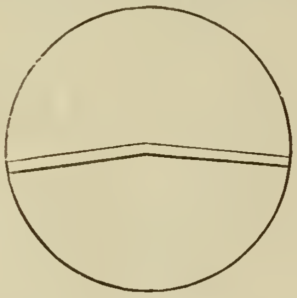


Fig. 8.

Don't make the angle in the hole too great, for if you do you will find that it will be impossible to get a cord through. All that is necessary is that the hole should be a little crooked, so as to bind the cord against the walls when it is drawn tight. If the cord won't go through easily, bind a small copper wire about six inches long on the end of it, and put the end of the wire through the hole. A small bit of wood stuck into the first hole will be a great help in making the second one, as it will show the angle, distance, etc., of it.

Now, when the hole (or holes) are made, put the cord through and tie a knot in each end of it to prevent it from coming out. Put your foot on one end of the cord, take the other end in the right hand, and hold it up, vertically. If it is held loosely, the ball, when placed at the upper end, will slide down freely. Put the ball back to the top again, and draw the cord taut. This binds it in the hole and it stays there! It is the alternate loosening and tightening of the cord which causes the ball to slide and stop anywhere on the line of march down the cord.

The reason why the cord should not be an elastic one is that the hand which draws the cord tight should not appear to move, even if it is looked at closely for the purpose of seeing whether it does or not. If the cord stretches, the movement of the hand will be noticed.

This closes the description of "The Ball and Cord."

Here is another simple illusion; that is, simple in execution. This one we will call "The Mesmeric Sentence Reader," and, of course, is done wholly through the aid of mesmerism.

Get a number of slips of paper of any convenient size, but not too large, as they will then be written full of sentences, phrases, etc., to such an extent as to be of *too much* use. Pieces about as large as this are about the best size for all concerned.

Virtue is its own
A. Ward.

They should be of very thin paper, not necessarily writing-paper, as they are to be written on with pencil. About six or seven pieces will be plenty, unless the performer has a very good memory.

Provide a *hard* lead-pencil. It is essential that it should *not* be a soft one, and yet not the hardest made. After the explanation, each can judge for himself what is best for this purpose.

Before commencing, our performer says that he can tell the inmost thoughts of any person in his audience, whether it be man, woman or child. If he is proficient with his tongue, he can turn this speech to account, and dilate upon it to great extent, and at the same time make much amusement from it in a quiet, unassuming way. Then he takes his slips of paper and passes them through the audience, one at a time, asking the auditors to write some short sentence, phrase or proverb on them.

As a rule, no one on the spur of the moment will be able to think of anything original, but can almost always find a proverb or catch-phrase to write. As he passes the slips out, *one at a time*, he notices that no one has any means of holding them while writing, so he comes to their aid by offering a small pad of paper such as can be found in any stationary store, for the support of the slip while the writing progresses. It is the most natural thing in the world to follow up the offer of the pad with the presentation of the hard pencil. After the first person has written his sentence, tell him to fold it up and allow no one to see it, and then pass on to the second one, to whom you present a slip, the pad and pencil as before. It is unnecessary to state that you must not stand so as to be able to see, or even to create the suspicion that you can see what is being written. Keep up your running fire of comments all along, so as not to allow the performance to drag or to become monotonous. You have a very good subject to create mirth upon, so don't fail to make the most of it. "No, no, *please* don't write that," you say to one, as she knits her brows in vain for a thought. "That's really a good one," to another, as he rushes pell-mell into it as soon as the slip and pad are given him. After the slips have all been passed out, written on and kept, the performer takes his pad and tells his audience that, inasmuch as this performance is all done by the means of mesmerism, it will be necessary to leave them for a moment to prepare for it, and then pass off the stage into a side room for a minute, not more. If your stage has a side wing, so you can come from the audience, enter that, and from that go to the stage, the foregoing need not be said. Few stages in private houses are so arranged as to admit of any such arrangement, so for that reason it was written. After you leave the audience, tear off the first sheet of the pad the audience has used as a support, and what does it disclose? A sheet of carbon paper. He raises this sheet of carbon paper, and under that he finds a number of neatly-written sentences which have been transferred by means of the pressure of the hard pencil on the hidden sheet of transfer paper.

If the pad has been judiciously turned around as sentence after sentence was written, the performer will have no trouble in reading them. Now let him read them and remember what was written. If he cannot do it, he hurriedly writes them on his cuff where it projects beyond the sleeve. A better way than the above is, if the stage is so built as to admit of its being carried out, is to give the sheet on which the sentences have been transferred to some person outside, who will act as a confederate and prompt the performer when he falters or forgets them. If the room is small, the confederate will have to stand very close to where the performer stands hidden, or else his prompting will be overheard. We will suppose that the performer has determined to trust to his memory.—(*Concluded.*)

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THE EXPERIENCE OF A MECHANIC IN THE NEW TOWN OF PULLMAN.

We find the following interesting letter in the *Iron Age:*

I belong to the working class, and having had some experience at Pullman, at the risk of having to assume all the odium which your article attaches to those who are "restive under such a system of restraints and conditions," I will tell you a little of how things look to me.

I hired a house of the Pullman Land Association, the same as any resident of Pullman has to do, assuming all the obligations as to rules and regulations which such an act requires, as follows: The rent was to be paid monthly, in advance, by my employer, who would take the amount from my wages. If the water-pipes got out of order—were to freeze up and burst—I must pay for the repairs. I was not allowed to do the repairs; the company would do that, and make out the bill against me and send it to my employer, to be taken from my wages; and it was just the same way with all other repairs. I had no right to put up a coat-hook, nor drive a picture-nail, nor even to put up a shelf in the cellar. If any such thing was wanted it must be reported—or, rather, petitioned for—through the medium of the janitor, who would report it to the agent's office, and if the agent thought best, he would send a workman to drive a nail or turn a screw, as the case might be. It may be all very nice to be waited upon in this way, but who has to pay for all this red tape? The tenant, of course; if not in one way he does in another. The landlord or his agent has the right at any and all times to enter upon the premises for the purpose of inspection and repairs, and in any default of mine any attorney of any court of record had the right to appear for me, and in my name and stead waive the issuing and service of process, and confess judgment against me. If there is any manliness in living in a house under such conditions, I would like to know it. I did it for a year, and it was a burden to my conscience all the time, and I hope this open confession will give me relief.

On first going to Pullman I expected to get a low rent, something on the European plan of paying for only just what I had use for. I found that I could get rooms that would hold me and my family, with hall, cellar and some other privileges (no bath-room), in common with our neighbors, for from $12 to $17 a month; but when I came to talk of a bath-room and some degree of exclusiveness (I mean exclusiveness; let them make most of it who will), I found that a whole house at $25 a month was the best I could do, with water extra. The house I took was twenty minutes' walk from the post-office, out on the prairie, where unoccupied acres of land were abundant, but I found that every foot was counted, like the hairs of our head, to suit the taste of the architect. The house I selected was projected one foot further in front than the adjoining house, and for this I had to pay $1 a month, making $26 a month, but the house was so small that I was glad to pay the extra dollar. I have had a more commodious house, with a good garden spot, in Toledo, Ohio, within twelve minutes' walk of the post-office, for $25 a month, and with 25 cents a day more wages than I got at Pullman.

As to protecting the workmen from the overcharges of shopkeepers, I never saw any evidence of it. My experience was that better and cheaper goods could be bought at Kensington, Roseland and Chicago than at Pullman, and it was of common remark that Pullman merchants could not sell as cheap as others because of high rents. I went to Pullman with the determination to make it my permanent home, and expecting to abide by the rules and regulations, in return for the benefits which I expected to receive from them, and I did not leave there because of any trouble with the rules or the administrators thereof. The officers and agents of the company were gentlemen; but when it comes to saying that Pullman is the best and cheapest place for the working classes to live in, and that it is mere pigheadedness on the part of workmen that they will not see it, I beg leave to differ.

Wherein, then, it may be asked, do the difficulties of the Pullman problem lie? You say that a return of six per cent. upon the investment will insure the permanency of the Pullman enterprise, and the tenor of your article and other circumstances indicate that the company are fully determined to have this six per cent. It appears that this interest is to be upon the $13,500,000 invested in building this beautiful city. Who has to pay this interest? The inhabitants of the city. Who are the inhabitants of the city? The working classes. Now, does it not look upon the face of it as if this is a pretty heavy debt for the working classes of a small city to assume? Would you, Mr. Editor, advise aspiring, enterprising mechanics to locate and remain in a city of 8,000 inhabitants which had a bonded debt of $13,500,000? You have stated the case exactly, and, in my opinion, it is the determination of the company to exact this payment, they having the monopoly of owning the city, whereby they expect to enforce the payment—that makes the trouble. Where else is this revenue to come from than from the working classes? Wherein is the difference between this and the landlord and tenant system of Ireland, where the landlord must have his rent, no matter at what cost to the tenant?

F. J. MASTEN.

Belmont, N. Y.

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A GREAT ENGLISH RAILWAY.

The Midland Railway Company of England owns and works 1,700 locomotives, and employs 46,000 men of all classes. Some account of the methods employed in the repair shops at Derby are here appended, and will be found interesting to American readers. We quote from the London *Engineer:*

Passing into the foundry, the moulding of chairs was seen, and to the surprise of some visitors this work is done by hand. With boxes or flasks about 2 in. wider and longer than the exterior dimension of the chairs, the quantity of sand used is not large. The iron pattern is laid on a board, the flask placed round it, a little facing sand put in, covered with body sand with a shovel, the handle of which is formed into a rather large pegging rammer. A little more sand is thrown in, flat-rammed with the shovel, and scraped off with it. The operation is thus wholly of the ordinary kind, but it is performed so quickly, the top part of the mould being only a struck top, that the cost of the moulding is but 2s. per ton of chairs. The pattern easily leaves the sand, and the loose pieces by which the jaw is formed leave without any trouble. This cost of moulding does not leave much room for economy by machine moulding.

While passing through another part of the foundry, the unusual appearance in this department of a locomotive crank-shaft in a moulding box was observed. Inspection showed that it had had the four eccentrics cast upon it in their proper positions. The eccentrics are moulded in a box provided with guides for moulding them with the pattern in the right position, so that when the real crank-shaft is afterwards put into the box, it is held with the cranks at the proper angle. The shaft is placed in a vertical position, the part which is to receive the sheave having been only rough turned. This gives the sheave sufficient hold when it has shrunk on. This method has been adopted about a year, and so far with success, although some fear of blown castings, chill next the shaft, and of bursting after the sheaves were turned up, might reasonably have been entertained, especially as, we were informed, the shaft is not heated at all when put into the mould.

Passing into the boiler-shops, some excellent work was seen. The screwed copper stays are reduced in diameter at that part which is between the plates when screwed in, so that the time occupied in screwing them in is lessened, and the stays are not so liable to break. Among the engines in course of construction were some of a new type for heavy express passenger traffic. These have cylinders 19in. by 26in. The two cylinders are made in one casting, by which a good deal of weight and work are saved, but this has only become possible by the adoption of the Joy valve gear. These engines have 7ft. driving wheels coupled, and with 9ft. centers. These erecting shops and machine shops are 450ft. in length, and are provided with 25-ton traveling cranes worked by constantly running endless cotton ropes. The shafting in these shops is driven by wall engines at a pressure of 140lb. per square inch. They are coupled, direct to the shafting, but steam is exhausted at rather a higher pressure than would agree with the notions of most constructors of economical engines.

In the machine shops were seen several emery-wheel shaping machines, shaping and finishing the surfaces of the guides for the axle-boxes of the locomotives, guide-bars, and other parts. The use of these machines permits the use of chilled cast iron where so very durable and cheap a material could not otherwise be used, and the extent to which this class of machine is now used is worthy of remark. The holes in the boiler-tube plates are drilled with large twist drills guided by large thick templates, but twist-drills are not in general use yet. The fire-box roof bridges are of wrought iron, and are drilled from the under side about 2·5in. deep, and are tapped by the same machine. The stays are screwed into them from within the box. About ninety of these roof bridges were seen in one large planing machine, on which the ends where they rest on the vertical plates of the box were being shaped at one operation. A new machine by Messrs Craven Bros., for slotting out the crank and rough-turning the pin of the cranks, was seen in operation. Attached to the periphery of a strong disc is a number of round-nosed tools, which successively come into operation as the disc slowly revolves like a big cutterhead, while the crank itself, when the pin is being shaped, is also slowly revolved. The pin is in this way rough-turned, and the total cost of turning this is thus lessened. Wrought iron cranks are used, experience being that warning of their failure is more often given than with steel.

In a separate shop for case-hardening were seen long tanks containing water for cooling the coupling-rod ends and other parts of locomotives when taken out of iron retorts in which they are heated, the noticeable feature in this shop being that the tanks are provided with two screws, one at either end, on vertical shafts, by which the liquid is kept in rapid circulation. This secures a much better result than can be obtained when the water is not properly kept in motion. Tilghman's sand-blast process is used for sharpening files, and cleaning castings which have to be turned, such as the inside of axle brasses, to which it is necessary to make the bearing metal adhere.

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MINE WATER FOR STEAM BOILERS.

The lack of pure water for use in steam boilers, at this season, considerably embarrasses the mining superintendents and operators whose meager supply frequently becomes almost entirely exhausted during the summer months. Expensive reservoirs and long lengths of pipes have, in not a few instances, been constructed out of necessity, with a view of overcoming the incommodity incident upon the scarcity of water. Four or five years ago operations were frequently suspended at collieries in various parts of the anthracite region because there was not sufficient water to maintain them in working order. This state of affairs led to numerous experiments with mine water, which was at first used in an impure condition, but which most rapidly corroded the iron of the expensive boilers and pipes with which it came in contact. Some of the mine water in the lower anthracite region was found to be so strongly impregnated with acid that it would ruin a set of boilers within 48 hours. The Philadelphia and Reading Coal and Iron Company, recognizing the necessity of making provision for an ample supply of water at all seasons of the year, employed a chemist to endeavor to purify the mine water. A systematic study of the subject was undertaken and resulted in discovering a process by which mine water can be made quite suitable for boiler use at a small cost. This process was published in the *Mining Herald* nearly two years ago, but having received numerous inquiries concerning it, in addition to requests for its republication, from various bituminous regions in other States, we append the essential parts of it for the benefit of those who may still be unacquainted with it. It is not patented, and any superintendent or operator who may desire to do so can give it a trial.

The least quantity of acid in water is injurious to iron. One grain of sulphuric acid to the gallon, it is estimated, will ruin a boiler within a year, unless frequently blown off. Mr. J. C. A. Fox, the chemist employed by the P. & R. C. & I. Co., found by analysis that the amount of acid contained in the mine water of the different collieries in the Schuylkill region varied from 12 to 200 grains per gallon. The amount of acid having béen determined, he sought the cheapest and best alkali, and calculated the amount necessary to neutralize the acid. Lime was found the most desirable, because least insoluble. Soda or potash will serve the purpose as well as lime, but the sulphates which are formed are entirely soluble in water and would occasion large deposits on evaporation. The sulphate of lime is also soluble, but to a very slight extent, one part of sulphate of lime being soluble in 400 parts of water.

The process may be described as follows: The mine water is pumped into a tank, and lime,slacked and reduced to a creamy consistency with water, is added,the amount varying from $\frac{1}{4}$ of a peck to $\frac{1}{2}$ of a bushel for every 4,000 gallons. When sufficient lime has been added the contents of the tank are stirred until thoroughly mixed and the mixture is then allowed to settle until perfectly clear. The time required for settling varies from $\frac{1}{2}$ hour to 5 hours, according to the amount and nature of the deposit. After settling, the water is drawn off into another tank, from which it is pumped or injected into the boilers. The deposit or settlings are then removed from the tank, which is refilled and again operated upon. Where a large quantity of water is used, two, four or six tanks are employed and are filled and settled alternately.

Care should be taken to add just sufficient lime so that the water will have no effect on litmus paper, either the red or the blue. If insufficient lime had been added, the blue paper will turn red, and if too much lime the red will turn blue. Litmus paper is the best test to use for acid or alkali in this process. A positive test for detecting sulphuric acid is: Add to the water suspected of containing sulphuric acid a strong solution of chloride of barium, when, if any acid is present, it will be precipitated in the shape of sulphate of barium, a white powder; but for purifying mine water upon a large scale, blue litmus paper is a sufficiently delicate test for acid. The paper is put into the water and moved around for a half minute. If the color of the paper does not change to red, no acid is present. This is not a positive test when minute quantities of acid are present; however, when such water is evaporated in a boiler, if blue litmus paper is placed at the guage cock it will turn red. As previously stated, the quantity of lime necessary to be added is gauged with litmus paper, the change of the blue paper to red showing that too little lime has been used, and the change of the red to blue showing that too much has been employed. It is in carefully guarding against the use of too little or too much lime, and thus obtaining water for use in the boilers as nearly pure as possible, that the secret of success lies. It is better, however, that there should be too much than too little lime used. If there is not sufficient lime the acid will eat away the iron, which cannot be replaced, but if there is a small excess of lime the only ill consequence is a little more dirt in the boilers.

In making steam from water purified by this process a small deposit will form in the boilers, which will require them to be cleaned out about once a month. If, however, the water is put through a heater, before entering the boilers, and raised to a temperature of from 280° to 320° Fahr. [these temperatures represent pressures of 45 lbs. and 90 lbs. respectively, and would require a separate boiler.—Eds. MECHANICAL ENGINEER] it will be rendered as fresh and pure as rain water, and will neither eat the iron nor form scale or mud.—*Mining Herald.*

CALIPERING UNDER THE MICROSCOPE.

The practicability of "calipering" under a microscope has long been urged by Professor Rogers as being the only exact method of inspecting standard gauges. The result obtained by use of this method, combining, as it does, science and practice, has demonstrated beyond any question, the simplicity, as well as the accuracy of the method. To give some idea of its value for the purpose of originating standard sizes, an instance in mind may be stated.

A number of cylindrical gauges, commonly called plugs and rings, were made. They were finished to agree with the subdivisions upon this little hardened steel line measure standard. Nearly eighteen months afterward, a new lot of the same sizes were made, and upon trial it was shown that any ring of the first lot fitted perfectly any plug of the second. Both lots had been made without reference to any intermediate standard set of plugs, except to "rough them out," as it is called, within about $\frac{2}{10000}$ of an inch, all finishing after this having been done from data determined by calipering under the microscope.

A good gauge fit is not that the ring shall slide freely over the plug without perceptible "shake," but such an one that the ring, when well lubricated with sperm oil, shall move easily after having it fairly on the plug, showing no tendency to "grip" while the ring is kept moving. Let the ring, however, stop moving even for a second, and this condition of an apparently easy fit is suddenly changed to a driving fit, often causing serious damage to the gauge in separating them. In order to show this condition of perfect fit to best advantage, the temperature, of course, must be the same for both. The surfaces of the plug and ring must be as hard as steel can be made, and polished as carefully as the state of the art will admit.

A good way of testing the accuracy of any set or pair of cylindrical gauges in reference to their being aliquot parts of any adopted standard, is to place within a ring which fits a standard plug, two smaller size gauges, and if their sum is equal to the diameter of the larger single gauge, they will be tangent to the ring also. If exactly right, they will be found to hold together tightly.

A thousandth of an inch, one may say, is almost not worth considering, but here I have a standard plug and ring, the ring fitting perfectly. I now insert the plug, which is only $\frac{1}{1000}$ of an inch too small; it can be literally thrown on or off; one might even say that it "fairly rattles," the difference seems so great as compared with the fit of the standard.

I have here a $\frac{3}{4}$-inch plug, it is only $\frac{3}{10000}$ of an inch smaller than the standard, the plug and ring representing which we also have. It is not so loose as was the inch plug $\frac{1}{1000}$ small, but still one-third of this is perceptible, and shows plainly that it does not perfectly fit the ring.

With a 2-inch gauge, a variation of $\frac{1}{20000}$ of an inch is imperceptible, when a ring is used to determine this small difference, while, with a caliper gauge, having polished parallel jaws, this minute difference may be readily detected, if the caliper be first carefully adjusted to a standard 2-inch cylindrical gauge.

To convey some idea of the minute variation which may thus be detected, I may state that a fragment of gold leaf, so thin that a mere touch of the fingers caused its total disappearance, on being carefully measured under the microscope, showed that its average thickness was $\frac{1}{30000}$ of an inch. This same gold leaf would actually float in the air like a spider's web, and yet this extreme "thinness," if it may be so termed, is actually twice the limit of error within which it is possible to duplicate standard plug gauges, referring them to a line measure under the microscope.

The lines ruled upon this standard line, measure-bar, in the space covered by the first 2 inches, 2,500 per inch, if placed 1 inch apart, the lines being magnified in proportion, would be represented by furrows or marks $\frac{1}{10}$ of an inch wide, and would extend over a length of 416 feet 8 inches, or nearly $\frac{1}{12}$ of a mile.

The application of standards of length to ordinary workshop practice has so wide a range that it would be impossible to attempt an enumeration of the many forms necessary to secure three important elements, cheapness, serviceableness, and accuracy, even in a single department of work requiring interchangeability of parts, as for instance the manufacture of sewing machines, or the results obtained by the use of standard gauges in the manufacture of firearms.

The gauges are the means provided for keeping within bounds in the production of thousands of pieces of the same size or shape, in which oftentimes a certain amount of variation is allowed, both plus and minus. Standard gauges prevent the gradual slipping away from the original size, and serve to bring back within the limit, variations of size, which would cause endless trouble and no small loss in the final assembling of these intended interchangeable parts.

This accurate fitting is only really necessary in gauge work, for if bearings or other parts of machinery were so closely made they would not move, or if by applying power enough they should be started, the absence of oil and the effect of the cohesion would quickly ruin the surface in contact.

A certain amount of "looseness" must be allowed, and by making the journals and the bearings in which they run, to certain definite sizes for each, the journal as many thousandths or ten thousandths of an inch smaller as the size or length of bearing may require, referring each to some particular gauge as a standard. This being done, no fear may be entertained that other than a satisfactory fit may be the practicable result. *Geo. W. Bond.*

THE SIX GATEWAYS OF KNOWLEDGE.—No. IV.

Now sense of light and sense of heat are very different; but we cannot define the difference. You perceive the heat of a hot kettle—how? By its radiant heat against the face—that is one way. But there is another way, not by radiant heat, of which I shall speak latter. You perceive by vision, but still in virtue of radiant heat, a hot body, if illuminated by light, or if hot enough to be self-luminous, red-hot or white-hot, you see it; you can both see a hot body and perceive it by its heat, otherwise than by seeing it. Take a piece of red-hot cinder with the tongs, or a red-hot poker, and study it; carry it into a dark room, and look at it. You see it for a certain time; after a certain time you cease to see it, but you still perceive radiant heat from it. Well now there is radiant heat perceived by the eye and the face and the hands all the time; but it is perceived only by the sense of temperature, when the hot body ceases to be red-hot. There is then, to our senses, an absolute distinction in modes of perception between that which is continuous in the external nature of the thing, namely, radiant heat in its visible and invisible varieties. It operates upon our senses in a way that I cannot ask anatomists to admit to be one and the same in both cases. They cannot now, at all events, say that there is an absolute continuity between the retina of the eye in its perception of radiant heat as light, and the skin of the hand in its perception of radiant heat as heat We may come to know more; it may yet appear that there is a continuity. Some of Darwin's sublime speculations may become realities to us; and we may come to recognize a cultivable retina all over the body. We have not done that yet, but Darwin's grand idea occurs as suggesting that there may be an absolute continuity between the perception of radiant heat and by the retina of the eye and its perception by the tissues and nerves concerned in the mere sense of heat. We must be content in the meantime, however, to make a distinction between the senses of light and heat. And indeed it must be remarked that our sense of heat is not excited by radiant heat only, while it is only and essentially radiant heat that gives to the retina the sense of light. Hold your hand under a red-hot poker in a dark room: you perceive it to be hot solely by its radiant heat, and you see it also by its radiant heat. Now place the hand over it: you feel more of heat. Now, in fact, you perceive its heat in three ways—by contact with the heated air which has ascended from the poker, and by radiant heat felt by your sense of heat, and by radiant heat seen as light (the iron being still red-hot). But the sense of heat is the same throughout, and is a certain effect experienced by the tissue, whether it be caused by radiant heat, or by contact with heated particles of the air.

Lastly, there remains—and I am afraid I have already taxed your patience too long—the sense of force. I have been vehemently attacked for asserting this sixth sense. I need not go into the controversy; I need not explain to you the ground on which I have been attacked; I could not, in fact, because in reading the attack I have not been able to understand it myself. The only tangible ground of attack, was, that a writer in New York published this theory in 1880. I had quoted Dr. Thomas Reid, without giving a date; his date chances to be 1780 or thereabouts. But physiologists have very strenuously resisted admitting that the sense of roughness is the same as that muscular sense which the metaphysicians who followed Dr. Thomas Reid in the University of Glasgow taught. It was in the University of Glasgow that I learned the muscular sense, and I have not seen it very distinctly stated elsewhere. What is this "muscular sense"? I press upon the desk before me with my right hand, or I walk forward holding out my hand in the dark, and using this means to feel my way, as a blind man does constantly who finds where he is, and guides himself by the sense of touch. I walk on until I perceive an obstruction by a sense of force in the palm of the hand. How and where do I perceive this sensation? Anatomists will tell you it is felt in the muscles of the arm. Here, then, is a force which I perceive in the muscles of the arm, and the corresponding perceptivity is properly enough called a muscular sense. But now take the tip of your finger and rub a piece of sandstone, or a piece of loaf sugar, or a smooth table. Take a piece of loaf sugar between your finger and thumb, and take a smooth glass between your finger and thumb. You perceive a difference. What is that difference? It is the sense of roughness and smoothness. Physiologists and anatomists have used the word "tactile" sense, to designate it. I confess that this does not convey much to my mind. "Tactile" is merely "of or belonging to touch," and in saying we perceive roughness and smoothness by a tactile sense, we are where we were. We are not enlightened by being told that there is a tactile sense as a department of our sense of touch. But I say the thing thought of is a sense of force. We cannot away with it; it is a sense of forces, of directions of forces, and of places of application of forces. If the places of application of the forces are the palms of the two hands, we perceive accordingly, and know that we perceive, in the muscles of the arms, effects of large pressures on the palms of the hands. But if the places of application are a hundred little areas on one finger, we still perceive the effect as force. We distinguish between a uniformly distributed force like the force of a piece of smooth glass, and forces distributed over ten or a hundred little areas. And this is the sense of smoothness and roughness. The sense of roughness is therefore a sense of forces, and of places of application of forces, just as the sense of forces in your two hands stretched out is the sense of forces in places at a distance of six feet apart. Whether the places be at a distance of six feet or at a distance of one hundredth of an inch, it is the sense of forces, and of places of application of forces, and of directions of forces, that we deal with in the sense of touch other than heat. Now anatomists and physiologists have a good right to distinguish between the kind of excitement of tissue in the finger, and the minute nerves of the skin and sub-skin of the finger, by which you perceive roughness and smoothness, in the one case; and of the muscles by which you perceive places of application very distant, in the other. But whether the forces be so near that anatomists cannot distinguish muscles, cannot point out muscles, resisting forces and balancing them—because, remember, when you take a piece of glass in your fingers every bit of pressure of every ten-thousandth of an inch pressed by the glass against the finger is a balanced force—or whether they be far asunder and obviously balanced by the muscles of the two arms, the thing perceived is the same in kind. Anatomists do not show us muscles balancing the individual forces experienced by the small areas of the finger itself, when we touch a piece of smooth glass, or the individual forces in the scores or hundreds of little areas experienced when we touch a piece of rough sugar or rough sandstone; and perhaps it is not by muscles smaller than the muscles of the finger as a whole that the multitudinousness is dealt with; or perhaps, on the other hand, these nerves and tissues are continuous in their qualities with muscles. I go beyond the range of my subject whenever I speak of muscles and nerves; but externally the sense of touch other than heat is the same in all cases—it is the sense of forces and of places of application of forces and of directions of forces. I hope now I have justified the sixth sense; and that you will excuse me for having taxed your patience so long in not having done it in fewer words.

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GOVERNMENT ENGINEERS.

Government engineers in England are a peculiar class, we judge from the vigorous analysis appended of their shortcomings. We quote from the *London Engineer:*

There has always been an antagonism between the routine of Government systems and the practice of engineering. Attempts have been made to tie down the forces of nature, and the forces of nature have had the best of it, and they have been hated accordingly. Let us take, for example, the introduction of steam power into our fleets. Nothing can be imagined more distasteful to the seamen of the time. Captains did not understand it. To them it was an unmitigated nuisance. Although the wind and the sea might not be very obedient, the sails of a ship were, at all events, entirely under the captain's control. The steam engine was not. We have heard of a captain who wanted to court-martial his chief engineer because he did not get up steam in one hour. As the captain told him, the ship could have been covered with canvas in three minutes after his order was given to make sail, yet he must wait three hours for steam. The introduction of machinery into war ships was followed very tardily by the introduction of new sailing orders and new tactics. An endeavor was made to carry out in the engine room and the stokehold a system of discipline that only applied to sailing vessels. If some men in authority had had their way, engineers would have worn swords in the engine room. × × × ×

Take, for example, the absurd stipulation that the plummer blocks for an earth wagon* are to be machined on the faces bolted to the timber side-frames. No doubt on some former occasion plummer blocks had to be fitted to iron plates, and were machined to make a good fit. In Government eyes a plummer-block is a plummer-block, whether for a crank-shaft or an earth wagon, and if one is machined, that constitutes a precedent, and all must be machined. It was once found useful to send out a good many tracings of rolling stock. The precedent thus established, the fiat went forth, and thousands of square yards of tracing cloth are yearly sent to India, covered with detailed drawings of locomotives and rolling stock. The tracing cloth alone for one order of this kind cost £45. It is perfectly well understood that these drawings are left to rot when they reach India, or supply food for white ants.

If we turn to the marine department of the Board of Trade, we shall find plenty of examples of the automatic manner in which work is performed, without any elasticity of practice or of action. If the Board of Trade rules for marine boilers applied to locomotives, and were enforced, it is questionable if a speed of thirty miles an hour could ever be exceeded. Fireboxes an inch thick would be demanded. Boilers now carrying, day after day, for years, pressures of 140 lb., would not be passed by a Government inspector for 60 lb. The wooden-jointed way in which the Board acts is admirably set forth in the reports on boiler explosions now published periodically. Every casualty is an "explosion." The blowing out of a lead plug is an "explosion;" the bursting of a mineral oil still by the application of a light to the gas it contained when empty of oil, is a "boiler explosion." The comments made on true explosions are often ludicrous in their simplicity. Thus, not long since the whole class of vertical boilers was condemned in sweeping terms, because it happened that one exploded.

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"LIBERTY ENLIGHTENING THE WORLD."

This famous copper statue will soon arrive in this country, and, as is generally known, it is the gift of France to America. It is to stand at the entrance of New York harbor. We append some details of dimensions from a foreign paper:

"The figure alone, in sheer height, clear of all reckoning for the coronet, stands 105 feet; the extreme length, from the sole of the foot to the end of the torch in the outstretched hand, is 137 feet 9 inches; the pedestal of granite will be 83 feet high, and the two together give a total of 220 feet for the entire work. The work has been going on eight years in a great workshop built specially for it. The further the coppersmiths advanced with their task the more lilliputian they became in relation to it. What were men, for instance, in that awful eye measuring 30 inches from corner to corner! A 6-foot man standing on the level of the lips only just reached the eyebrow. While they were working on the crown of her head they seemed to be making a huge sugar cauldron, and they jumped with ease in and out the tip of the nose. Fifteen people might sit round the flame of the torch, and they would reach that elevation by a spiral staircase within the outstretched arm. × × × ×

"It was decided to make it of plates of copper—only an eighth of an inch thick—forming an inner and an outer skin about a foot apart, and to fill the space between them with sand, especially toward the base, so as to give the statue the requisite solidity. The two skins are kept in their places by a gigantic skeleton framework in iron, running from the basement to the crown of the head. This iron frame is to be carried up into the extended arm, which has all along presented a mechanical problem of peculiar difficulty, its leverage, with the weight of the torch, being very great indeed. The framework, therefore, runs down almost to the center of the body, and well below the center of gravity.

"Some people think the statue will never stand, and that the winds will play havoc with it. It is not solid enough, and never can be with its epidermis of mere copper and sand. If it could not be in solid metal like the older works, it might have been in masonry or wood covered with copper plates. But this is a question for engineers rather than for artists, and the engineers are quite convinced that 'Liberty' will resist the Atlantic storms."

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FACTS ABOUT THE ACCIDENT AT THE SOUTH BOSTON FOUNDRY.

Our readers may have read in the papers of the day accounts of the failure of a large gun casting in Boston; the facts in the case are interesting, and convey warning to others in similar business. We quote from the *Iron Age:*

"The mold being in readiness, and every precaution which experience and foresight could suggest having been taken to guard against mishap, the furnaces were tapped, and in 30 minutes the 120 tons of molten iron flowed through into the mold, forming a column 4 feet 9 inches diameter at the bottom, and 3 feet 7 inches at the top, and 39 feet high. The operation was so satisfactory that congratulations were exchanged and visitors left. About an hour later, when only a few workmen remained in the foundry, the iron flask which held this column of iron gave way near the bottom. Of course the 40-foot column settled and became a *cheese* some 13 feet diameter and 6 feet thick, filling the bottom of the pit. As the pit was perfectly dry there was no explosion, but, unfortunately, some of the iron found its way into a flue, made for conducting gas and smoke from the bottom of the pit to the foundry floor, and at the bottom of this flue there must have been moisture, as some 100 pounds of molten iron was thrown through this flue to the roof of the foundry and instantly set it on fire. The roof was burnt off and fixtures damaged by the fire; but this mass of 120 tons of iron in the bottom of a 40-foot pit (32 feet below tidewater) is an incumbrance that will require engineering skill to dispose of, and no doubt serious expense.

"As the pit will have to be cleared before we can recast the gun, much delay will be experienced. As the flask proved strong enough to resist the pressure for an hour after it was subjected to it, I conclude that the expansion of the iron flask against the fastenings as the heat gradually reached it proved 'the last straw that broke the camel's back.'"

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An Idea Of The Extent to which cotton thread is used can be had from the fact that one mill made, in one month, over 11,000,000 spools.

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* We should like to be told what an "earth wagon" is; is it a wheelbarrow, for instance?

REPORT ON THE ELECTRIC LIGHTING OF THE UNITED STATES STEAMER ALBATROSS.

By Passed Assistant Engineer G. W. Baird, U. S. N.

The steadiness and uniformity of brightness of the lamps depend almost entirely on the engine driving the dynamo, and the success of the system lies more in the attention paid to the engine, where the plant is correctly installed, than anything else. Uniformity of speed is the great object sought, and to secure this Mr. Edison has adopted a high-speed engine, with a sensitive governor and a single steam-cylinder, $8\frac{1}{2}'' \times 10''$ diameter; it runs 300 revolutions per minute very uniformly, the automatic cut-off regulating the quantity of steam admitted to the load on the engine. This particular engine is larger than should be employed for this plant, as the short cut-off at high pressures and light loads causes great cylinder condensation, not only diminishing the economy, but causing such incessant hammering in the cylinder that I have been obliged to introduce a pressure-regulating valve, which limits the pressure to what is desired. Previous to introducing this valve, two cross-head keys had been sheared off and one cross-head broken by water in the steam cylinder. The Edison Company furnished drawings for the setting of the engine and its foundation, which design I followed implicitly. The plant is so installed as to bring the driving side of the belt on top, so that the slack falls from the pulleys. This results in slipping, particularly as the belt stretches, and when the arc lamps are thrown in circuit the belt slips and the dynamo often slows down from 1,200 to 1,000 revolutions per minute. I procured a heavier belt, but the stretch soon introduced slipping. I then had a tightener put in. This has been of great assistance, but it augments the stretching of the belts very much. I then resorted to doubling the belts, *i. e.*, running one belt on top of the other; this diminished the slipping, but the belts tend to separate and run off in opposite directions; to prevent this we have improvised guides.

The wiring has required but little attention; in several places the deck leaked and the salt water short-circuited, but there have been no serious mishaps. The trouble from this cause, however, has resulted in the destruction of the nearest cut-out plug, thus preventing damage to the wire; in such cases I added insulation to the wires to prevent a repetition of the accident.

A few lamp sockets have burnt out, principally from arcing, and a few have been broken by accident. I provided myself with a number of the various-sized screws used in these sockets and have been able to repair them. The arc lamp has destroyed two of these sockets, probably by arcing through the socket as the circuit was opened or closed. For this reason I have substituted two key sockets for two ordinary sockets at points where the arc lamps were attached, and am now making a special attachment which I think will eliminate this difficulty. × ×

By indicating the engine I find the economy to be practically uniform. When using 45 lamps we get 7·77 per indicated horse-power; when using 50, we get 8·5 per indicated horse-power; and when using 70, we get 10·11. We have not, to my knowledge, ever used more than 70 lamps at one time, though there are 140 in the plant. The average number of lamps in daily use is about 47, for which purpose we consume about 21 pounds of coal per hour, and use, on an average, two-thirds of a gill of oil. Assuming this to be correct, the cost of running the lights for the year has been as follows:

The dynamo was in operation 1,592 hours and 45 minutes, during which time the consumption of coal for this purpose was 14 tons 2,082 pounds, at a total cost of $68.67.

The oil used during the same period and for the same purpose is estimated to be 67 gallons, the mean cost of which was $72\frac{1}{2}$ cents per gallon, making the total cost for oil $48.57.

The cost for repairs, preservation, and restoration has been $231.23.

This does not include the cost of lamps and shades, which do not come in my department. Deducting the cost of the piston valve, pressure regulator, and cross-head [incident to an original error], and also the cost of the deep-sea lamps, cigar-lighter plugs, and attachment plugs, which do not form part of the ship's illumination, leaves the cost of the light, in candle-power, per hour $\left(\frac{14013}{1592 \cdot 75 \times 47 \times 8} = \right)$ 0·0234 cents. This is less by about 40 per cent. than the bare cost of an equivalent amount of gas-light in Washington City.

The steadiness, brilliancy, and convenience of the light is all that can be desired, while its hygienic advantages over gas or oil-lamps is very great. When it is remembered that an ordinary gas-jet consumes about as much air as six men, and that the breathing-room *per capita* on board ship is so contracted, there ceases to be any comparison between our incandescent electric light and all other means of illumination viewed from a hygienic point. The convenience of being able to light a lamp without fire is great, and the safety of the system, especially at sea, makes it very valuable. The cheerful appearance of the interior of the ship when thus illuminated, as compared with the interior of other ships lighted with oil lamps, marks a most agreeable contrast and goes far towards lightening the burden and easing the yoke of a life at sea.

Our submarine lamps have been useful in attracting amphipods, squid, young blue fish, silver-sides, &c., into the nets, when used near the surface.

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HOW LOCOMOTIVE ENGINEERS ARE TRAINED.

At the last meeting of the Master Mechanics Association, Mr. Flynn, of the Western & Atlantic R. R., gave the following account of his system of training engineers:

"Engineers should do ordinary repairs, such as packing the stuffing-boxes, etc. We do not allow them to meddle with the boxes. The fireman learns from seeing the engineer do the work, and if intelligent, can move his engine into a siding when disabled. A young machinist knows virtually nothing about running a loaded train regularly between stations, up and down grades, and should fire for some time in order to learn the management of trains, the control of the train, how to stop, and what distance to stop in.

"We would select engineers from our machinists, but the trouble is they have too much confidence in their own abilities. If young men are selected, as recommended, they go into the round-house first as wipers and floor-sweepers, or anything to make them useful in a general way, and assist around the engine-house, by which they will get some general knowledge as to the operation and manipulation of engines. After they have worked there for six months or so, and are apt, industrious boys, we take them into the machine shop, not as apprentices for machinists, but as general helpers, and make them work around the pits, to take down and put up the engines and help the men generally, so as to get familiar with all the parts of the engine. We keep them there from six months to a year, and if they develop satisfactorily, we then send them to fire. It depends then entirely on their own exertions whether they ever are promoted to be engineers or not. Some are and some are not; and when we discover that some man is not going to develop into an engineer, we generally set him on one side and do not allow him to continue on an engine. That is my present practice. It may not be the best possible; I am still feeling my way to a more perfect system. × × × ×

"Every engineer has to set out his own packing, set up his wedges, and make the current repairs on his own engine. It is impossible for a man to do that unless he has more knowledge than can be obtained from firing with some very indifferent engineers. That system worked very well, and the men thoroughly understood that no foreign men would be employed at all so long as we had material of our own ready to fill the position. We received plenty of applications. Every one wanted to be a fireman. In four or five years every man in the employ of the road could have left his engine, and we could have double-manned every engine with competent, steady and sober men.

"If this plan was carried out universally, engineers could not obtain employment when out of a job. But when a company discharges an engineer, and refuses to reinstate him, he is generally an unprofitable man for any road. I look with suspicion on every man who has been on many roads. I ask, 'Why did you quit?'

"'I thought the old man did not like me.'

"I generally concluded that this old man might get the same idea in time."

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CHARLES READE'S SCRAP HEAP.

In one corner of his workroom is a pile, in hopeless confusion, of the folio boards from which Reade used to work when writing his novels. These do not represent a tenth part of the cards, for many of them have been lost or destroyed. They are of different sizes, from a yard to a couple of inches in length; some are in his own handwriting, but most of them are transcribed in a neat and legible round hand by a copyist. They are divided into columns, and in most cases lines have been ruled at right angles to these, so as to give its proper position to each subject. But it would be impossible in our small space to give any idea of the method of classification pursued. The books consulted for the particular novel upon which he was engaged are given according to the subjects. They contain innumerable references to histories, encyclopedias, books scientific and monetary, novels, and references to scrap books, newspapers and magazines. The key to these aids to novel writing is lost, but no one can turn them over in the most casual manner without being struck by the enormous labor that has been spent upon their preparation. Here he will find hints for dialogue, catchwords and phrases there; bits of conversation, a scrap here and a scrap there. The following collection of household words is taken from one of the cards, and will serve as an example:

"Pshaw"—"Stop your noise"—"Shut up this minute!"—"Go away!"—"Get away!"—"Get out!"—"Never mind"—"You'll catch it"—"Don't bother!"—"Come here directly!"—"Put away those things"—"You'll kill yourself!"—"I don't care"—"Mind your own business"—"I'll tell ma!"—"You mean thing!"—"There, I told you so!"—"I will have it!"—"There, look what you have done"—"'Twas you!"—"Won't you catch it, though?"—"It's my house!"—"Who's afraid of you?"—"Mah-h-h!"—"Boo, hoo, hoo, hoo, oo!"—"What's the matter?"—"Get out of this room directly!"—"Do you hear me?"—"Dear me!"—"I never did see in all my born days!"—"It's enough to send one crazy!"—"Would you put a tuck in it?"—"Well, says I!"—"Says he!"—"Says she!"—"Says they!"—"Bless me!"—"No!"—"Hem it all this way round!"—"Three flounces"—"Gored"—"Worked crosswise"—"Trimmed with velvet"—"Ten yards"—"Cut bias"—"Real sweet."—*English Paper.*

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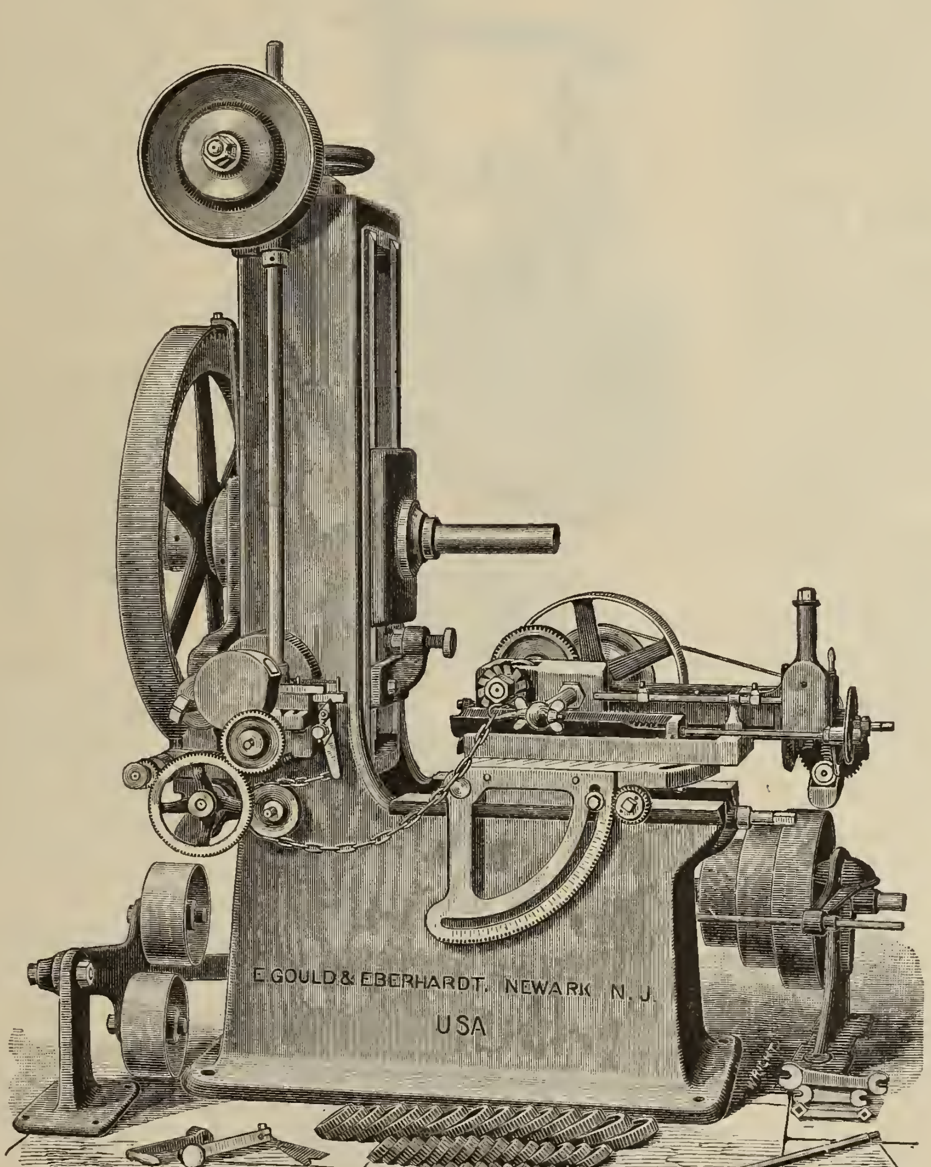
It is not our intention to describe in detail the mechanical movements by which these things are rendered possible. It is sufficient to enumerate the functions it performs as catalogued below, leaving to patent specifications the *A*'s and *B*'s of special parts.

The manufacturers say:

Before the introduction of this machine, it was necessary to cut gears by manual operations wholly. For instance, after having the blank wheel and cutter in position the workman must feed the cutter through by hand, withdraw it, then give the divisions on worm gear or dial, repeating this operation as many times as the wheel has teeth. With those gear cutters known as automatic feed, the workman goes through the same work with this exception: The cutter feeds itself through the wheel, then stops itself. The workman then withdraws cutter, gives the required divisions by hand, sets the self-feed and proceeds, again repeating the operation as many times as wheel is to have teeth. Nearly his whole time and attention must be given when in operation, because the machine only feeds the cutter through the tooth. Some machines are automatic in their movements, but they are designed and only fitted for some special work. It is to meet a general demand that our new universally automatic gear cutter has been designed, the result of years of practical experiment. With it we can cut without attention, either bevel, spur or worm gears, and after the machine has been set and started the cost of running it is nothing. First. Because the machine feeds the cutter through the wheel itself. Second. Because the machine draws the cutter out itself, and withdraws it 32 times as fast as it feeds it in. Third. Because the machine makes every change or division of worm wheel itself with perfect accuracy—it cannot make any mistake when properly set. In a hand machine mistakes are liable, and often occur. Fourth. Because the machine after it is done cutting a wheel, strikes a gong, thus notifying the workman to come and put in another wheel. This machine is fully warranted to be correct; the workmanship and materials are first-class. Address Gould & Eberhardt, Railroad Ave., Newark, N. J., for prices and sizes.


E. GOULD & EBERHARDT. NEWARK N. J.
USA

Gould And Eberhardt's Universal Automatic Gear Cutter.

◆

A French Paper states that a quantity of chloride of lime sent from France into Spain was carefully fumigated at the frontier by the zealous quarantine authorities of King Alfonso.

TO THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

The Third Annual Convention of the National Association of Stationary Engineers will be held in the city of Baltimore, Md., commencing on Tuesday, September 2d, 1884, at 10 A.M. Each Association is entitled to representation, as per Article 8, Sect. 2, of the National Association's Constitution. James G. Beckerleg, *President*, Chicago, Ill. 862 *Washington Boulevard.*

◆

The White Deposit that streaks the walls of brick buildings is a sulphate formed in several ways. In the opinion of some the sulphurous acid that is continually belched by chimnies combines with the potash, soda, lime, or magnesia in the brick. The sulphate is dissolved by rain-water, and spread over the surface of the walls. When the moisture has evaporated it remains in white patches. It is believed, also, that sulphate of soda is generated in bricks, from the clay with which coal-dust has been mixed to make them burn thoroughly, and that it is carried to the surface by capillary attraction. Whatever the substance may be, it should be kept off the walls, and one experimenter says that dilute muriatic acid, in the proportion of four parts to one, applied with a stiff broom, next washing it with clean water, again using a broom, and finally applying a coat of boiled linseed oil, will remove it.—*Building.*

◆

Mechanics Seem To Have Learned Prudence by adversity in former dull times. In Paterson, N. J., it is very dull, but the managers of the savings bank say the balance on hand is hundreds of thousands of dollars larger than ever before.

All Of Us Will Admit the truth of this from a master mechanic at the last meeting of the Association:

"A man who wishes to become an engineer should not be put on an engine unless he is a reliable man. It is our duty, as locomotive superintendents and master mechanics, to reject a man who we think will not fill the place worthily. I sometimes ask a young man who applies for promotion: 'How long is it since you have been intoxicated? or were you ever intoxicated?' and he has said it is about two months or so; but that he had sworn off. I say to him: 'You must not expect to be promoted unless you can establish at least as long a record for sobriety as I require of you to establish as a fireman.'

"I think this course should be adopted by us all. Most of the damage done by strikers is done through the influence of drink. Sober men will not wrong their employers or the traveling public. They are earnest men, good engineers and good citizens, and they are not going to throw away their positions for the chance of getting a slight increase of pay. They are men who are willing to talk the matter over, and you can do something with them. The less men know of whisky the better firemen and engineers they make. We cannot be too careful on that point."

An Ingenious Arrangement for facilitating taking down an old chimney was designed and put in use at the Middlesborough Iron Works, England.

The chimney had to be taken down from the top and the bricks lowered inside, as it was situated in a crowded locality. It was desirable to lower them without damage, as they were to be used again; lowering by ordinary mechanical means was too tedious and impracticable. The following device was adopted, which would allow them to fall by their own gravity, and at the same time be cushioned sufficiently to break their fall and prevent damage. An air-tight iron box was placed at the bottom of the chimney; this box was fitted with an air-tight door, mounted on hinges and closing on an india-rubber face, against which it was tightened by a wedge.

A wooden spout, also air-tight, was then fixed on top of the box and carried up the chimney. The inside of this spout was slightly larger than a brick, so that the air would cushion it sufficiently to break the fall and prevent damage. The air-tight box was opened, when full, at the bottom and the bricks removed. This device proved quite effective.

◆

A Reporter of the Cleveland *Herald*, on asking a railroad official why the irons used in splicing rails are called fish-plates, received the following answer: "When a sailor breaks a spar or anything that can be mended he places wooden sticks around it, just like splits used in setting a broken limb, wraps the whole firmly with cord, and 'fishes' it. So the iron bars bolted on either side of a track rail to make it stiff are called fish-plates."

"Wooden sticks" is good.—Eds.

SOLDERING ALUMINIUM.

The use of aluminium in the arts has been much restricted by our ignorance of any method of soldering it, either to itself or other metals. Now, however, a French engineer, M. Bourbouze, has discovered a way of effecting both classes of the operation with ease. The process consists in plating both surfaces to be soldered, not with pure tin, but alloys of tin and zinc, or tin, bismuth, and aluminium, &c. Good results are obtained with all such alloys, but those containing tin and aluminium are best. They should contain different proportions, according to the work the soldered parts have to do. For parts to be fashioned after soldering, the alloy should be composed of 45 parts of tin and 10 of aluminium, as it is sufficiently malleable to resist the hammer. Pieces thus united can also be turned. Parts which have not to be worked after being soldered, may be united with a soft solder of tin containing less aluminium. This last solder can be applied with a hot soldering iron, as one solders white iron, or even with a flame. Neither of these solders requires any prior preparation of the pieces to be soldered. It suffices to apply the solder, and extend it by help of the iron over the parts to be joined. When, however, it is desired to solder certain metals with aluminium, it is best to plate the part of the metals to be soldered with pure tin. It is sufficient then to apply to the part the aluminium plated with alloy, and to finish the operation in the usual manner.—*Engineering.*

◆

CONCERNING HYDROSTATIC TESTS OF BOILERS.

In an article in the *Iron Age* John W. Nystrom says:

In hydrostatic boiler tests the pipe between the pump and the boiler is generally made too small, which increases the force of impact and may overstrain the boiler if the pump is worked fast. The diameter of the pipe should not be less than that of the plunger, but it is better to make it larger. Sharp bends and friction in the pipe, air in the water and elasticity of the materials of which the boiler is made considerably diminish the force of impact.

Long suction-pipes very often give trouble by force of impact, which can be avoided by an air-vessel on the suction side of the pump.

When a pump is worked by crank motion, the force of impact of the water in the pipe may be reduced to no importance, depending upon the length of the pipe, but the velocity of the pump-plunger and length of the pipe may be of such proportion that the momentum of the water cannot keep time with the strokes, which may result in bursting of the pipe if the momentum is not relieved by air vessels.

When the pump is worked by hand and a lever, the velocity of the plunger is nearly uniform to the end of the stroke, where it suddenly stops, and the momentum of the water continues with its force of impact.

The force of impact can never be greater than the resistance against the water entering the boiler from the pipe. But if there is no elasticity in the materials of which the boiler is made, and the air in the water is compressed to a high degree, then the motion of the water in the pipe will be stopped in a shorter time, and thus increase the force of impact beyond the hydrostatic pressure from the pump, the index on the pressure gauge will thus be suddenly pushed forward and returned to the normal pressure. If there be a maximum hand on the gauge dial, that hand may be carried forward by its own momentum far beyond the maximum force of impact, and thus indicate a wrong pressure.

[The latter indication is never taken by inspectors.—Eds. M. E.]

◆

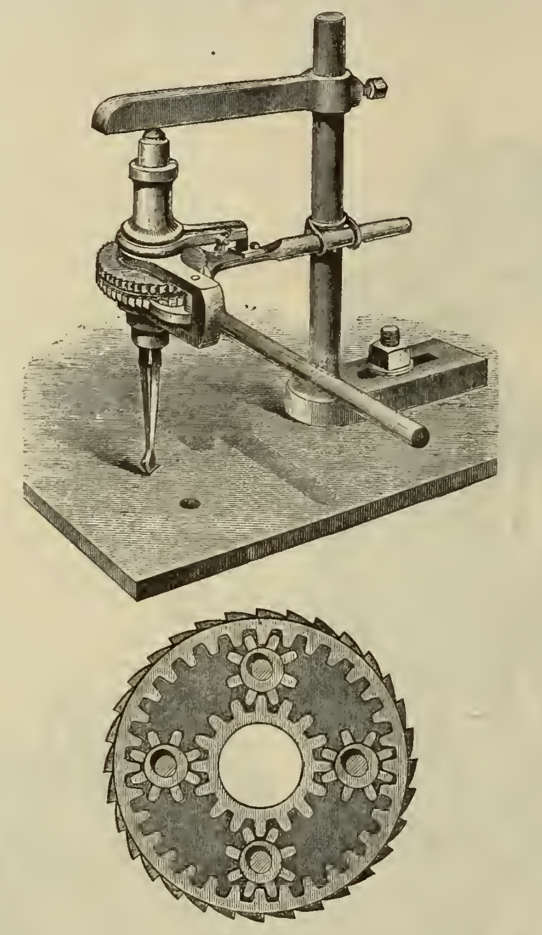
Pure Beeswax, when chewed, should have no disagreeable taste and should not stick to the teeth. In an adulterated wax, the nature of the foreign material can generally be detected by the taste; the addition of fat can usually be detected. If it sticks to the teeth the presence of rosin may be assumed.

◆

English Steel Guns of large diameter are bored and ground also, the grinding medium being sand, which is readily washed out. Emery is objectionable, because it becomes imbedded in the metal.

DOUBLE-ACTING RATCHET WRENCH.

If the back stroke of the ratchet wrench could be made to do half the work, then the time occupied by it would be no loss. As it is, however, the back stroke is wholly lost, unless we may consider the rest which the hand gets to be some set-off. Many attempts have been made to utilize the back stroke, but no simple arrangements have been brought out, and a complicated thing for this purpose will not answer. The feeding device is more difficult of arrangement in a double-acting wrench, and this has proved an obstacle to its production. The greater efficiency of such a wrench will compensate for some extra cost and weight, while some gain will also be made, which is due to the continuous action of the drill. A double-acting wrench illustrated herewith, has been brought out, with the object of overcoming the objections noted. It is constructed so that it can be used for speed or power; that is to say, to work fast for drilling small holes, or at slow speed for drilling large holes, this being effected by using one or both handles, shown in the accompanying engraving.



When holes above ¾ in. are to be drilled, one handle is made fast to the drill-post, as shown. The arms may be extended until they have 180 deg. between them, and in this way a 2 in. hole may be drilled with a 16 in. ratchet wrench, and a 1 in. hole through a ⅞ in. plate has been drilled with a 22 in. wrench. The wrench and its construction are clearly shown by the engravings above. From the section it will be seen that in one stroke the drill is driven by the ratchet and pawl direct, and in the other stroke by the other ratchet and pawl, through the intervention of the spur gear between the two ratchet wheels hollowed out to receive it. The action of the wrench is thus rendered continuous.—*London Engineer.*

◆

Respecting The Uniforms of conductors the Albany *Evening Journal* says:

"It beats anything I ever saw. Those men are as superstitious as the d—l in selecting badges. Why, there are conductors who think if they take an odd number in selecting a badge that it certainly will bring them an accident and that a fearful collision will result. In several instances, two conductors demanded two consecutive numbers; as they were particular friends they must be numbered in rotation.

◆

Ratchet Drills that operate on both motions, so as to keep the drill going continuously, are not specially useful, for the reason that a man cannot push so much as he can pull; if he puts on as much feed as he can pull through he is "stalled" when he comes to push.

THE WASHINGTON MONUMENT.

The Washington monument is now 507 feet high, and rapidly approaching completion. It is not ⅜ths of an inch from perpendicular. The foundation base has been extended since its commencement materially. A reporter of the Washington *Star* interviewed Col. Casey, who has charge of the work, in relation to this, and that gentleman said:

"The original foundation covered an area of 80 feet square, making 6,400 feet of bearing surface. It is now 146½ feet square at the bottom, giving 21,462¼ feet of bearing."

"Was there any deflection of the shaft from perpendicular while the delicate work of underpinning was in progress?"

"There was. Although but a small surface was left without support at any one time, never exceeding an area of 8 by 9 feet, yet the excavation of even that small space under the foundation would cause a perceptible inclination of the shaft toward the side under which it was. When this was walled up tight and a similar excavation made on the other side, the shaft would lean in that direction. And so, by careful working and watching we have only an inappreciable inclination of the now almost finished column."

◆

In Regard To Sight Feed Lubricators On Locomotives, Mr. Lander, of the Old Colony R. R., said recently:

"My experience is in favor of using the automatic cup located in the cab, under the eye of the engineer, with a sight feed and ordinary oil pipes leading to the steam-chests. A passenger engine with a lubricator is running 262 miles with one filling, or a quart of oil."

Another master mechanic said his engines run 520 miles with one quart of oil. The steam-chest covers have not been off for ten months.

◆

The *British Trade Journal* says that, within the past few days, manufacturers have been disturbed by an announcement that a discovery had been made which will enable yarn to be spun without the aid of the spinning-jenny. The correspondent adds: "There are perhaps £2,000,000 invested in spinning machinery alone. The inventor has not publicly exhibited his invention, but is willing to allow it to be tested by a committee. If the machine is as represented it will cause a great change, and revolutionize the trade."

◆

A THEORY OF LUBRICATION.

Walter R. Browne, an English investigator of some note, writes to the *Engineer* as follows:

Certain theoretical conclusions as to the nature of friction, in the case of lubricated surfaces, may perhaps be deduced. We may assume that the surface of the journal and bearing are divided from each other by a film of oil sufficiently thick to prevent their coming in contact; that this film is divided into two rings, one adhering to the moving journal, the other to the stationary bearing; and that the resistances, here called by the name of friction, are really those which occur at the bounding surface where these two rings meet each other. This is, in fact, a conclusion to which engineers have generally come from practical experience; and it is confirmed by a curious fact which occurred in the course of Mr. Tower's experiments. It was found that when a small hole was drilled down from above, through the brass bearing on which the load rested, the oil rose in this hole, and could not be kept from doing so, except by the application of a very great pressure—more than 200 lb. per square inch in that particular case. This proves the existence, at the point of greatest pressure between journal and bearing, of a film of oil capable of sustaining that pressure, and of being slowly squeezed out by it where an opening presented itself. It is clear that this film cannot be wholly at rest, but must be recruited from the oil bath below through the action of the rotating journal; otherwise the film would almost immediately have been squeezed out, and thus the whole of the journal would have become dry and would have seized.

We are therefore justified in assuming that there is, in the case of a completely lubricated journal, such as we are considering, a film of oil adhering to the outside of the journal, and another film adhering to the inside of the bearing. These two films are constantly sliding or shearing one past the other at the surface speed, whatever that may be, of the journal.

GREAT SUMS IN PATENT FEES.

Two members of one company spent in their individual interest, in a certain patent, over $87,000 each in fees.

Respecting litigation and the uncertainty of results in this line, the *Sun* says, in the matter of clinkerless grates:

"The head of the firm also examined them and determined to go into the manufacture. Spear demanded $10,000 a year for a license to use his invention. The Perrys thought this excessive; but in the meantime a lady had begun a search to ascertain whether Mr. Spear's patent was a good one. A patent had been granted three or four years before to a man living in a small town in Massachusetts, involving the same principle. An agent of the firm was sent there with instructions to buy it, but on arriving in the village he found that the inventor was dead, never having used his patent but in a single case, which was that of a church, in which he had placed a furnace. Something was wrong with it the first night it was used, for the ashes and coal were precipitated on the floor in the night, and the church was burned. That ended his experimenting, and inclined the heirs to dispose of their interests at a nominal sum. But of his half dozen children who held the right of the patent one had gone to Texas and his address was unknown. Armed with a photograph and a description, the agent sailed for Texas, and after two months' search found the man, from whom he purchased the remaining interest. Perry & Co. accordingly did not take out a license from Spear, but went on manufacturing the clinkerless grates without permission. They were immediately sued by Spear, a compliment which they at once returned. Other manufacturers also began making these grates, and were sued by both Spear and Perry. The novelty was, however, too taking for them to desist, and within two years every manufacturer in the United States was producing this kind of stove, under license from the Perrys or Spear, or as an infringer. Those who were sued as infringers formed an association to defend each other, the amount spent in litigation being enormous. Spear and the Perrys finally joined forces, but it was of little avail, for the Supreme Court of the United States decided that their claims were not good, and the making of clinkerless stoves is now free."

◆

WALL PAPER.

The manufacture of wall paper is carried on on a large scale in this city, one concern employing 350 hands and turning out over 2,000,000 eight-yard rolls annually, with an expense each year of over $50,000 for patterns and designs, and a weekly pay roll of nearly $8,000.

The magnitude of the business may be judged from the fact that over 1,200 tons of paper are annually used and more than 200 tons of color are required.

The printing is done upon four cylinder presses, the same as are used in printing textile fabrics. The patterns are engraved on copper cylinders, and by the arrangement of the presses, the number of revolutions of the various cylinders—each pattern being on an independent one—complete the paper, as many as 12 colors being worked at one process. Bronzing is done immediately after the printing and before drying.

◆

It Is Pretty Generally Known, now, that cream is extracted from milk, so soon as it is drawn from the cow, by centrifugal machines, similar in construction to those used for drying cloth, etc., etc. A little fact in connection with the process, however, shows the extraordinary change which takes place in fluids at high velocities. We quote from *Engineering*:

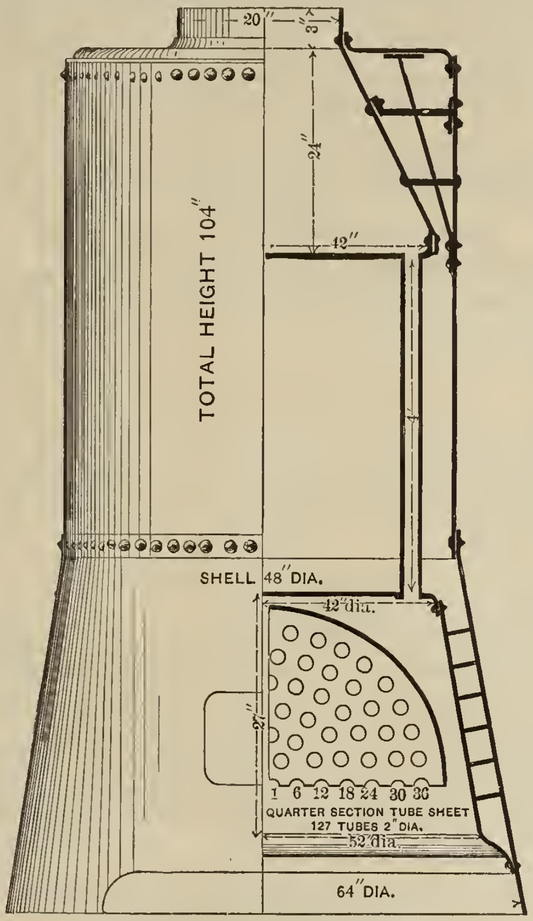
"The center part of the casing of the containing vessels is left open, and through the orifice thus left a tube can be projected, until it is brought in contact with the interior surface of the revolving mass of milk and cream, the latter of course being in the more central part, owing to its less specific gravity. The tube strikes the interior of the cream annulus at a tangent, and its edge therefore detaches a continuous stream of cream, which flows downwards through the bore of the tube into a suitable vessel provided for it. The action of the tube may be likened to that of a lathe tool turning out a piece of hollow work, and indeed so far is the similitude carried that, we are informed, the machine will spring or 'chatter' if the cutting edge of the tube is not kept fairly sharp."

◆

In An English Ordnance Works there are lathes capable of taking 44 feet between centers, and swinging 36″, another lathe takes a piece on the chuck 20′ in diameter, and 4′ 6″ long; or a job 34′ long and 8′ in diameter.

◆

Manufacturers desiring trade catalogues in superior style can obtain estimates of probable cost by addressing us. Engravings of machinery furnished at low rates for good work.



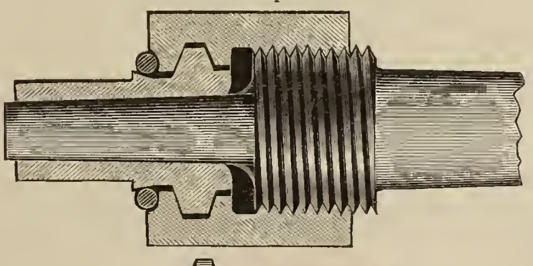
VERTICAL TUBULAR BOILER.

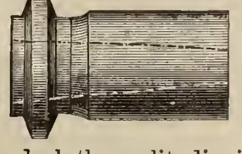
The engraving shows a vertical tubular boiler of 25 h. p., which will be found very efficient in service. Our correspondent says its action leaves nothing to be desired. All the dimensions are marked in plain figures.

◆

AN ENGLISH EXPANDING MANDREL.

The engraving represents a form of expanding mandrel manufactured in England. The body and taper spindle are forged of one piece of steel, and the steel nut has a recess in which the collar of the die rests. The die is split into three pieces after it has been bored, reamed, and turned to the desired diameter. In order to prevent dirt and chips entering between the die and the spindle, a spiral spring surrounds the die, and holds it in contact with the spindle. To secure the work on the mandrel, the split die is expanded by screwing up the nut, which draws the die along the taper spindle.





The grip or holding power of this mandrel is thorough, as the parallel die fills the hole in the job. The range of the mandrel can be readily increased by using split bushes on the die, which can be changed from one side to another in a moment. By cutting a thread on the die or on a split bush, large nuts can be squared on their faces true with the thread, and in less time than usual.—*Engineering.*

THE DUMBTALK.

Great progress has been made in the education of the deaf and dumb. An institution in Connecticut teaches such persons to speak as plainly as others not so afflicted. Through the aid of an ingenious alphabet (invented by the late Zerah C. Whipple), which pictures the organs of speech in the position they assume in producing audible sounds, the pupils are soon able to speak so as to be easily understood.

The most wonderful case of deaf-mute speaking in this country, and perhaps in the whole world, is a man about 60 years old, who lives about six miles from New London, Conn. The following account appeared in a paper published near his home:

"This deaf man possesses quick perceptions, with a fine intellect. He meets and converses with strangers, and they never mistrust that he is deaf. The only serious difficulty he encounters is a moustache, which hides the mouth. Evenings he has some trouble, especially when the face is shaded so that he cannot plainly see the movement of the lips. It is then he spends much of his time reading, often orally, to his family or invited friends. At a meeting held at Mystic River he was introduced from the platform and spoke to an astonished audience of over 5,000 people, who listened in breathless silence to the words of one who was born deaf and dumb. He once met a stranger near his home who asked him if there was a deaf-mute in that neighborhood who had been taught to speak, and he replied, 'I am the man of whom you speak, and you can judge for yourself.'

"This deaf mute was taught to speak by his father, the late Jonathan Whipple, who was the first in this country to make the discovery and demonstrate the fact to the people that deaf mutes may be successfully taught to speak and understand spoken words through the sense of sight."

◆

WOODEN WATER PIPE.

Respecting the durability of wooden water pipe, a member of the *Engineers' Club*, of Philadelphia, said:

The section, of spruce, was originally about 14 inches in diameter at the large end and somewhat smaller at the other, having a wrought-iron band about 1½ inches wide, ⅜ inch thick at one side and tapering to a thin edge at the other, so that it could be driven on or into the end of the log near the outer circumference. A piece of iron pipe 4 inches internal diameter and about 12 inches long, tapered to a thin edge at each end, served to connect the ends of two adjoining logs, which were driven over it end to end, and prevented from splitting by the iron bands around the ends of the logs. In some cases no interior iron coupling pipe was used; one log was tapered at the end and driven into the next one, which was prevented from splitting by the exterior iron band.

The 4-inch pipes, so far found, were of yellow pine, spruce and oak, of about 12-foot lengths, and from 12 to 24 inches in diameter, and supposed to have been laid between 1795 and 1805; the depths at which they were found varied from two to eight feet below the surface of the street.

The outer bark and heart wood of the spruce logs were generally sound, while the inner bark and sapwood were decayed, except where the soil was dry, gravelly or porous, when the greater part of the wood was decayed and the iron badly corroded. A specimen of red oak from a log adjoining the spruce one was decayed on the under side, but other portions looked nearly as fresh as if recently laid.

This is very useful information, and those interested should make a note of it.

◆

The C., B. & Q. R. R. is running a "weed burner" locomotive over its tracks. Instead of exhausting through the smoke-stack, the engine exhausts through two iron pipes, which project like the tusks of an elephant. The steam and gas goes through the pipes and destroy the weeds and grass for a space of about two feet each side of the track.—*Railway Age.*

◆

Egbert T. Smith, of Brookhaven, Long Island, and Capt. Edward A. Smith have been appointed by the Secretary of the Treasury to test the power of oil to still rough water at sea.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

PULSATING BOILERS.

Editors Mechanical Engineer:

The article in your issue of Aug. 9th, signed "*Corliss*," brings to my mind a somewhat similar experience.

Some years ago the writer was in charge of a 30''×60'' poppet valve (condensing) engine; steam was supplied by 4 horizontal tubular boilers, 54''×16''; each pair of boilers being fitted with steam and mud drums, and being placed at right angles to length of boilers; feed water entered at top of mud drums.

The steam drums pulsated in a manner that made me fear for the joints on nozzles and other connections, and as occasion sometimes existed for running non-condensing, the evil was then aggravated. The cards taken from this engine were most excellent, the cut-off being very clearly defined indeed.

As the pulsations were confined to the steam drums alone, I reasoned that the abrupt opening and closing of the steam valves resulted in a shock being imparted to the drums through the sudden release of a certain quantity of steam, and the then sudden checking of that flow; the result being much the same as the water hammer produced in water pipes when a cock is suddenly closed. The steam connections between boilers and engine were very rigid; a slip joint placed in steam pipe near to the boilers did much to remedy the evil, besides making the life of all joints longer thereon. The steam pipe ran at right-angles to the length of steam drums.

A couple of tie-braces from convenient points in walls to steam drums further remedied the evil, and as you suggest, Mr. Editor, I found that by carrying but one full gauge of water it further helped me.

The cards taken in general from Corliss engines show a sharp cut-off, and "*Corliss*" is not the first engineer whom I have met who relates a similar experience. Undoubtedly, if he were deficient in boiler power, the crowding they would necessarily receive would be largely responsible for the pulsations he refers to.

"*Corliss*" does not mention the point where his feed water enters, but doubtless the leaky seams he refers to are in a measure due to the water entering as you say, Mr. Editor, in the hottest part of the boiler, and possibly at a low temperature at that. Cut Off.

New York.

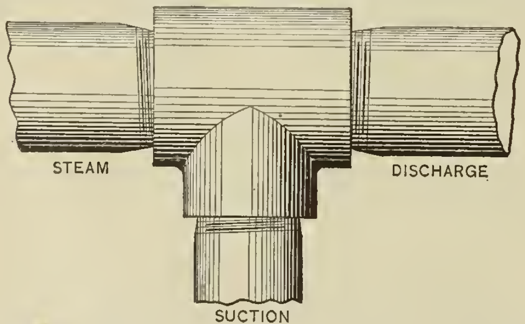
[Let us have more experience on this matter. This is a good letter, and deals with the question directly.—Eds.]

◆

STEAM SIPHONS.

Editors Mechanical Engineer:

Can a steam jet like the enclosed free-hand sketch be made of rough iron pipe, and would it be serviceable? What size chamber, suction and discharge would be proper for a one-inch steam pipe? Could it be used to empty the hull of a boat of water? Please answer in your valuable paper, and oblige a reader. J. A. S.



Iowa.

[Common iron pipe fittings made as shown, will answer the purpose without any attention as to sizes. A three-quarter pipe, with the T which belongs to it, will lift the water out of a boat, but the suction should be as short as possible; the discharge may be any length horizontally, but not too high vertically. The steam pipe should be smaller than the discharge and suction, but this is not indispensable. We have made siphons of all sizes, without reference to dimensions, and they never failed. The amount of steam they require, however, will surprise one. A steam pump is much cheaper where the work is regular.—Eds.]

◆

THE PROFESSOR MISQUOTES.

Editors Mechanical Engineer:

I was considerably amused at the Professor in Number II. I am not much acquainted with Shakespeare's characters, but I am sure the Professor is the first man I ever heard call Solomon one of them. With best wishes for your prosperity, J. W. Cook.

Bay City, Mich.

[Thanks for the correction. Glad to observe that friend Cook knows more about the Bible than he does about Shakespeare.] Moulton.

◆

VERY GREAT DIFFERENCE.

Editors Mechanical Engineer:

What will be the difference in the power developed by two 10×20 engines of same displacement, differing only in pressure and point of cut-off, one using steam of 100 lbs. pressure, cutting off at $\frac{1}{4}$ stroke, the other using steam of 50 lbs. pressure and cutting off at $\frac{1}{2}$ stroke.

By answering the above through The Mechanical Engineer, you will greatly oblige two subscribers of your excellent paper. Find Out.

Philadelphia, Pa.

[Very great difference. The first is the most powerful. The mean effective pressures are respectively: 54·04 for 100 lbs. cutting off at $\frac{1}{4}$ of the stroke, and 32·88 for 50 lbs, at $\frac{1}{2}$ stroke.—Eds.]

◆

THE CARLIN LIBRARY ASSOCIATION.

Editors Mechanical Engineer:

In The Mechanical Engineer of 26th ult. you make kindly mention of the Central Pacific R. R. employes' library at this point, with some commendations in regard to it, and I therefore do myself the honor of sending you one of our catalogues of books in said library, thinking it may be of interest to you. At the same time would call your particular attention to the Latin motto, "*Omnia vincit labor*"—"Labor conquers all"—on the outside cover of catalogue. Wm. F. Smith,

Div. M. M. and President of Library.

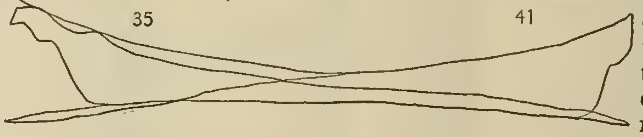
[The catalogue has been received, and we have looked it over carefully. The selections of works are good, standard authors being largely represented.—Eds.]

◆

WHAT THE EXPERT MEASURED FROM.

Editors Mechanical Engineer:

A manufacturer in this city sent to a large engine builder for an expert to measure his power. I send you one of the cards he measured from. It was handed to me by the engineer in charge. The expert said: "She has too much back pressure." J. E.



Chicago, Ills.

◆

FROM SECRETARY DAVY.

Editors Mechanical Engineer:

The third annual meeting of the *National Association of Stationary Engineers* will be held in the city of Baltimore, Md., commencing on Tuesday, September 2, 1884, at 10 A. M.

Every association chartered by the National Association will, if they have not already, elect a delegate. All associations not heretofore chartered by the National Association, can elect their delegate and apply at the annual meeting for a charter, provided they have heretofore complied with the requirements of the National Association. A. M. Davy, *Sec.*

Detroit, Mich.

◆

NEW JERSEY ASSOCIATION OF STATIONARY ENGINEERS, N. A. S. E.

Editors Mechanical Engineer:

I hereby inform you that at the last regular meeting, Mr. J. A. Crouthers was elected as our delegate to the National Convention at Baltimore.

J. H. Clark, *Cor. Sec.*

3 Storm Ave., J. C. Heights, N. J.

◆

HE GIVES IT UP.

Editors Mechanical Engineer:

I reckon I will have to give it up. I have tried twice to write Wiwurna so plain that a compositor could read it—and didn't do it. N. W. W.

[This relates to the name of the boat on the Kennebec River, and we will have it right if it takes all summer.—Eds.]

◆

FROM THE AUTHOR OF "A TREATISE ON TOOTHED GEARING."

Editors Mechanical Engineer:

In your issue dated August 9th you give a review of my "Treatise on Toothed Gearing," which seems to me to be unjust to say the least, and I trust that you will allow me enough of your valuable space to explain wherein I think you are unfair. In the first place, I stated in my preface that I had "sought *often and earnestly*" for a terse and comprehensive book on Toothed Gearing, and not "many years," as your review has it. You say that after carefully examining the book, you are compelled to say that I have not simplified the subject any. Permit me to say that, since a man who understands the addition, substraction, multiplication, division, and square, and cube roots of the simple arithmetic can, by the use of my Treatise, *completely design* any kind of toothed wheel in common use, I think it not unfair for me to claim that my book is as simple as the complicated subject will allow.

Again you say: "We think that, for the use of machinists and others, the mathematical portions of the work might have been expressed in *rules or forms*, intelligible to them" (the italics are my own). In the whole work in question there is not a single principal *formula* (which alone are necessary in designing) which has not a corresponding *simple rule*, or an illustrating *simple example, or* both. These, I think, are very ample provisions for the "incapables" who cannot "soar to algebraic heights" of whom you speak, and I sincerely hope that there is no man, professing to be an intelligent mechanic, in the United States, who is so "incapable" and so timid as to be frightened out of a commendable desire to learn by my modest little "Treatise on Toothed Gearing."

J. Howard Cromwell.

Cranford, N. J., Aug. 11, 1884.

[We do not think Mr. Cromwell has any cause for complaint, but we willingly give him an opportunity to express his views.—Eds.]

Chippings and Filings.

Ropes, In Lieu Of Belts, are used in England on engines of 2,000 h. p. The rope runs at a velocity of 7,040 feet per minute in one instance.

◆

A Contemporary Says:

"Such messes as printers' ink, coal-tar and flour, etc., may help a slipping belt for a short time, but this influence is short-lived, and their subsequent effect highly hurtful. Neatsfoot oil is a bad dressing for leather belts. It makes new ones more pliable at first, but afterward rots and ruins them. Castor oil is the best plain dressing for them. It makes them supple, adhesive, and proof against rats and moisture."

As to the first line—yes; but as regards the castor oil—guess not. Neatsfoot oil is the natural emollient for belts, for the reason that it comes from the ox itself, which may be supposed to know what is good for its hide.

◆

For Keeping Belts In Line, this method is unique. A correspondent of the *Paper Trade Journal* says: "I remember working in a mill where the millwright pledged himself to keep the sides of the belt in line with the edge of the pulleys, and to fulfill his promise, when a belt ran to one side he would take his plane and rasp off one side of the driving pulley. This brought the belt right for the time being, but as soon as the engineer had occasion to raise or lower the roll the belt would run to the opposite side, and by this means the millwright had his hands full; he had steady employment all the time."

◆

Involved Sentences often cause readers to feel that they are lacking in perception, when the fault is in the writer. This is a case in point:

In an article "On the Teeth of Wheels," in the *Practical Mechanics' and Engineers' Magazine*, the writer remarks: "The pitched circle of a toothed wheel is simply the circle whose diameter is equal to that of a cylinder, the rolling action of which would be equal to that of the toothed wheel. It is the limit to which the wheel approaches as the teeth are indefinitely diminished in size and increased in number, the distance of the axis remaining the same."

If the pitch line is defined as the working centers of the teeth, that conveys the idea in six words.

◆

Captain John Ericsson was 81 years old on the 31st ult., and as he expresses, it "just in the prime of life." He works eighteen hours a day, at any rate, regularly, which is pretty good proof of it.

◆

The Old-Fashioned Trip Hammer used to be a simple effective machine, with the fewest possible parts. The modern trip hammer is an agglomeration of cushions, springs, toggles, levers, "back lash catchers" and various things for which there is no name. It will be improved off the face of the earth presently.

◆

A Contemporary Says:

"There is always more or less slip to wheels running on a track. If you start to haul a dead engine with the side rods off, the relative position of the crank pins will change within a few rods."

Very true, but we do not understand this to be due to slip; on a dead engine there is nothing to slip the wheels, they simply roll. We think the change noted due to a difference in diameters. If the treads are coned at all this difference readily occurs, even in brand new engines.

◆

Polish For Pine Wood.—A wash of one part nitric acid in ten parts of water will impart a stain resembling mahogany to pine wood that does not contain much resin. When the wood is thoroughly dry, shellac varnish will impart a fine polish to the surface. A glaze of carmine or lake will produce a rosewood finish. A turpentine extract of alkanet root produces a beautiful stain which admits of French polishing. Asphaltum thinned with turpentine makes an excellent mahogany color on new wood.

◆

PLAIN TALK.

Shop talk among those who have nearly finished, and those who have finished their trade generally runs as follows:

"Well, my time is nearly out; and just as soon, to a day, as it is, I am going to the office and demand journeyman's wages, and also a recommendation."

On one occasion I remember, when serving my time with a young man—his time was out a little before mine. One day he exclaimed, "Well, my time is nearly up. I am going to ask for a recommendation."

What do you suppose he wanted with it? why, to show that he had served a regular apprenticeship and what was thought of him; beside all this it would get him a job. This was all very nice—on paper.

It seems to me, and I have verified it in several years of experience and by close observation, that in employing a man with such papers, nine times out of ten he is not what they say he is. I had a paper presented to me by a young man recommending him as a first-class lathe hand. He was not satisfied with the eulogy of his paper, but was quite knowing in all pertaining to lathes. A simple question put to him, such as this: What wheels would you put on a lathe with four threads to the inch feed screw, to cut ten threads to the inch?

"Oh," he said, "we find that by the index screwed on the lathe, already worked out for us." Like most others, he worked by some prescribed formula, and could not tell the why and wherefore of any process, or try to work them out. Some persons, if they can handle a saw and a jack-plane, think they can build a house, when they could not build a first-class pig-pen. Masons also, if they can handle a trowel, sling mortar, and put one brick upon another, think they are masters of the business, when it is impossible for some to point up an old wall decently. The blacksmith, if he can manage to hold a piece of iron in his tongs without its flying in his face, and weld two pieces together, head a bolt or dress a chisel, thinks he can make an engine-crank, when it would be a difficult task for him to shoe a steer. If a moulder can make a plow point and perhaps help on a large piece of work of some kind, he is also of the opinion that he can build up in loam a propeller wheel, when he is not competent to make cores for a steam cylinder properly.

To sum up the causes of all these errors: Instead of men making their trades a study in and out of working hours, they pursue very different courses. They rush their work through regardless of quality, and are always watching the clock. They take no interest in the trade itself, but expect the best wages going, simply because they are "out of their time." It is no wonder that trades are degrading, in the eyes of some, when they see such members of it. If such men as I have mentioned would devote some of the time they spend in watching the clock and loafing on street corners, or in worse places, they would be more appreciated and get much better wages. The reason that they are down, socially and morally, is because they put themselves down.

R. J. Steele.

Petersburg, Va.

CAUSES OF FAILURE.

A writer in the *Economist* sets forth the causes of failure to succeed in life. We summarize as follows:

Idleness, intemperance, want of punctuality, honesty, and truth. Incorrect views of the great end and aim of life. Lack of principle, of fixed purpose, of perseverance. Stupidity, laziness, rashness, and dishonesty. Want of thoroughness of preparation. Want of fixedness of purpose. Want of faith in the triumph of right and truth. Fast living, mental, spiritual and bodily; lack of attention to the details of business. Breaking the divine laws of the body by vice, those of the mind by overwork and idleness, and those of the heart by making an idol of self. Ill health. Mistake in the choice of employment. Lack of persistent and protracted effort. A low ideal. The combined spirit of laziness and self-conceit that makes a man unwilling to do anything unless he can choose just what he will do. Outside of intemperance, failure to grasp and hold, scattering too much, want of integrity and promptness, unwillingness to achieve success by earning it in the old-fashioned way. Living beyond income, and speculating with borrowed funds; unwillingness to begin at the foot of the ladder and work up. Young men want to be masters at the start, and assume to know before they have learned. Desiring the success that another has, without being willing to work as that man does. Giving money-making a first place and right-doing a second place. Trying to carry too big a load. Liquor-drinking, gambling, reckless speculation, dishonesty, tricky conduct, cheating, idleness, shirking hard work, frivolous reading, lack of manhood in the battle of life, failure to improve opportunities.

Among the causes of failure may be classified wavering purpose, non-stick-to-it-iveness, failure to grasp and hold, scattering too much, trying to do too many things rather than stick to the one thing one knows most about. A young man spends seven years in a grocery store, and when he has just learned the business he concludes to go into dry goods. By failing to choose that first he has thrown away seven years' experience. Probably, after learning the dry goods business, he will conclude to become a watchmaker, and at last become a jack-at-all-trades, good at none. A prominent merchant says: Nearly all failures in legitimate business come from not serving an apprenticeship to it—that is, from leaving a business one knows for another which he does not understand.

Another cause of failure is the disposition to escape hard work, and get rich in haste. How many who were in haste to get rich, to reap without patient industry in sowing, have learned the truth of the old proverb: "The more haste the worse speed"!

MAGAZINE LITERATURE AND ILLUSTRATIONS.

The wages paid artists and engravers on wood have doubled and trebled in the last ten years. Artists do not draw on wood so much as formerly, but in black and white on a large scale, which is reduced to the desired size by photography on the wood. The very best artists in oil occasionally draw in black and white for the engraver. Mr. Boughton's illustrations of his story in the last Christmas *Harper* were made on a large scale, probably three feet square. As drawings he could probably command $250 each for the originals. The engravers of the present day are very superior to the workmen of ten years ago, because they not only have greater experience, but are furnished with much better drawings than formerly. American publishers do not "transfer" engravings from the English and French periodicals as formerly.

Except in special cases of distinguished contributors, magazine writers are not paid much better than formerly. Available matter for the magazines rules at about the same old rate of $10 per thousand words, which was paid thirty years ago.—*Paper World.*

A WONDERFUL MACHINE.

Every man is the possessor of a machine more wonderful than anything made by hands, and that is his body. In all its complex functions mechanical action is manifest. The trouble with many who own these machines is that they do not know how to run them, and they suffer accordingly. Nine-tenths of a doctor's business comes from petty illnesses brought on by excess. A young engineer, Fred. Olin, Perry, N. Y., has sensible views on this subject and he says:

> "Let us consider our body. In many respects it resembles a locomotive. It requires fuel or food, and water and air; and these of the right kind and intelligently administered. If we cram too much coal into the furnace of a boiler the air is often shut off, and it is difficult to make steam; of course we would not think of starving a boiler and expect it to work. If ashes collect, there is less room for the fuel to burn, the air-passages are stopped and the fire burns low. If the water is impure, scale or sediment will form in the boiler, evaporation will be retarded, and some parts may become dangerously overheated. A good engineer will most carefully regulate these three factors—fuel, air and water—as to quantity, quality, and also time of administering. Nothing is done spasmodically. In feeding a boiler we only supply material for heat and force; but in feeding our bodies we must, in addition, supply material to build up and repair the machine."

The writer likens a man who stuffs himself to repletion, to a careless engineer.

> "Now, did our uncomfortable friend exercise what is known as horse sense? Is he a good engineer? He started in the morning with a clogged grate and worn machine. His tissues were too full of scale and sediment to admit of a free evaporation of water from the surface of the body to keep it cool. Inwardly he was dirty. He stuffed himself with food that would furnish heat, stimulate, and tear down tissue. He ate but little that would build up and preserve. He overworked his nerves and digestive organs by improper eating and worry, by not giving nature half a chance to throw off the waste matter and replace it by new. In short, he did not use horse sense.
>
> "If, now, you would be cool, eat food appropriate to the season—as fruits, vegetables and cereals. Eat it slowly, not hastily. Finally, let your disposition be as bright and sunny as are the days, and there will be harmony between you and nature."

THE HYDRAULIC LIFT AS A VEHICLE FOR HUMOR.

It would seem scarcely possible to get any humor out of such a subject as hydraulic lifts, or elevators; nevertheless, a correspondent of the *London Engineer* combines the causticity of Charles Reade with the saturnine and splenetic diction of Carlyle, and produces the following. It refers by name to various American manufacturers; these references we have left blank.

> It is, I think, impossible to read the lengthy letters which have appeared in your columns without perceiving that the writers are more anxious to puff their own wares and glorify the astuteness that they hold to be in them, than desirous of putting before the world the best means of serving humanity that wants to be lifted from the street to the attic. This is not engineering of the best kind, although it may be commercial engineering. Now, I am not a lift maker, although I use lifts very frequently, and I am indifferently well versed in the construction of lifts of all kinds. I once nearly lost my life in one—and served me right for adventuring in a thing which worked with a friction clutch—and I fully appreciate the necessity for safety. It is not with safety, nevertheless, that I have now to do. May I venture to hold the faith that some, at least, will believe that I have no interest to serve, either of my own, or, being selfish, of any one else's; least of all that of the ——— ——— Company, which, having in Mr. ———, a man excellent with the tongue and yet more fluent with the pen (even to the risk of being called long-winded by scoffers), needs not that I should urge a single word in favor of its claims. Yet would I here digress to say that I would give something to learn how the other gentleman, whose name I know not, who represents the other Best Lift in the World, also coming from America, wherein bests can be found by dozens; I would give, I say, some small *baculum* to know how Mr. ——— and the other gentleman will settle between them how both their lifts is each better at all points than the other.
>
> Being, then, a dispassionate individual, with at least a modicum of engineering knowledge and some aptitude in hydraulics, I cannot help smiling, even to the degree of broad grins, when I read the lucubrations of those who claim that their lifts are economical or the reverse. They actually fail to see that there can be no question about economy, though there be some about the thing termed net efficiency, the nature of which they seem not to comprehend—yet to the smaller tyros of engineering it ought to be known—that thing, which for obscure yet perchance wise purposes has been hidden even from Mr. ———, namely, that so long as a given weight has to be lifted by a given weight of water under a given pressure, the quantity of water that must be used is as fixed and unalterable as is the appetite of lions for lambs, or the desires of builders to put streets on end. If a lift is mounted on the top of a ram, the only loss of efficiency will lie in the friction of the leather collars, that of the water in the pipes, and the loss of sufficient *vis viva* at each end, and such a lift made must have a higher efficiency or do more useful work than a rope lift such as that of the ——— ——— Company.
>
> But the true way to economize is to reduce the load to be lifted, and that can be done by making folks descend in the lift as well as go up in it. It is by no means to be supposed that all the people who go up in lifts stay up. A few may, peradventure, walk down-stairs, but I understand that in New York no one who goes up in a lift ever comes down save in a lift, unless, indeed, he fall out of window or be dropped down a fire-escape. Now, this being the case, it is clear that the whole work to be done need but consist, not in lifting folk up, but in overcoming the friction and inertia of the moving parts; and a few gallons of water might be made to work very large lifts. Let us suppose that on the existing system 75 per cent. of all the water used is employed in lifting people, and 25 per cent. in overcoming friction. A properly made lift, for 100 gallons used by the normal elevator, would need but 25 gallons. I am quite prepared to hear it said that the thing can't be done, yet when the sayers see one at work they will exclaim:—"There is nothing new in it." For the present they must take my *ipse dixit* that it can be done. That all the work of the descending weight of heavy parties, men with whom gravity does not play but makes a serious business of its duties; of light parties, children, dogs, etc., may be used to raise a corresponding load of humanity or dog flesh; and this may even be done with a single lift, but better with two.
>
> The true balanced lifts will be so much better than any other that those who have not got them will turn, even with loathing, from the works of the ——— ——— Company, Messrs. "Economizer," and —— and ——, and ——— ———, and others too numerous to name, and will fly multivious to the makers of the new lifts, beseeching them to make them new elevators which will set the water companies and all their works at defiance. And lest I should be much plagued and troubled by those desirous to know how such lifts can be made, I take to myself the name of one long since defunct, but in his time well versed in hydraulic lore, and the inventor of much-that-is-to-this-day valued in waterworks, and places where there are presses, and so sign myself,
>
> Joseph Bramah.

The writer quoted has a nimble wit, but his information concerning the habits of Americans, as regards descending in lifts, is at fault. We will say to the writer quoted, that an American is never known to walk, where he can possibly get any conveyance.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

150 Nassau Street, New York.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

THE RAILWAY OF THE FUTURE.

Which is the cheapest—a railway which is straight from end to end, or one which runs as the crow flies—very crookedly so far as our observation extends. The question of cost does not apply to immediate construction nor to cost per mile only, but to an almost infinite number of conditions, some of which are not yet known. Many of them are. Under certain of these it might be cheaper to buy a whole village and remove it from the earth, rather than go twenty miles round it, and in this postulate lies our present argument. The railway of the future for rapid transit between important points will be a mathematically straight line. When we have it we may consider that other question, possible speeds. Until we have it we are simply traveling in a circle. As railways are now built, they are laid upon the surface of the earth, with its accompanying hills and valleys. The surveyors who lay them out, and the capitalists who build them, have found that modern mechanics can furnish very powerful engines, and they, therefore, save at the spigot in construction and leak at the bunghole in maintenance. They lay down tracks more or less level and straight, open the line and call upon engineers to furnish machines for high speed. These are forthcoming and are built with a view to the work they have to perform. They are enormously heavy and clumsy to overcome the obstacles in their way, and they do not accomplish the object, for railway speeds of to-day are not high. They are absurdly low all through the country. The utmost achievement, as a supreme effort in daily traffic, is under 50 miles per hour, while with proper conditions it should be, for fast time, 80 miles per hour.

The railroad of to-day is an argument between untoward conditions and restricted mechanical possibilities. Within certain narrow limits the master mechanic is commanded to furnish machines to encounter natural obstructions more or less great. Where the obstacles are slight he succeeds, and achieves rates of speed which show what could be done if the first requisite, a straight, level track was furnished him. There would then be no need of fifty and sixty ton engines to move loads of 150 tons; the dead weight of engine could be reduced, which would make the same weight of train hauled more profitable. The cost of cars would be reduced, both in construction and in maintenance; in a word, every single item of expenditure now incurred would be materially lessened. Not in our day will this change in the railroads of the country be made. It is too great and too radical, but the longer it is deferred the more expensive it will become. Where now the right of way could be had for comparatively small sums it will be greatly enhanced; but whether the railway of the future hangs between heaven and earth, or whether it is built up from it, the permanent way will be a mathematically straight line from end to end without a break in its continuity.

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ABOUT CASE-HARDENING.

A contemporary who objects to criticism, considering it only as an affront, has the following: We omit the source of the matter quoted, out of respect for our contemporary's feelings.

> "Among some master mechanics and locomotive builders there exists a strong prejudice in favor of using case-hardened pins, yet pins of this kind fail oftener than any other part of a first-class locomotive. Some time ago the Baldwin people becoming convinced that case-hardened pins were unreliable, they determined to make some systematic tests to prove the matter beyond peradventure. They took a bar of 2-in. iron and cut it into lengths of 12 in. One piece they kept out and the others they put in the case-hardening furnace. After being an hour in the furnace one piece was taken out, and another after it had been two hours in, and so on till the five pieces had gone through the case-hardening operation, the last piece taken out having been in five hours. All the pieces were then in succession subjected to a breaking strain, when it was found they had decreased in strength in proportion to the time they had been in the furnace. Examination showed that the case-hardening process did not merely affect the outside of the iron, it went to the center. In the piece that had been in longest, the heart had become crystalline, and very coarse. All the others showed similar indications in smaller degrees, according to the time they had been in the furnace. In the breaking tests, the piece that had not been in the furnace doubled without breaking, but all the others snapped off.

Case-hardening is simply a process of converting iron into steel; it is cementation arrested at a certain stage. If, therefore, it is desired to cover any iron part with a skin of steel, and the process is so unskillfully performed as to convert the whole mass into crude steel, the fault is in the manipulation, and not in the system.

Fifteen years ago Mr. J. N. Lauder, then of the Northern R. R. of New Hampshire, but now of the Old Colony R. R., told the writer of this article that he would not have a steel crank-pin on an engine, preferring case-hardened iron, and he showed some pins of this kind which were perfect. What Mr. Lauder's practice may be now we do not know; but if it was good then, it is still.

Undoubtedly case-hardening, after the manner spoken of by our contemporary, would result in bad work, but so would any other branch of the business, if carried on in the same way. It is rather late in the day to impugn the value of case-hardening as a means of preventing wear, where the case-hardening is properly done.

◆

THE STEAM YACHT RACES.

The result of the steam yacht races spoken of in our last issue is that the *Atalanta*, Jay Gould's vessel, is declared the winner. The interest in the race was centered chiefly on the *Atalanta* and the *Yosemite*, the latter being owned by John Roach. These vessels are very similar in power, but the *Atalanta* has an advantage of 15 feet in length. She made the 95 statute miles in 4 h. 48 minutes, which is very good time—equal to 17.43 miles per hour. The *Yosemite* came in 31 minutes later. This casualty is due, it is stated, to the fact that the blower gave out after two miles had been run, when the revolutions of the screw fell off from 106 per minute to 95.

As a matter of fact, the *Atalanta* arrived first, but the curious calculations for time allowance may give a different aspect to the matter. We defer comment until we know more.

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THE BOILERS OF THE LOUISIANA.

Our next issue will contain the boilers of the SS. *Louisiana*, as they were before the alteration and as they are now running, with firebrick furnaces. Full data of performance will accompany the illustrations.

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A GREAT MOVEMENT.

In our last issue, A. M. Davy, the efficient secretary of the *National Association of Stationary Engineers*, writes that there are now 57 Associations of Stationary Engineers in the United States, with more coming. The significance of this fact is very great, for it sets forth that engineers are the first to find out that the straight road to advancement, to personal recognition, lies in the improvement of the individual. They have, therefore, massed their forces and established associations for mutual benefit and interchange of experiences in their calling. At periodical meetings they advise and sustain each other, each member contributing to the common stock of trade matters. In all this there is not a trace of so-called trade unionism in its offensive sense. There is no discussion of wages or salaries or any matter affecting prejudicially the interests of employers. On the contrary, the direct result of such meetings is to very greatly benefit employers. An engineer who is a member of an association sees, by the direct advice of his fellows, where he might save or be more efficient, and the steam user is the gainer.

More than all this, beyond the question of dollars and cents, lies the status of the engineer himself. This is the good work which our friends are doing, and which those who come after them will reap the full value of. Such associations cannot exist without very greatly benefiting the trade at large. Just so long as they stand by their present platform and constitution will the calling of stationary engineers advance in public estimation, for a better knowledge of what their intentions are will be disseminated, and aid will be tendered them.

It is not to be denied that, in some sections, the objects of the National Association are still misunderstood. Many steam users cannot conceive of any trade organization that has not some ulterior design upon their pockets. They pooh pooh all assertions about mutual improvement, and pretend to believe that at the bottom of it all lies hostility to them.

This attitude is not unnatural; it is to be expected. The long years wherein men attempted, and still attempt in some instances, to gain their ends by force, and fix a scale of wages for the trade at large, have convinced many that there can be no other aim in the Stationary Engineers Association. Such steam users will find out their error, and in the fullness of time their friendliness will be changed to active co-operation.

Thus far the National Association has been consistent in its course. It has adhered (and it will adhere) rigidly to the reasons for its being: No interference in any way with the liberty of the individual, or with employers—no countenance to strikes. These alone, aside from its other aims, will make the National Association of Stationary Engineers the greatest movement of the day for the members and the public at large.

MACHINE-CUT FILES.

American machine-cut files have received prominent mention from an English gentleman who was recently in this country; his opinion is, that they are equal to the best English hand-cut files. This is saying a great deal, perhaps even more than some American mechanics would say. We are not, however, disposed to animadvert upon this point, for opinions differ widely.

It is easy to understand that English tradesmen and trade journals would not allow so bold a statement to pass unchallenged, and we read, therefore, that the *Ironmonger*, a prominent trade paper, says:

"We are not disposed to attach undue weight to an individual utterance, but when there is other evidence in the shape of the almost universal use of machine-cut files in the States, the matter assumes an importance which it might not otherwise attain. Hitherto the weight of evidence has appeared to be largely in favor of the hand-cut articles, and our own pages have frequently contained announcements in which special stress has been laid upon the fact that the files made by certain firms were entirely cut by hand. That being so, we are not disposed to discuss the technical merits of the contending articles but prefer for the time being to deal with the subject in a more general aspect. We are confronted with the spectacle of a whole nation, comprising some of the cleverest mechanics in the world, making and using machine-cut files, and with such tools turning out engineering and other work which is in many departments equal to any manufactured in this country. This alone should lead to an impartial and sober reconsideration of the situation. By adhering exclusively, or almost wholly, to hand cut files, it is probable that we have lost or are losing the American market, simply because we cannot compete in point of prices."

In respect to the closing paragraph we may add that, other things being equal, it is natural that home productions should be preferred to foreign.

TURNING BESSEMER STEEL.

An exchange says:

A job of Bessemer steel turned with an ordinary tool would not come out right; the material appeared to lack tenacity; it crumbled when brought up to an edge. As an instance, some axles for cars were scored circumferentially. They were made of excellent Bessemer steel. The scores were turned in the usual way, but before the vees could be finished to a depth of about five-sixteenths of an inch, the metal crumbled at the top and the entire job had a ragged look. It was found that the only way to do a good job on this material was to mill the scores instead of turning them. If the axles had been made of tenacious material like Norway or Low Moor iron, there would have been no difficulty in cutting scores possessing all the toughness of the solid material.

The above would seem to imply that Bessemer steel cannot be turned in a lathe. No metal is tougher than it; it surpasses Norway iron. If the job mentioned above had been annealed, there would have been no trouble with it.

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IT IS SAID that a match has been made in Russia by impregnating splints with a liquid which ignites when dry, by friction. It can be used several times, if not all burned. This will afford a new delight to alleged economizers.

OVERHAULING AN ENGINE.

If you were going to overhaul an engine what would you do first?

"Take a good look at it."

"Then what?"

"Take off the cylinder head, and take out the piston."

"For what reason?"

"So that I could send the piston to the shop and have it going along while I was doing the rest of the work."

"Would you examine the piston to see if it needed overhauling before you sent it away?"

"I would examine it closely. I would have the rings refitted, that is, refaced, so that I could barely turn them between the follower and the spider with my hands. If the piston was over 36″ diameter I would take a single turn with a jute rope around the rings, and try them that way for fit."

"Well, you have got the cylinder head off and the piston out; how about the piston rod?"

"I would have the rod 'skinned' over when the piston was faced, because it is more than possible that it would be out of round, although it might not appear so externally."

"Would you have the rod filed up, turned up, or draw filed?"

"I would be pleased to see a man filing a piston rod round and round in the lathe, if it was my rod. I should give the gentleman my opinion of his course in language that could not be misunderstood."

"Give your reasons for objecting to the piston rod being filed up between the lathe centers."

"My reasons are that those who practice such a course have no conscience. It is a monotonous task and one that no man likes, so the first thing done in beginning a job of this kind is to roll up the shirt sleeves and take a chew of tobacco. Then, with the fast speed on, the man proceeds to file; meanwhile he is looking all over the shop, so as to ease his mind and not get too worried over his work. All the care he takes is that he shall not hit his elbow on the flying lathe dog when he gets near the face-plate. Sometimes he digs the corner of the file in, and more times he keeps filing away in one spot, so as to get the tool-marks out. The consequences are that when I come to pack that rod, and run it awhile, I find as many rings on it as there are on a snake. No piston-rods filed up in the lathe for me."

"Would you use a piston-rod right from the tool?"

"No, sir. I think it is common sense to say that a piston-rod should be draw filed, for then the marks run with the rod, and there are no hills and hollows in it. A very little draw filing is enough; it is not necessary to get the tool marks out entirely."

"Some engineers say that draw filing makes a rod score; what is your opinion on that point?"

"I can't see it myself. A draw filed rod is not scored when it is first put in, is it?"

"It is not."

"The packing is supposed to be clean, without grit, and properly adjusted; the gland does not touch it at any part. If this is true how does a rod become scored? By dirt externally, but not by draw filing. A good smooth rod is very economical on packing and friction, and when it is as easy to have one right as wrong why not fix it right on the start?"

"What would you do to the valves?"

"That would depend upon what kind of valves they were. If simple slide valves I should take care that they were tight; if not I would make them so."

"Tell us how you would do this?"

"If the valve, or valves, were plain slides I would get the steam chest off if I could. Most modern engines are so made that they easily disconnect here, and I would probably have no trouble. If the bolts were studs I might have some trouble getting them out, but if they were through bolts, with nuts top and bottom, that would be all the better. Once having a clear valve-seat to work on I would stop the steam ports tight with wood, get a straight edge, and face one side of the seat true, then the other; after that both ends. Then I would try the straight edge diagonally, both ways, and face to it. After I had the seat, as I supposed, faced true, I would try it for wind, and keep on until I had it dead flat. I could make it practically true in every direction with a simple straight edge. Then I would have the valve planed up so that the tool marks ran across the line of movement, and I would not touch the valve after it left the planer, except to take the wind out of it, if there was any in it."

"Would that valve be tight?"

"Not on the start, no sir; but it wouldn't leak much then, if I had done the work properly. In a week or so, however, that valve would have a first-class seat on it, and be less liable to cut than one faced on a face-plate. The oil gets into the grooves, or small ridges, left by the tool, and keeps the face lubricated, and the metal does not touch all over at once; it wears gradually to its place."

"Do you not think you could have done this work, or had it done, much cheaper in the shop than you could do it yourself?"

"Not necessarily; no sir. If the cylinder needed boring and had to be taken up to do it, it might be cheaper to plane the valve face, but that would depend upon how much had to be taken off of it. I would always re-bore a cylinder in place where it was possible to do so. It is a bother to get bed-plate bolts out and nuts off sometimes, and it costs money to do it. Unless the cylinder was badly cut I would not re-bore it, if practically true. If it was slightly oval only I would let it alone."

(To be continued.)

SOMETHING ABOUT METALLURGY, INTERESTING FACTS ABOUT COMBUSTION.—Number II.

By NORMAN W. WHEELER.

For a full understanding of the reduction or deoxidation of ores, it is necessary to know the different ways in which fuel burns, or combines with O, and especially to understand the combustion of C, which is the universal fuel for metallurgic furnaces.

Before going further in this direction it will be well for all whose knowledge is not fresh, to look up in the chemistry books the definition of chemical equivalents, whereby they will see that any element combines—and burning is a combination—with another element, or with all other elements in definite quantities by weight, and when they look the matter up for a purpose they will see readily that C and O burn together in two definite ways, one way yielding CO, with one equivalent, or portion each of C and O, and one way yielding CO_2, which equals one portion of C to two portions of O. This makes complete combustion, and we do not know how to make any more O combine with a portion of C.

Now this burning takes place in different orders, depending upon the supply of air to the fire, and upon the amount of O which can be got from the ore.

The simplest burning is when the fire is open and the draught good, so that two portions of O may at once be absorbed by each portion of C. When such is the case the fire is very hot and the "smoke" consists chiefly of CO_2 mixed with N of the air—which N is of no use at all in the world, except to dilute the O and prevent everything from burning up at once. There is also in most cases an uncertain quantity of free O in the smoke, which has passed through the fire without finding its portion of C.

The next simplest way of burning is when the draught is restricted or the fire is too deep for the draught; each portion of O takes one portion of C, which gives CO gas. This is the gas used in the Siemens steel furnaces, and is also the gas found escaping from blast furnaces. When this gas is mixed with air enough to furnish another portion of O, and is so hot that they will kindle, the gases burn together, and the result is CO_2, as before, but the burning is by two operations instead of one.

Another and still less simple way is when the fire is very deep and the draught is replaced by a blast, as in a common cupola, the air is forced amongst the fuel in such quantity that near the tuyers the air goes in faster than the fuel can take up the O, so that at that place we have a very hot fire. This is called the zone of CO_2 combustion. The CO_2 gas made in this zone is very hot, is driven upwards amongst the fuel, and while in that state of great heat has the power of taking from the fuel another portion of C and making CO which we have seen will burn again to CO_2 if it be supplied with O from air or from ore.

All the ordinary combustions are modified and made slower than they otherwise would be by the presence of N [nitrogen] in the air, which neither burns with fuel nor has any other positive effect upon combustion, or upon the reduction of metals; its atoms are merely interspersed with those atoms seeking to combine, and absorb and carry off heat.

It may be well for us to rest here a while and speculate as to the effects of these different ways of combustion upon the ordinary operations of steam boilers.

We all know that if the draught be poor we cannot make the boiler steam well; more than that, we find our fuel going out of all proportion to the steam we get. Now the fact is, our poor draught induces CO combustion on the grate, and this combustion only gives us a low red heat in the hottest part of the fire; worse than this, it gives only about one-half the quantity of heat which the same fuel will give if completely burned, although it will get away with as much fuel per square foot of grate per hour, as will complete combustion.

If the fire is run very thin and perfectly even, we may get nearly a complete combustion with a poor draught, but there is great difficulty in keeping the fire even, and when there are holes or thin places in the fire, the chief part of the air goes through these holes or thin places and makes good combustion there, while the draught is slackened through the thicker parts, and CO combustion goes on there at great loss. It is true that an excess of O may go through the holes in the fire and burn the CO made in the thicker parts of it, but the conditions are too uncertain and ungovernable to give good results.

The fact is, a good and skillful fireman is an economical necessity wherever steam is made. If the draught be poor he will make the best of it, and if good he will make the most of his fuel. He need not know much about C and O, but after a few trials he will know that a fire which has one aspect will give him certain results, while one having another appearance will give other results. Some men cannot fire well because they are in a manner color-blind, as regards flame. I am inclined to think that the eye is at fault rather than the intelligence in a great number of cases where poor firing occurs.

Although a man may be a good fireman without a scientific knowledge of combustion, yet he will certainly do his work better and easier if he has that knowledge.

After all, science merely furnishes smooth handles to things, and saves work in that way.

(To be continued.)

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THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LXXI.

No one has as yet explained the reason why some lathe hands can make a fit the first time, while others are never sure of their measurements at any time. We have in our shop men of good ability, but they vary in this quality. Their skill lies in different lines; if it were only possible to combine the special excellencies of each in one man, we should have the ideal lathe hand.

Paul's hand trembles so much, through chewing a paper of tobacco per diem, that when he goes to take a size he jabs at the work just as a blacksmith does, and it is a wonder that he can get a size at all. So it is when he cuts threads; I have often watched him plunge at the handle to run the tool in, and expected to see the whole job come flying out of the lathe, or else the tool-point break off, but I never saw either thing happen. Every one knows how tender the point of a threading-tool is, but Paul grinds his very seldom; his threads are all that could be asked, and as for fitting a shaft to a bore, there is not his equal in the shop. He sets his callipers—old-fashioned, straight legs—and turns the job to them; then he puts the work on the floor when it is done, and bothers himself no more about it. It never occurs to him to lug his job over to the pulley, or what not, and try it for fit; neither is it necessary. Paul lets the other fellows do the lugging, and possesses his soul in peace.

On the other hand we have at least one man, whose name is not to be mentioned here, who is at no time sure of anything about sizes. He whittles more sticks, files more wires for gauges, and makes more fuss than a hen with a new brood, and the result is, in many cases, that the job is not a good one. If, by chance, it is a fit (such cases have occurred), he calls upon the whole shop to witness his triumph. Not by word of mouth, of course, but by overt acts; an ostentatious exhibit of difficulties in getting the shaft out of the pulley wherein he has tried it; by shaking it critically to see if it fills the hole, and by a dozen different artifices to attract attention, which machinists know so well that I need not describe them at length.

Here are two men, then, in the same shop the exact opposites of each other in the same branch of work. The difference in them lies in what Sir William Thompson calls the tactile sense—in his beautifully clear articles on the "*Six Gateways of Knowledge*," which have just been concluded in The Mechanical Engineer. The reason why a man can fit work properly at once, while another man cannot without great labor, lies in the sense of touch—delicacy of it—for one thing, and for another in a capacity to estimate quantities. When these two faculties are united, the fitter exists. Without them, results are luck and chance.

Perhaps it never occurred to the reader, but in taking a size to turn or bore to, there are three chances for error where standard gauges are not used. The first is in setting the callipers, or making the gauge; the second is in transferring this size to inside callipers; and the third is in finally turning the work to the callipers last set. To reduce all these quantities to their lowest terms, or, rather, to make these sizes interchangeable from one gauge to another, requires good judgment, and it is not every man who has it. Neither have all lathe hands the ability to fit work upon all sizes.

It is a curious fact that some whom I have observed in the course of my experience, do excellent work on sizes to which they have been accustomed, but when they jump way above them they do not do so well. The new size seems to puzzle them, or scare them, I don't know which. The responsibility, or perhaps possibility is a better word, of spoiling the job, appalls them. I have seen men taken off of a jobbing lathe and put on to heavy work, such as fitting a twelve-inch crank pin into a crank, make poor work of it. And the reverse is true. Men used to heavy work often make misfits of small jobs.

It should not be a reproach to a man that he is not a good fitter on lathe work, but it is a sad loss to him, and a great disability, for it is a most important qualification. A new man came into a shop once where I was at work; the first job he had was to fit a six inch shaft into a large spur-wheel. I saw that he was nervous over it, and a long time in getting it done. The boss saw the same thing, and took the man to task for it.

"I could do it quicker the next time," the man said.

"May be so," said the boss, "but that ain't what I hire men for—to experiment on jobs. You get paid for doing that work in a reasonable time and it is no profit to me to have you say you can do it quicker next time. Suppose when I send this work out to the purchaser he finds fault with it. I tell him I will do it better next time. There won't be any next time for me; when he wants more machinery he will go to some place where the next time was this time."

This sounds harsh and unfeeling, but it is the standard by which we are all judged or gauged—our ability to do what we undertake to.

I have digressed a little, insensibly, from what I was discussing chiefly, though one thing seems to be related to the other; but to make closer connection on sizes, let me ask what seems like a catch question, and that is this: We are all agreed that one piece $1\frac{1}{2}$ inches in diameter will not enter a hole exactly $1\frac{1}{2}$ inches in diameter. In the case of a plug and collar gauge which is exactly $1\frac{1}{2}$ inches, the plug or the collar? What is the difference in fractions of thousandths of an inch between them? It might help us some if the parts were stamped thus: "$1\frac{1}{2}$ inches standard" for the collar; 1 499000—500,000 for the plug. I would like to have "the sense of the meeting" on this point.

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A New Telephone is in market, constructed of cork, which is wholly devoid of induction, and transmits speech 1,000 miles.

THE MAN WHO WORRIES.

A writer in the *American Miller* thus describes the evils of worrying over work:

"Many a time when taking a day off I have looked with pity on men at work, and many a time when at work I have seen men loafing, and thought what fools they were to spend their time in that way. A shoemaker whom I knew well was accustomed to work until nine o'clock every evening. Upon one occasion I spoke deprecatingly of his having to work so much nights.

"'Umph,'" said he, 'I guess you would be glad to make a little overtime if you could get paid for it.'

"This man did not brood and think over the hardships of his lot until life was a burden to him, and he was a thinking man, too. Hard work can be made of anything, even of breathing. If any one doubts this let him pay strict attention to his breathing, and think of nothing else for one minute.

"In machine shops it is the custom to quit work an hour earlier on Saturday afternoons than on other days, and Saturday afternoon is the most irksome half-day in the week, because we keep thinking of the time and watching the clock, and do our work grudgingly. If we start on a twelve-hour journey by rail, and watch the speed of the train and worry about the number of its stops, we will tire ourselves much more than we would to just make up our minds to a twelve-hour ride, and get what entertainment we could from scenery, books, papers, and passengers, and in the latter case we would arrive at out destination just as soon and in much better health and spirits. To begin a day's work with a long-drawn sigh, bewailing the fate which compels us to work, and be continually comparing our lot with that of those whom we deem more fortunate than ourselves, is a sure way to lengthen our days and shorten our lives.

"It is now thirty-two years since I first heard of the immediate prospects of an eight-hour law. I never based any great hopes or expectations on it. The less law there is between employer and employed, the less occasion there will be for interference. It is law that makes convict labor possible. Free labor should be free, and freedom should be accorded to the employer as well as the employed. A national eight-hour law would not give the operative any more money, nor any more time to himself, than he now has. He would have to work by the hour instead of by the day, and that is all there would be of it. If there is anything in this world that a man has a right to use as he thinks best it is his own money, and no law can compel him to hire labor at a greater cost than he is willing to pay, and when operatives become owners they quickly see these things in this light.

"The number of hours for a day's work should be just as much a matter of mutual agreement, expressed or understood, as the wages paid and received."

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BOILER EFFICIENCY.

A writer in a late impression referred to the difference between the quantity of heat utilized and that actually developed in the combustion of fuel in the furnaces of steam boilers. He repeated the statement so often made about the steam engine wasting nine-tenths of this heat, and about two-tenths of the heat passing away up the chimney; statements which are not true as they stand. × × × ×

When leading men speak of the steam engine wasting nine-tenths of the heat energy supplied to it, they should guard against misconception by admitting from the first that a steam engine cannot be said to waste that heat which it must give up in consequence, not of its own defects, but in consequence of inherent defects in steam considered as a gas. Again, it is necessary to be more exact when dealing with this question as far as it relates to the boiler as a heat engine. × × × For instance, it is not true that at the very outset of our operations towards the use of heat in a steam engine we throw away twice as much heat as we succeed in utilizing in the steam engine. There are what we call losses which are as inevitable as is the loss of energy due to the necessity for using, say, a lever or a wheelbarrow which has weight, because one without it does not exist, and a steam engine or a boiler works under these abstract disadvantages; they cannot be called practical disadvantages, because the practice cannot be realized under other conditions; nor theoretical disadvantages, because real theory takes into consideration all practical conditions.

We may see what a moderately good boiler does with a pound of coal. The heat of combustion of 1 lb. of pure carbon burned to carbonic acid is 14,544 units, and will require for its combustion 2·666 lb. of oxygen. As we are not dealing with calorimeter experiments, we will assume that the oxygen is obtained from atmospheric air. Of this 12·2 lb. will provide the oxygen required. We shall then have 12·2 + 1 = 13·2 lb. of gases heated by the 14,544 units, and shall therefore have as the highest possible temperature with air at 60 deg., and having a specific heat of 0·238, of

$$T=(460+60)+\frac{14{,}544}{13{\cdot}2\times{\cdot}238}=5150 \text{ deg.}$$

Now, if we assume that the heat of the escaping gases could be so far utilized as to fall to that of the feed-water, or say, 100 deg. or 560 absolute, we should then have as the greatest possible proportion of available heat, or heat which could under the most favorable and hitherto impracticable conditions be realized, only $\frac{5150-560}{5150}={\cdot}891$; that is to say, with an absolutely perfect boiler, burning pure carbon to carbonic acid with air at 60 deg. Fah., and only enough to provide the oxygen necessary for chemical combination, there must be a loss of 11 per cent. But this is not waste. Now to follow this up, to see how far a good steam boiler deserves the character for wastefulness which it is so common to ascribe to it, we must take more numerical values. We must make out the worst case for the boiler, and so must credit the fuel with all it possesses in the form of heat. We have supposed the air to be at 60 deg. Fah., and must take the same temperature for the 1 lb. of carbon, or an absolute temperature of 520 deg. The specific heat of carbon being 0 25, it must be credited with 1 × ·25 × 520=130 units; the air must be credited with 12·2 × ·238 × 520=1485 units, and these quantites with the heat developed in combustion=16,159 units, from which, however, must be deducted 32 units as the equivalent of the work done in displacing atmospheric air by products of combustion raised from 60 deg. to 100 deg., at which they are supposed to escape, or increased in volume from 149·8 cubic feet, to 161·3 cubic feet, which leaves us 16,127 units as the total quantity of heat available. This is sufficient to evaporate 16·69 lb. of water from and at 212 deg., but as the greatest possible quantity of the total heat realizable is 0·891, as above shown, the greatest possible evaporation from and at 212 deg. by 1 lb. of carbon, the heat required to evaporate 1 lb. of water at this temperature being 966 units, is

$$\frac{16{,}159\times{\cdot}891-32}{966}=14{\cdot}87 \text{ lb.}$$

Now what do we get, as compared with this, from a good boiler? Following Mr. W. Anderson's excellent lecture, delivered before the Institution of Civil Engineers last December, we may refer to the results obtained in the portable engine trials made under the Royal Agricultural Society, at Cardiff, in 1872, with a portable engine boiler, nominally of 8-horse power. To begin with, the coal used was not, of course, all carbon. It was a smokeless Welsh coal, containing 0·8497 lb. of carbon per pound; but it contained 0·0426 lb. of hydrogen, and as the heat developed in the combustion of 1 lb. of hydrogen is 4·265 times as much as by 1 lb. of carbon, we have to take this into our calculation; and inasmuch as the coal also contained 0·035 lb. of oxygen in combination with hydrogen, in the form of water, and will abstract its combining equivalent of hydrogen from the fuel, one-eighth of the weight of the hydrogen must be deducted. Thus, as the 14,544 units developed in the combustion of 1 lb. of carbon is equivalent to 15·06 lb. of water evaporated at 212 deg., we have, for 1 lb. of the above coal, the heat, expressed in pounds of water evaporated =

$$15{\cdot}06\left\{0{\cdot}8497+4{\cdot}26\left(0{\cdot}0426-\frac{0{\cdot}035}{8}\right)\right\}=15{\cdot}24 \text{ lb.}$$

of water from and at 212 deg., equivalent to 14,727 units of heat. The conditions of combustion in the furnace of a steam boiler being so different from those in a calorimeter, the quantity of air used vastly exceeds that used in the laboratory as represented by oxygen; and in the boiler we are now dealing with 50 per cent. more air was admitted than would be necessary to supply theoretically the oxygen required for perfect combustion. This makes 18 lb.—about 24 lb. is more commonly used—of air per lb. of coal, and consequently 19 lb. of gases would have to be heated by the 14,727 units available, and hence the maximum temperature obtainable above that of the atmosphere would be

$$\frac{14{,}727}{19\times0{\cdot}238}=3257 \text{ deg., or } 3777 \text{ absolute.}$$

The temperature of the smoke from this boiler was 849 deg. absolute, and hence the maximum duty of the obtainable heat would be

$$\frac{3777 \text{ deg.} - 849 \text{ deg.}}{3749 \text{ deg.}}=0{\cdot}7752.$$

The specific heat of coal is about the same as that of gases at constant pressure, or as above given, and hence the temperature of the air being 60 deg., the 18 lb. of air and 1 lb. coal took to the furnace, 19 lb. × 520 × 0·238=2350 units, which, with the heat of combustion = 14,727 units, gives a total of 17,078 units, from which must be deducted 422 units for the heat expended in displacing atmosphere, or 151 cubic feet, which leaves us as the total available energy of the 1 lb. of coal 16,656 units. The greatest possible quantity of work to be obtained from such a boiler would, then, be

$$\frac{17{,}078\times\left(\frac{3777-849}{3777}\right)-422}{966}=13{\cdot}27 \text{ lb.}$$

of water evaporated from and at 212 deg., or equal to 12,819 units. Now, the boiler actually evaporated 11·83 lb. of water per pound of coal, and hence the efficiency of this boiler was $\frac{11{\cdot}83}{13{\cdot}27}=0{\cdot}892$, or less than 11 per cent. below the greatest possible efficiency under perfect conditions.

The portable engine or locomotive type of steam boiler is thus very far from being the inefficient thing which on incomplete bases of calculation it is often said to be, and there is not after all a great deal of room for that increase in efficiency which—it is sometimes asserted we ought in some way to attain. It may certainly be said that the reproaches referred to by our correspondent are not deserved by good boilers, nor are the results obtainable by their use so very miserable. It may be necessary to remark that we are referring to good and not to cheap and bad boilers.—*London Engineer.*

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CASTING STEEL GUNS UNDER PRESSURE.

Steel cast under hydraulic pressure results in a metal of peculiar strength and homogeneity, or unity of structure. The following account of the process from an American official Commission who witnessed it is taken from the Gun Foundry Board Report:

"The casting is made directly into the mould from the top. On the completion of the casting, the mould is moved (by means of a railway at the bottom of the casting-pit, which is a deep trench running parallel to the position of the furnaces) to a position under the movable head of the press, which is allowed to descend until the tup is in contact with the metal in the mould, and in this position it is locked; a shower of metal is induced, which ceases almost as soon as commenced, by the complete closing of the mould. The first impress felt by the metal is due to the weight of the head of the press alone. This pressure is gradually increased from below by hydraulic action, applied by four rams upon the table on which the flask rests, until the pressure exerted amounts to 6 tons per square inch. The interval from the commencement of the pressure until the maximum is reached varies with the size of the ingot, being for a 45-ton ingot as much as 35 minutes. During this time the flow of gas and flame from the apertures in the flanges of the flask, at top and at bottom, is continuous and violent, exhibiting the practical effect of the compression. This pressure is applied by the direct action of steam and pumping engines, and is indicated by a dial. At the end of this time the pump is taken off, and a uniform pressure of about 1,500 pounds per square inch is established by attaching an accumulator to the press, and allowed to remain until the metal is sufficiently cooled to insure no farther contraction in the mould.

"The contraction in length in the mould during the action of the pump, while the maximum pressure is being reached and sustained, amounts to one-eighth of the length of the ingot. After this effect has been produced, there is no farther advantage derived from the pressure in the way of eliminating impurities, but the contraction, in cooling, still goes on, and the pressure by the accumulator is considered necessary in order to follow up the metal as it contracts, for the purpose of preventing cracks being inaugurated at the end and on the exterior of the ingot by the adhesion of particles of the metal to the sides of the mould.

"When cooled and re-heated, the ingot is brought under the influence of the forging press. This press is hydraulic, with a moving head having the main hydraulic cylinder fixed in it, and it is provided with an arrangement of mechanism for raising and lowering the moving head of the press and for locking the same in any desired position. The press has four hollow pillars screwed part of their length, which are attached to the base of the press by nuts. On the top of the pillars is fixed a cast-iron head or table supporting two hydraulic lifting-cylinders, the rams of which are fitted with crossheads carrying four suspension bars. These bars pass through the moving head, and are connected at the lower ends by cross-bars, which are fastened to the pressing ram. The moving head works between the base and the top or fixed head of the press, and is raised or lowered by the admission or exit of water from the under side of the rams of the lifting cylinders. The moving head can be firmly and rapidly locked at any height from the base which may suit the work to be operated upon. The moving head, as already mentioned, carries a forging or compressing cylinder, which forces a ram down upon the work. By attaching the compressing cylinder to, and making it part of, the moving head, a short stroke can be employed when forging objects which may vary in size from a few inches to several feet in diameter.

"This in general terms explains the working of the ram. The effect produced by it requires to be seen in order to be thoroughly appreciated, and is altogether different from that produced by the hammer. The heated ingot resists the blow of the hammer, but the insinuating, persevering effort of the press cannot be denied. The longer time (several seconds) during which the effort lasts is a great element in its successful effect. As pressure succeeds pressure, the stability of the particles is thoroughly disturbed and a veritable *flow* of metal induced, which arranges itself in such shape as the pressure indicates; the particles are forced into closer contact and the whole mass writhes under the constraint which it is impotent to resist."

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IRIDIUM.

The principal sources of the supply of iridium are Russia and California. It is extracted from gold and platinum ores as a by-product, and is always found in small grains or fine powder, the largest pieces being about the size of a grain of rice. It is generally found alloyed with platinum or osmium. When pure it possesses a white luster resembling that of steel; its hardness is about equal to that of the ruby; when cold it is quite brittle, but at a white heat it is somewhat malleable. It is one of the heaviest metals, having a specific gravity of 22.38. When heated in the air to a red heat the metal is very slowly oxidized; but upon raising the temperature to about 1,000 deg. Cent., it parts with its oxygen, and above that temperature it is not oxidized. It is insoluble in all single acids, and but very slightly soluble, when in a state of fine powder, in aqua regia.

According to the new system of manufacture, and in cases where the article is not subject to great heat, the metal is melted with phosphorus, and cast into the desired shape; it is then ground or worked into the exact required form. The first application to which it was put was the manufacture of Mackinnon pen-points; these consist of a little cone pierced with a central hole. For this purpose the fused metal is poured between two plates, which are suddenly brought together, so as to subject the casting to pressure. The slabs are about one thirty-second of an inch in thickness, and are broken into small, irregular pieces, which are soldered on a strip of brass and ground down to a flat surface by means of a copper lap. This is a disc of copper $\frac{1}{2}$ in. in thickness and 8 in. in diameter, revolving at 800 to 1,000 revolutions per minute, and fed with corundum or diamond-dust. After the slabs are ground to a surface they are drilled. They are first countersunk by a diamond running at 900 revolutions per minute, and then they are pierced by means of a copper drill, consisting of a piece of soft copper wire filed down to a point, and set in a drill spindle. This tool makes 3,500 revolutions, and is fed with corundum or diamond-dust and oil. When the drilling is accomplished the brass is dissolved away, and the pieces of iridium are soldered to the ends of the Mackinnon pens, and are ground to the proper form externally by a copper lap.

Iridium is sawn by a copper disc 4 in. to 8 in. in diameter running at 2,500 revolutions per minute, and dipping into a bath of cotton-seed oil and corundum or diamond-dust.

Many new uses are now opening for iridium since it has been possible to melt and cast it. It is used for draw-plates, to replace the ruby plate, in the manufacture of gold and silver wire; for knife edges for scales and balances; for tipping hypodermic needles, and for many other purposes. It has been tried for the negative pole of an arc lamp, and was found to keep its shape, in spite of the heat, provided the positive carbon was not allowed to strike or fall too heavily upon it. One of the most important applications is for the contact points of telegraphic instruments; these outlive many platinum contacts, and do not oxidize or stick.—*Engineering.*

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ROPES vs. BELTS.*

Rope driving has now been in use in England for twelve or thirteen years, but it is only within about the last eight years that its superiority has been recognized. In Lancashire especially the system has obtained great favor, and now in building a cotton mill hardly any other means of driving is thought of. The system has been in use so long now that its merits have been thoroughly tested under all sorts of conditions, and any one adopting it may do so with the confidence that it is out of the experimental stage. Well known as it is, there are still certain points necessary to be considered in its application which will determine the difference between a good working arrangement and a bad one.

Before ropes came into general use in Lancashire the American system of driving by means of large leather belts was widely adopted, and the system worked very well when properly carried out, when good leather belts could be obtained, when due care was taken of them, and when the shafts were kept properly leveled and squared; but the belts themselves were so enormously expensive that they became a very serious item in the expenses of working a mill, as the life of a belt could only with safety be reckoned at about ten years. Then there was the difficulty of getting thoroughly good belts and sound well-tanned leather. On the other hand, ropes cost so little, and will work well under such apparently adverse circumstances, and with little or no attention, that they soon became adopted in preference to belting.

Various forms of ropes and various materials have been used; some good and some bad, and others again only applicable under particular circumstances. The common form is the round three-strand rope, and the materials most in use are hemp and cotton.

The ropes run in grooves on the rims of the pulleys, and the power is usually taken off from the fly-wheel rim itself. The diameter of ropes varies from $\frac{3}{4}$ inch to $2\frac{1}{4}$ inches, the usual size being $1\frac{3}{4}$ inch diameter for main driving. The adoption of rope driving gives great facilities for placing the engine in a convenient and suitable position. The engine can be placed at the height which best suits the drawing and discharge of the water for condensing purposes; and laterally the most suitable position may be chosen, so long as the fly-wheel shaft lies parallel to the shafts in the mill. The distance between two shafts connected by ropes varies from 10 feet to 100 feet or more, depending on the size of pulleys and diameter of ropes employed, and convenience. Any direction of drive may be adopted, except a perfectly vertical one; and it makes no practical difference in the working of the ropes if the slack side is at the top or the bottom. The speed at which ropes are run varies between 2,000 feet and 7,000 feet per minute, being usually from 4,000 feet to 5,500 feet in main driving; but it may be taken as a rule that the faster a rope runs the better and more steadily it will work. The power which can be transmitted varies in direct proportion to the speed at which the rope runs. The power that a rope will drive at a given speed is limited by the length of bearing it has on the smaller pulley on which it works, it being usual to transmit from 25 to 30 I. H. P. by a rope $1\frac{3}{4}$ inch diameter at 4,000 feet per minute, working on a 5-foot pulley. It is very important that the diameter of a hemp or cotton rope should not be more than 1-35 of the diameter of the smaller pulley, or the rope is soon ruined by being bent round too sharp a curve.

It is a common error to suppose that by putting an increased number of ropes to do a certain amount of work the durability of the ropes will be correspondingly increased. How erroneous this idea is will be seen when it is considered that it is not the actual tensile strain which is put on a rope that deteriorates it, as the greater part of the wear results from the rubbing of the strands of the rope against each other in bending round the pulley. This fact is proved by the way in which ropes are found to be worn when they are taken off. On cutting an old hemp or cotton rope in two it is found that a considerable portion of the heart has been ground to powder. Many means have been tried to prevent this internal wear, such as making ropes with six or more external strands, and a central core, but nothing has as yet been proved to excel the ordinary three-strand rope, and the best means of reducing the wear is to lubricate the strands before twisting them together, and to lubricate the ropes sufficiently afterward.

Good manilla hemp ropes may be safely reckoned to last six or eight years, while good cotton ropes may be counted upon for ten years, when working ten hours a day. There are very great variations in the quality of the cotton yarn from which ropes are made.

Rope driving admits of application in many cases to old engines where it would be impossible to adopt belting. The width occupied by the ropes to drive, say, 100 indicated horse power, would be 9 inches; the width required by a belt to drive the same power, would be about 12 inches, and when several belts have to drive off the same pulley, it is necessary to leave about three inches of space between the belts. This space is saved in the case of ropes.

One reason why the application of rope driving to old engines is limited, is that the fly-wheel race is very often so narrow that it will not allow of a width of pulley sufficient for the number of ropes required to drive the power. In these cases the difficulty can often be got over by the use of steel wire ropes. These ropes will stand a much greater tensile strain than the hemp or cotton ropes, and will transmit a much greater power, provided the pulleys are large enough to give the necessary adhesion between rope and pulley. It is easily understood that a very strong rope is of no more use than a weak one if the adhesion is so small that the rope will slip before the strain necessary to transmit the power is put upon it. The wire ropes referred to have a steel wire rope core $\frac{1}{2}$ inch in diameter, the rope being made up to $1\frac{1}{2}$ inch in diameter by a leather covering. The minimum size of pulley for a wire rope should be not less than 170 times the diameter of the steel rope, say a 7-feet pulley for a rope $\frac{1}{2}$ inch in diameter. The larger the pulleys are, however, the better.

For very high rope speeds it is necessary to take every precaution against bursting. Such pulleys as described are running at periphery speeds of over 7,000 feet per minute. It would be unsafe to subject an ordinary cast iron pulley to the strains induced by such a speed.

The great advantages of running the ropes at high speed are as follows: Fewer ropes are required, consequently the first cost is less, the wear and tear on the ropes are less, and they last longer, the friction is very greatly reduced, as the side pull on the bearings is exactly in proportion to the number of ropes, and has no relation whatever to the speed.

As yet I have said nothing on the question of ropes versus spur wheels, and will now just point out some of the advantages of the new over the old system. Spur wheels form a rigid and inelastic connection between the engine and the machinery, while ropes are elastic to a considerable extent, and with a bad and unsteady engine machinery will often work well when driven by ropes, when the opposite would be the case with wheel driving. The ropes, in fact, act as a cushion, taking up any sudden strain. Ropes are all in sight as they work, and anything wrong with them can be seen at once; whereas with wheels something may easily go wrong without its being suspected, until serious mischief is done. The breakage of a pair of wheels, especially if on an upright or second motion shaft, is a very serious matter, and yet it may happen at any time, and stop a mill for days. A rope gives ample warning before breaking, and can generally be taken off in time, and the others drive till it is replaced. The time required to splice a rope is about three hours, but all repairs to ropes, if properly managed, can be done at week ends. Ropes require taking up occasionally, the number of times depending on the work they have to do. A good rope with fair play should not require taking up more than three times in its life. It is sometimes desired to alter the speed of one shaft of a mill. When the mill is driven by wheels, this is often a great undertaking, while in the case of ropes it simply means ordering one new pulley.

Again, ropes are cleaner than wheels, and the freedom from noise and jar is a great advantage; while over and above all these, the first cost of rope gearing is less. The heavy fixings and shafting, the massive gearing wall, and the heavy foundations required are done away with. Against all these advantages there is only one slight disadvantage in rope driving. It sometimes absorbs more power in friction than wheels; but when ropes are run at high speed, and their number is properly proportioned to the power, the advantage in favor of wheels is not such as to have any practical weight in the face of all their other disadvantages.

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LUBRICANTS.

"Lubricants" are substances employed to reduce friction. "Friction" may be described as the effect produced by two bodies sliding one upon the other, which have upon their opposing surfaces minute asperities, that interlock each other. The sliding movement, which forcibly removes these minute irregularities, creates what we call friction. Friction is reduced when these asperities are small, and lubrication is resorted to to prevent that loss of power caused by motion under these conditions. The chief lubricants used have a less co efficient of friction than the parts in contact. The term "co-efficient of friction" is an expression which indicates the proportion which resistance to sliding bears to the force which presses the surfaces together. There is little friction when this amounts to only $\frac{1}{20}$; it is moderate when it is $\frac{1}{10}$, and it is very high when it is $\frac{1}{4}$, or 25 per cent., of the force which presses the surfaces together.

In a steam engine, where many parts are moving, a large amount of friction is produced, which tends to stop those parts, and it would ultimately do it were they not continually resupplied with fresh motion obtained by the burning of fuel. Hence it is apparent that the engine has not only to overcome the resistance of the work to be done, but also the resistance offered by its own parts. In other words, the amount of heat manifested in friction is the amount of extra heat that will have to be generated under the boiler, and the extra cost of working will be the cost of the fuel necessary to produce that heat. From the experiments of Morin, we find that the friction of a cast-iron shaft upon a dry bell-metal bearing amounts to ·2 of the transmitted power, while with a wrought-iron shaft the friction is more than ·25; therefore, if such shafts were dry and unlubricated, $\frac{1}{5}$ and $\frac{1}{4}$ respectively of the total fuel cost would be wasted in overcoming friction. By careful lubrication of the same shafts, the loss may be reduced to ·035 in the one case, and ·089 in the other. Hence the importance of a good lubricant. One of the next essential points is that it shall be properly distributed over the surface on which it is required, that just sufficient shall be used, and all waste avoided; otherwise, what would have to be spent in overcoming friction will have to be spent in buying oil.

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*Portion of a paper read before the Millers' Convention at Stockton-on-Tees by Norman Macbeth.

For very heavy bearings, tallow and other solid lubricants are used, such as mixtures of sulphur and tallow, asbestos, soapstone with asbestos, graphite, caustic soda, beeswax, and other similar mixtures which find favor among locomotive engineers and those in charge of heavy machinery. The pressure that can be borne by a good lubricant for a useful length of time depends upon the nature of the bearings as well as upon the lubricant itself. The velocity of the rubbing action also must be taken into consideration. The maximum of pressure that solid lubricants will bear without destruction is unknown. For steel surfaces, lubricated with the best sperm-oil, moving slowly, 1200 lb. pressure per sq. in. of bearing surface has been found permissible. Under the pivots of swinging bridges, several thousand lb. per sq. in. have been found to work; for iron journals, 800 lb. per sq. in. should not be exceeded.

An efficient lubricant must exhibit the following characteristics:—(1) Sufficient "body" to keep the surfaces between which it is interposed from coming into contact; (2) the greatest fluidity consistent with (1); (3) a minimum co-efficient of friction; (4) a maximum capacity for receiving and distributing heat; (5) freedom from tendency to "gum" or oxidize; (6) absence of acid and other properties injurious to the materials in contact with it; (7) high vaporization and decomposition temperatures, and low solidification temperature; (8) special adaptation to the conditions of use; (9) freedom from all foreign matters. The modern methods of testing the lubricating qualities of oils are directed to a discovery of the following points:—(1) Their identification and adulteration; (2) density; (3) viscosity; (4) "gumming"; (5) decomposition, vaporization, and ignition temperatures; (6) acidity; (7) co-efficient of friction. The first and second stages are described very fully in an original article by Dr. Muter in Spons' 'Encyclopædia,' pp. 1462–1477. The viscosity and gumming tendency may be simultaneously detected by noting the time required by a drop to traverse a known distance on an inclined plane. A 9 days' trial gave the following result:—Common sperm-oil, 5 ft. 8 in. on the 9th day; olive-oil, 1 ft. $9\frac{1}{2}$ in. on the 9th day; rape oil, 1 ft. $7\frac{3}{4}$ in. on the 8th day; best sperm-oil, 4 ft. $6\frac{1}{3}$ in. on the 7th day; linseed-oil, 1 ft. $6\frac{1}{4}$ in. on the 7th day; lard oil, $11\frac{3}{4}$ in on the 5th day. The day given is in each case that on which the oil ceased to travel. There are several ways of applying the plane test. A very simple and general test of fluidity is to dip blotting paper in the oil, and hold it up to drain: symmetrical drops indicate good fluidity; a spreading tendency, vicosity. Retention of the oil on the paper for some hours at 200° F. ($93\frac{1}{3}$° C.), or for some days at ordinary temperatures, will show the rate of gumming. (*Thurston.*)

THE USE OF SAND IN WELDING.

The flux chiefly in use is sand; being abundantly found in nature, it is, consequently, cheap. It is composed of silicon and oxygen, and technically known as silica. It readily melts on being applied to hot iron; and it is this property, combined with its cheapness, that accounts for its general use. Why is it used by the smith? Because, in joining two pieces of iron together, different kinds of splicing or scarfing are adopted; those, or at least the most common in use, are of a pointed character, and they present an unequal thickness of iron to the action of the heat; and as the point of the scarf is farthest into the fire, and through its unequal thickness conducts the heat much quicker than the heel, or thick part of the scarf, it consequently arrives in a welding state first, and, if the action of the heat was not checked, the point would be burned away before the heel had arrived at a welding state. To prevent this, the smith throws on or dips the back of the point into the sand; the sand, on coming in contact with the heated iron, melts and absorbs so much of the heat of the part to which it is applied, and, on melting, becomes vitrified. This glassy silicate readily combines with the iron, and forms a covering to the part exposed to the heat; and, being of a very refractory nature, it is some time before it is burnt off the iron. It thus protects the iron in its weak or exposed part, while the other or thicker part is absorbing the heat and arriving at the welding condition. It is sometimes used when the iron is on the anvil, but only when such iron is overheated and will not bear hammering. A little sand thrown on absorbs the heat and restores its cohesive power. The smith, in using sand, is always careful to keep it from the face of the scarf; he knows from experience that the cleaner he keeps the two surfaces to be welded, the closer and more perfect will be the weld. This is the legitimate use of sand in welding; it is employed as a chemical agent to prevent waste of iron, and even in this capacity should be used as sparingly as possible, for its baneful effects are left behind on the forged articles, which, if they have to be either planed or turned, present on their surfaces a series of knotty or flinty points, which blunt the tool and are a source of much annoyance to the operator.

The use of sand is injurious to iron, and though it may be used as an agent to prevent waste of iron in some particular kinds of scarfing, it is not essential to sound welding. In support of this assertion Newcombe refers to the welding of tires for railways and tubes for boilers; both these articles are continually under inspection for the purpose of detecting flaws or unsoundness, and they are subjected to continual tensile strain and shocks, which tend to develop any flaws or unsoundness; yet how few out of the many thousands in use give way at the weld, and they are invariably welded without any flux being used. Numerous other examples might be given of specialties of manufacture where the welding is done without any flux.—*Spon's Workshop Receipts.*

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OPTICAL ILLUSIONS.—Number VI.

By Egbert P. Watson, Jr.

By an oversight in the last issue we announced the conclusion of these articles. We continue them with an explanation of a simple performance which may be the means of enlightening many. The operator says:

"Here is a quantity of cotton wool (*showing a flat basket full of it*) upon which I propose to stay my hunger. I take out a handful thus (*illustrating*), and commence to eat it. It takes considerable chewing to masticate it thoroughly and is somewhat difficult to swallow" (*cranes out his neck and apparently experiences much difficulty in so doing*). He continues the eating and talking until the greater portion of the cotton wool is chewed up and eaten. Suddenly he stops, as if he had bitten something unusual. Placing one finger in his mouth, he draws out the end of a bright-colored ribbon. Looking at it curiously, he continues to draw it out. By the time he has finished, he finds he has about twenty-five or thirty feet of parti-colored ribbon. "I thought there was a foreign taste to what I was eating," says he. As the cotton wool is all puffed out before commencing to eat it, no one can see where the ribbon comes from. He then proceeds to eat what is left; just before it is all gone he stops once more and again inserts one finger into his mouth. This time he is rather astonished, as are also the audience, to find that he holds between his thumb and forefinger the beginning of a wooden barber's pole. He naturally wants to know how long it is, and, in order to find out, keeps on pulling until the pole has all been taken out. Then it will be found that it is about five or six feet long, about an inch and a half in diameter at the base and tapering to a point. "I have wondered for a week why it was that I felt so stiff, but this explains it. It's worse than having a ramrod down one's throat." The production of the ribbons can be repeated as many times as the performer wishes, but twice is ample; if it is repeated more times than this it loses its charm and becomes monotonous.

The explanation is this: The cotton wool, or cotton batting, can be purchased in any dry goods store, in roll, for about fifteen cents. A quarter of the roll will be sufficient. The ribbons and the barber pole which are taken from the mouth must, of course, be put in there before they can be produced. To do this, first buy what ribbon you wish and then roll it up in the same way that telegraph or stock indicator paper is rolled. After this is done, pull out the end which is in the center of the roll about a quarter of an inch and to this tie a small piece of thread, say about three inches long, the same color as the ribbon. Your roll will look something like this figure. The projecting thread is to pull when the ribbon is in the mouth; this, of course, starts the rest of it out. Now take a little loose cotton wool and wrap it around the roll, taking care to have the loose end of the thread outside of everything. Then put it in your basket where you can find it when you want it. It is a good plan to vary the colors in each roll. If one roll is white and red, make the second blue and yellow, but in order to have it look yellow in the evening a salmon-colored ribbon must be used. Yellow at night is nearly white.

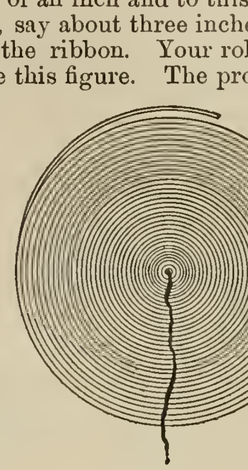
Fig. 10.

Now for the barber pole. To make this, get some manilla paper and cut it into strips an inch and a half wide. Paste them together so as to make one strip ten feet long. On one side of this paint a red mark or line the whole length of the strip and one-half an inch wide. This will leave a blank space of one inch. When your paint has dried roll the paper up tight, tie a string around it and leave it for a day or two. This is necessary, as the roll should keep closed.

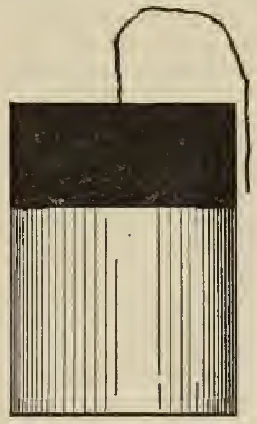
Fig. 11.

What looks like the fuse of a large firecracker is a thread glued to the inside end for the same purpose as that which was attached to the ribbon roll. Act as you did with the ribbon in placing cotton around it and putting it in your basket. With the above and a glass of water you are ready for your audience. Before going on the stage make your quarter roll of cotton wool as airy and as fluffy as possible without giving it the appearance of a cobweb.

By this means the quantity you really use appears to be twice or three times as much as it actually is. Step out on the stage and commence to talk. Pick out a handful of cotton, and commence to poke it in your mouth with your wand. When you have all you can conveniently manage, take a small mouthful of water and chew. The water will help the cotton to pack into a very small compass, and is absolutely necessary. When you put your second handful in the mouth, take it with the *tips* of the fingers; this will form a hollow in the hand, into which the first mouthful can be dropped under cover of the ingoing handful. When you reach for the third handful the chewed mouthful can be unostentatiously placed in the basket. Repeat this until the cotton is almost consumed, and then take out one of the rolls of ribbon covered with the cotton. Place this in the mouth, make a wry face and proceed to investigate. Catch hold of the loose end of the cord and pull slowly; the result is, of course, a long ribbon coming from the supper of cotton wool. Proceed in the same way with the barber pole. When you draw out the pole, a screwing motion must be kept up so as to have the pole perfectly firm, solid and tight. It is a good plan to put a small elastic band around the roll before putting the cotton around it. This insures keeping the large end of the pole tight. Do not draw the white turns out further than the red ones are painted; that is, your red band will be a half-inch wide; when you pull the pole out don't make the white band any wider than the red one. This will leave a half-inch inside of all to hold it together. Above all things, be careful not to pull the whole out too much, for if you do it will come apart somewhere, and then, of course, every one can see that the wooden pole is made of paper. After it has been drawn out hold the large end in the right hand and use the left to keep the whole length straight. Hold it out for the examination of the audience, talk for a moment with it in your hands, and then put it on your table.

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WORKING GIRLS IN BOSTON.

The report of the Massachusetts Bureau of statistics of labor has some interesting details upon the condition of working girls in Boston, from which we quote a portion:

In 1880, 38,881 females were employed in all wage-paying industries in Boston; of these, about 19,000 were domestics, while about 20,000 were engaged in trades of various kinds, and in manufacturing occupations. The object of the Bureau was to ascertain the moral, sanitary, physical, and economical condition of the working girls of Boston. To do this, 1,032 were visited at their homes after working hours, and subjected to a searching inquiry into their actual condition. These 1,032 working girls formed but 5 per cent. of the 20,000, but as they were taken at random, all sections of the city being visited, and the leading industries being well represented, the results for the 1,032 are indicative of the condition of the entire 20,000.

They work from 4½ to 18 hours a day, 369 having a short day on Saturday, while 58 find Saturday calls for more time than other days. The Massachusetts law, which limits the weekly working hours to 60, was found to be violated in 89 instances. The statistics of lost time for 758 show 12.32 weeks each, or nearly one-quarter of their possible working time. A great part of this lost time is due to "seasons," that is, the practice of making up in a few months enough goods to last half a year or even a year.

As regards accidents, 1,000 have escaped any injury, and in but few of the 32 cases were the injuries sustained while at work.

The subject of economic condition covers wages, earnings, expenses, and surplus or debt. The weekly earnings were found to be $6.13 per week in personal service, $5.71 in trade, $6.47 in manufactures, the average in all branches of employment being $6.35. Of the 1,032, 921 girls earned less than $10 per week. If these earnings, which were for an average of 42.95 weeks employed, are distributed over the whole year, the average is $4.91 per week.

To this must be added the amount received for other work besides the regular occupation, and all forms of assistance. When this is done the average weekly income for girls engaged in personal service is found to be $5.25; in trade, $4.81; in manufactures, $5.22; and in all industries, $5.17. This latter figure ($5.17) is the average weekly income from all sources of the working girls of Boston.

The items of expense cover room, board, food, lodging, clothing, medical attendance, fuel, washing, car fares, support of others, and sundry outlays. The grand result is an annual income of $269.07 on an average, a yearly expense of $261.30, and an average margin in excess of $7.77.

The topic of moral condition is dwelt on to a marked degree. The charges so often made that shop girls are an immoral class, that it is largely from their ranks that prostitution is recruited, and that the employment of girls is often based upon immoral relations with foremen and employers, are denied *seriatim* and *in toto*, and are said, as far as Boston is concerned, to be entirely disproved by the evidence obtained; the same can be said of other cities.

RUMBLINGS FROM AN EARTHQUAKE.

Earthquakes are a novelty in this vicinity, and more surprising than agreeable. A shock passed over the eastern portion of the United States on the 10th inst. about 2 P. M., and the unusual manifestation gave many a new topic for conversation. We quote from the daily press some incidents:

"At the Western Union Building, a very solid structure, there was a sudden shock, which shook the building to its foundations, and the operators stared at each other in fear and trembling. When it passed, the word went around that the new engine just put up in the basement had been started up on trial, and one of the clerks remarked that an engine so powerful as that would shake the building down some day."

An amusing incident happened at the Occidental Hotel. A number of persons were dining in the restaurant. The building began to shake until the chandeliers swayed to and fro. People looked at the chandeliers and then at each other in astonishment until a middle-aged, well-dressed man hastily put his hat on, declaring at the same time in a loud voice: "That's an earthquake. I'm from California, and I know it!"

At Ludlow street a German issued slowly from his saloon and said excitedly: "Officer, you must do sometings. Der iss a man up apove me vot dances until I am tired. Chust now he makes all the house rumble up stairs."

Two stuffed birds in a barber shop began to move up and down, and an astonished customer sprang from his chair and asked if the birds were alive.

A nervous waiter danced around the dining-room like a cat on a hot stove, and sought to allay the panic by shouting: "Seet down! seet down! It's only der boiler what is busted!"

General Viele has figured closely on the subject, but he does not say where he gets his data from.

"When Gen. Viele had ascertained all he could through the telephone, he made a careful computation of the potentiality of the shock. With the assistance of his son he made calculations which showed that the potentiality would be represented by about 700,000,000 horse-power. He also demonstrated to the complete satisfaction of the visitor that his potentiality, when connected with a subterranean force, would represent a movement of solid matter covering an area of about 400 cubic miles."

An interesting feature of the excitement caused by the earthquake shock was the curious light which it threw on the tendency of men's minds to find a reason for an unexpected phenomenon close at home. There were almost as many different notions about the cause of the roar and shock as there are different occupations. For instance, the men at Police Headquarters, with an eye to business, thought burglars had blown open the safe in the Treasurer's office up stairs; employees in the newspaper offices thought the presses had suddenly been set going on a jump; in crowded tenement houses a cry of fire was raised; the occupants of the municipal building in Brooklyn, where a severe gas explosion had occurred, thought it was another explosion; residents in the neighborhood of big factories thought a boiler had burst; the Greenpoint police were sure that another oil tank had been blown up; the toll collector at the entrance to the big bridge supposed a car had run off the track in the depot over his head; workmen reconstructing a burned bridge in New Jersey thought the timbers were falling; the employees of the elevated railroads, being accustomed to the continuous shaking of those structures, thought nothing about it, and the Italian residents of the city, who have had much experience of earthquakes in their own country, obeyed an irresistible impulse to run into the center of the streets and wait for the buildings to fall. They appear to have been the only people who with one accord immediately recognized the fact that it was an earthquake.

◆

The First Paper Floor ever laid has just been completed in the new rink on North Pennsylvania street, says the Indianapolis *Journal*. This floor is made by pasting and pressing straw boards together under a powerful hydraulic press in the same way as the discs of the paper car wheels are made. When these blocks are perfectly seasoned and dried they are sawed up into flooring boards and laid with the edge of the paper forming the surface of the floor. This surface is sand-papered until it is as smooth as one vast sheet of ice, and the adhesive quality of the paper prevents any slipping of the roller upon the floor. The floor being without joints, perfectly smooth and comparatively noiseless, with no slipping of the rollers upon it.

◆

According To Mr. Jacob Johann (Wabash, St. Louis & Pacific R. R.):

"The general tendency among American master mechanics seems to be toward building larger boilers, thereby increasing the heating and water capacity. In my opinion this is in the right direction, especially in the case of fast engines running heavy trains. The increased piston speed necessitates an increase in the capacity of the boilers. If the boiler is not capable of furnishing all the steam that is required under any and all circumstances, we can safely predict a failure as the result. The increasing working pressure necessitates a stronger boiler, requiring more attention to the material of the boiler and firebox, the manner of riveting, and the strength of the bracing. Every advance in this direction secures more effective work from the evaporation of a given amount of water. A successful and economical engine should have as large a boiler as possible, with maximum heating surface, and designed to carry a working pressure considerably above the ordinary practice. He who first reaches the limits in these three directions will secure the fastest and most powerful locomotive, under given conditions, minor details being also improved."

◆

A Novelty In Campaign Torches is one which shoots a stream of fire into the air. It consists of three wicks fed from a kerosene lamp. In the center of these wicks is a tube projecting from the handle. At the end of the barrel there is a receptacle filled with a chemical powder. This powder is blown through the tube at will, and as it passes the flame it ignites and appears in the air in the form of a cornucopia of colored fire. Its height, of course, depends upon the lung power of the blower. Ten to twelve feet have been reached.

◆

By A Recent Fire in Jersey City the depot at the Pennsylvania R. R. was burned. An officer said to a reporter: "We had some invaluable documents in the nature of inventories and historical and legal data concerning our properties, and these have perished. Ten years ago I suggested the building of a fire-proof building for them, but the plan was postponed, and now they are gone. It will be the labor of years and will cost thousands of dollars to replace them.

If a man's foresight was as good as his hindsight what sagacious persons we should be!

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

AS BOILER-SHOP FOREMAN.—The writer of the articles on Steam Boilers in this paper is open to an engagement to take charge of works. Has had long experience on all kinds of work, and understands it in detail. Is now employed, but wishes to change. Address, Button-Set, care Egbert P. Watson & Son, 150 Nassau St., N. Y.

MARINE ENGINE DRAUGHTSMAN, 13 years experience, now holding responsible position in one of the largest British Engineering and Ship-building Works, where highest class of mail steamers and gunboats are built, desires a situation in the United States. Has sea-going experience and is competent to design all classes of machinery and superintend construction. Draughtsman, care Mechanical Engineer, 150 Nassau Street, New York.

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INDICATOR FOR SALE. I have a new Crosby Indicator which I will sell for $65. Entirely new and sold only for want of use, as I am changing business. Address Indicator, care Egbert P. Watson & Son, 150 Nassau St., N. Y.

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BOILERS OF THE "LOUISIANA" WITH WATER WALL AND FIRE BRICK ENCLOSED FURNACES.

Fig. 1 sectional elevation, and fig. 2 are respectively the front view and section of one nest of the original boilers.

Fig. 3 is a sectional elevation and fig. 4 front view and section of one nest since the alterations.

There are eight (8) boilers in all, divided into four (4) nests of two (2) each, by the arrangement of their valves and fittings.

The shells are 8 ft. 6 ins. diam., the boilers are each 12 ft. 2 ins. long, from head to head, and $\frac{5}{8}$ inch thickness.

Each boiler has 217 tubes of 3 ins. outside diam., by 10 feet long.

Each boiler has *now* a grate surface of 37 square feet, and a tube area (calorimeter) of 1,280 square ins.—in the proportion of 34·6 to one square foot of grates.

The heating surface of one boiler is *now* distributed as follows:

Bottom of shell in furnace	76 sq. ft.
Top of back-connection....	34 " "
Back and front tube heads.	56 " "
Tubes.....	1,689 " "
Total heating surface in present boiler of	1,855 " "

These eight (8) boilers have the totals of 296 sq. ft. grate surface, and 14,840 sq. ft. heating surface, in the proportion of nearly 50 sq. ft. to one of grate area.

The alterations diminished the heating surface on the bottom of shell in furnace 54 sq. ft.

Removing the side walls entirely.........	144 sq. ft.
Removing the back wall of back-connection........	32 " "
Removing front wall of furnace..................	15 " "
Total heating surface diminished in one boiler......	245 " "

Each furnace lost 10 sq. ft. of grate surface. Therefore the 8 original boilers had 376 sq. ft. of grate surface, and 16,800 sq. ft. heating surface; since the alteration we have 296 sq. ft. of grate surface and 14,840 of heating surface.

For the several voyages from which we get the data given, the average load displacement has been 4,300 tons. The average speed for these voyages was 14 sea knots per hour, on an average consumption per hour of 3,360 lbs. of coal—in the proportion of 11.35 lbs. per hour per sq. ft. of grate.

The average horse-power developed was 1,780, in the proportion of 1·898 lbs. of coal per hour per horse-power.

There are 8·337 sq. ft. of heating surface for each horse-power, and each sq. ft. of grate gives 6 horse-power.

The horse-power is calculated from indicator diagrams taken about every watch during the voyages, and the consumption of coal is what was actually taken from the bunkers without deduction, for the amount used for the galley, for the steering and anchor engines, and for the cargo hoister—actually all the coal the owners have to pay for.

Six boilers will do the work with the same coal, but we avoid cleaning fires on the voyage when using the whole number, and thus give easier work for the firemen, which is economically better, taking in the whole voyage; the whole eight boilers are usually fired under.

Therefore the comparison should be from six boilers; when we have 15 lbs. coal consumed per hour per sq. ft. of grate, and each sq. ft. of grate gives eight (8) horse-power; also, a horse-power is had from each 6·25 sq. ft. of heating surface.

The small amount of horse-power required in this vessel to produce the average speed of 14 knots per hour continuously for 127 hours should be noted, but the results are from a number of trips; currents and weather favorable, or the contrary, as they may happen. For a reason of my own I have purposely selected those passages where the load displacement of the vessel averaged 4,300 tons.

These boilers when at work, are remarkable for carrying their water *steadily*, and for the fact that there is no violent water movement in them. The water supply is steadily furnished at the point marked "feed pipe," in the engraving, and replaces without agitation the quantity passed off in steam.

It is a very important discovery, that the protection from the great furnace heat, given by the brick walls to the sides of the shell, effectually takes from the water inside all undue tendency to agitation.

Circulation, as commonly understood, does not apply to this type of boiler, the water movement for replacement, being very direct; it could be made still more so, by an internal perforated feed delivery.

The brick-wall protection at the sides of the shell provides spaces within its fluid content for *quiet water*, so placed as to insure freedom from disturbing influences; particularly from such movements or forces as are powerful enough to prevent the water from maintaining its *solid* condition, by its inherent gravity.

The positions of both feed and blow-off pipe holes are the same as before the alterations, and are properly placed, as proved by experience.

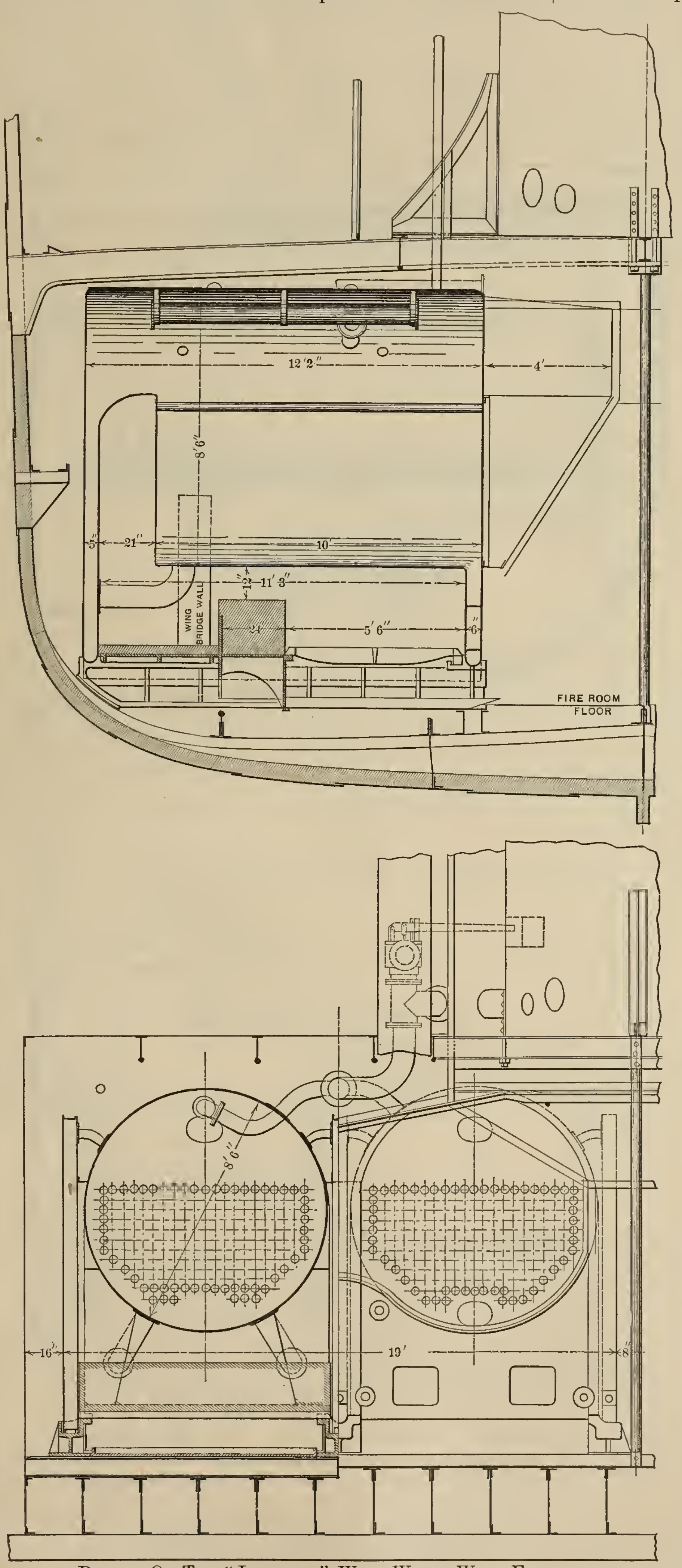
There is a surface blow upon each boiler shell; this is not shown on the drawings.

The point from which the bottom-blow-off should be made, is at the quietest portion of the water within the boiler, as shown on the drawing, but I would prefer a steady outflow through a small opening from each shell, passing through a feed-water-heater, to utilize the waste heat, to that of blowing-off periodically.

In caring for these boilers, as they contain but a limited quantity of water, relatively to their evaporative power, everything depends upon the perfect filtering arrangement, for the feed water, in use in connection with them; consisting simply of sponges, carefully cleaned each watch during a voyage.

Allowing the brick-work and water to cool off before emptying the boilers, and following this by a thorough hose washing is good practice in any kind of a boiler, but it is particularly effective here because the washing is so thorough.

I am of the opinion that the *steadiness* of the water noticeable in these boilers is, in part, due to the fact that each tube becomes a *deflector* and *separator* of the water carried with the steam; the latter passing



BOILERS OF THE "LOUISIANA" WITH WATER WALL FURNACES.

directly upward, while the former is deflected into the *quiet water* spaces at the sides.

It is certain that the perfect combustion of the fuel, at the furnace of this boiler, forces the tubes to give out a larger proportion of heat to the water, and distributes the work done, over a greater amount of heating surface than is common to many other types of boilers.

We have demonstrated in these boilers the great value of brick enclosed furnaces for sea-going vessels, and have developed a most efficient boiler, safe, simple, and cheaply constructed, but it is limited to pressures of about 100 lbs , and is not up to the requirements of modern practice, which can only be reached by the safer constructed sectional-water-tubular type, where pressures of 200 lbs. are possible.

Upon comparing the drawings, the radical change made in the construction of the space beyond the bridgewall will be seen. The combustion chamber, so called, is removed and a plain hearth, or brick floor on a level with the top of bridgewall has been substituted.

The area above the bridgewall is about ⅙ the grate area, as usual, and beyond the bridgewall are two wing-bridgewalls which are used simply as deflectors of the heat current; these are necessary to distribute it properly among the tubes.

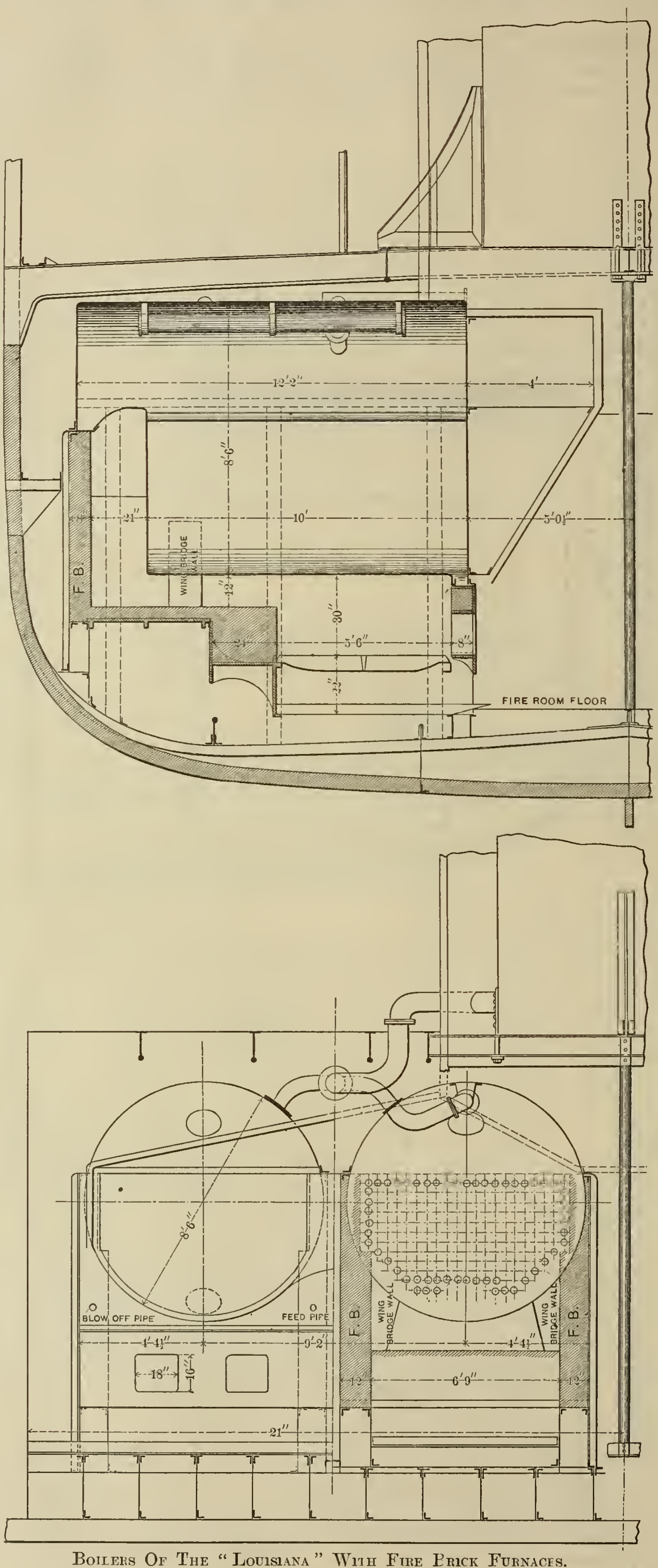
The drawings of the boilers have been very carefully made, both before and after the alterations, the desire being to give positive information upon the subject, and great care has been exercised to test practically all the changes before deciding upon using them. This relates particularly to removing the back head of the back connection, and the removal of the curved pipes connecting the bottom of the shell to the water-leg, which was the supposed collector of all the sediment, but no sediment ever reached that part of the boiler unless from over accumulation by neglect.

These boilers are now using semi-bituminous coal with great advantage. The furnaces seem particularly well adapted for it, and the absence of smoke at the top of the smoke pipe is an assurance of excellent combustion, if any other evidence is needed.

Engineers have given considerable attention to these boilers, and lately there have been several put in operation with good success. Though said to be in opposition to the U. S. Steamboat inspection laws, I hardly think a fair interpretation of the whole of the law warrants the assertion.

In setting up on ship-board the brick-work must be carefully done, to be lasting. In the two years' practice on these boilers, I found that all masons are not to be trusted to use the required care in building the walls.
MIERS CORYELL.

Aug. 20, 1884.



BOILERS OF THE "LOUISIANA" WITH FIRE BRICK FURNACES.

ACCORDING TO MR. JOHN S. PERRY, of Albany, N. Y., it costs $107 per ton to make cast-iron stoves, say five cents per lb. in round numbers. A 200 lb. stove at $26 ought to pay somebody a profit.

THE UNITED STATES USE MORE STOVES than all the rest of the world put together. There are about 8,000,000 of them in use here, costing perhaps $180,000,000. They range in size from little toy affairs, which could be carried under each arm, up to colossal stoves intended for summer hotels and wood-burning districts, which will do the cooking for a hundred persons. Their price is calculated by their weight. The founders sell them at rates ranging from 5 to 8 cents a pound, and the retailers at about 50 per cent. advance on these figures. One stove lasts on an average about five years. Some large founders show nearly 500 kinds. The chief producing places are Troy, Albany, Cincinnati, Buffalo, St Louis, Louisville, philadelphia and Cleveland. The largest foundries are two in Albany, one in Troy, one in Buffalo and one in St. Louis. Each of them makes from $500,000 to $750,000 worth of stoves annually.

Last year square stoves for heating were brought out, and this season every manufacturer has a supply, but in no case are the designs identical with those of 1883. Each has been changed, involving great expense to the founders. The bills of some of them for patterns alone mount up to fifty or sixty thousand dollars a year, as there are changes to make nearly all the way through.—*The Sun.*

CUSTOM OF THE COUNTRY, in Mexico. A correspondent of the *Times* says:

> They always raise the price in Mexico when you want anything in large quantities. The Mexican Central Road wanted a quantity of ties, and the contractors went to a Mexican and ordered 10,000 from him on trial. The ties were found to be suitable, and then they ordered 100,000. Then the man doubled the price. They tried to argue the matter with him, but he said that if they wanted so much more work of him they must pay more. Another incident, related to me by one of the parties, concerned a Judge. His signature was wanted on a certain paper. In the ordinary course of law six months would have elapsed before he signed the paper. A great deal of money was involved in the matter, so the interested persons went to the Judge and made him a proposition.
>
> "If you will sign this paper at once," said they, "we'll give you $5,000, and not a living soul shall ever know it."
>
> "Not a living soul?" he asked.
>
> "No, not one."
>
> "Well," answered the Judge, "make it $6,000 and I don't care who knows it."

PRESS DISPATCHES SAY:

Capt. Henry N. Throop, the oldest steamboat man in this country, died at his home, Pultneyville, N. Y., Aug. 6, at the age of 87. When a young man he turned his attention to ship building, in which business he always remained. He was the builder of the first propeller wheel in 1836, and a year later invented propeller or screw wheels attached to sides of a boat. The wheels are still extant at Pultneyville, and are the oldest known.

THE *Lumberman's Gazette* says: "Some idiot has started on its rounds an article advising the use of alcohol in connection with water in steam boilers, for the purpose of making steam more effectually and with less danger than with water alone. We believe the author of that idea should be sent to an asylum for idiots by the first train. We are sustained in this view by the directors of the Manufacturers' Mutual Fire Insurance Company, who refuse to permit its use in any mill on which they hold a policy."

If our contemporary intends to catalogue all the idiotic inventions extant, it has plenty of work on hand.

THE BEAUTIFUL RED AND BLACK ORES of Franklin, N. J., are cut, polished, and sold as ornaments and paper weights. The ore is a compound of iron, zinc, and manganese.

CRUDE PETROLEUM AS FUEL.

English engineers have been quite enthusiastic upon the subject of petroleum as fuel for steam boilers, but they have found what a great many have in this country, and what others have yet to discover—to wit: that the supply of crude petroleum is limited, and that so soon as a regular demand for it arises it increases in price, so that it is no longer a cheap fuel. The heating value of it, pound for pound with coal, is another objection, for which as yet no remedy has been discovered.

There is no difficulty in using crude petroleum as fuel. Patents without number are extant, covering apparatus for burning it, but the commercial aspect has not yet been patented, and until new and inexhaustible supplies are discovered petroleum cannot compete with coal.

UNHOOK HER!

The sort of argument put forward by people who mean to revolutionize things, is fitly shown in this paragraph. This is the story invention boomers compose when they float new companies:

> "It is stated that a thermo-electric generator has been invented, which is believed to be the beginning of a revolution in the use of the electric fluid. The generator is like a copper boiler, and stands on the frame of an ordinary sewing machine. It is operated by a coal-oil lamp, and the flame of one used to give partial light in a sick room furnished a supply of electricity which ran a one-horse engine and illuminated four incandescent lamps. The inventor claims that he will be able to furnish motive power for all purposes in which stationary engines are used at one-twentieth of the present cost. His generator is attached to a telegraph wire running to Louisville, and thence by a loop to New Albany, and with the expenditure of no material, except the oil in the lamps under the generator, is supplying all the electricity needed for telegraph purposes."

Exactly; but between the one-horse power business from a turned-down kerosene lamp, and running a telegraph instrument, there is a chasm—as one might say. Give us a little at a time. Unhook e r.

CARPETS WORTH $20,000.

Carpets worth $20,000 are not common but they are in existence. They are Persian carpets, and some of them are two centuries old. The colors and the fabric are unimpaired. The secret of their durability lies in the material they are made from. This is hair, not wool. Camel's hair, yak's hair, goat's hair are all used. The London *Art Journal* says:

"The stiff goat's hair cannot retain grime, while dust shakes off from it at once. The finest hair is difficult to obtain, and equally difficult to dye and spin, but it forms the larger part of finest carpets, the colors of which are unaltered after several hundred years of use. A Persian carpet of the fourteenth or fifteenth century is a real work of art, having the same relation to an ordinary carpet that a picture of Titian has to a third-rate canvas in an auction room. One carpet described required 10 hours a day for 20 years and could not be manufactured to-day for less than $20,000, and the carpets of the "fine period" have, many of them, 500 to 775 stitches to the inch, being worked on silk warps, with often the introduction of gold or silver thread."

The Steam Yacht *Radha* has been sold for $65,000 to a Chicago gentleman. She will be the largest and most elegant private pleasure boat on the lakes. The *Radha* is a screw steamer, built at Newburg, in 1880. Her length is 156 feet over all, 20 feet 4 inches beam, 9 feet deep, and she draws 8 feet 3 inches of water. She is propelled by a compound engine with three cylinders, two of 20 inches and one of 23 inches in diameter, with 24-inch stroke, supplied with steam from a boiler 9 feet 4 inches by 14 feet. She is one of the fastest yachts of her size in the New York yacht club.

A Correspondent writes to an English paper: "While lying off Madras, in the harbor, on my way from India, I had my attention drawn to a white gentleman with brown legs, on a catamaran. It was explained to me that the natives went about the shark-infested harbor with impunity, and that a European had had several narrow escapes until he colored the lower part of his body and its extremities, since which he had gone about unscared" (unscarred?).

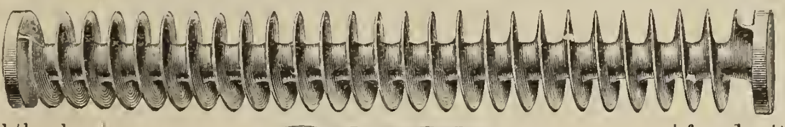
SPECIAL DEVICE FOR CUTTING QUICK PITCHES IN SMALL LATHES.

The Tower Machine Works, of East Brookfield, Mass., have a special device which they apply to small lathes for cutting screws of quick pitch—such as multiple threads—which is said to be very effective. They do not describe the attachment, and we cannot, therefore, give any idea of what it is like, but as the fixture is for sale it is presumable that intending purchasers will be given full particulars. The makers say:

By the use of this method the screw cutting capacity of a lathe is increased on an average one hundred and fifty per cent., without any addition to the usual number of gears. They have a 16-inch swing 6 ft. bed, Blaisdell lathe, on which they cut screws as coarse as one thread in four and one-half inches, and as fine as 132 threads to the inch.

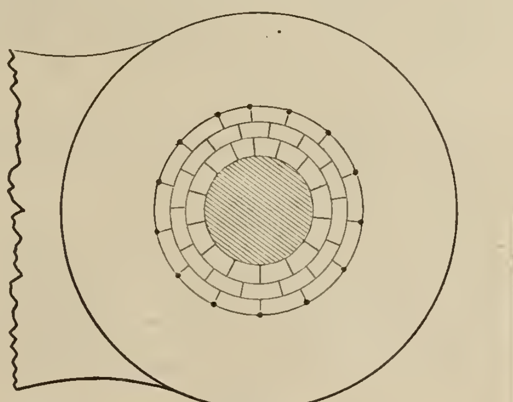
One of the unique features of this device is that in cutting screws of coarse pitches very heavy chips can be taken, inasmuch as the driving power from the cone-belt is not consumed by friction arising from the use of a multiplicity of compounded gears, but is at once directly applied to the work without material loss. Therefore the ability to take a heavy chip is limited only by the driving capacity of the belt. This device is also of great utility where cross feed is used, either in squaring or facing up.

As specimens of work done on this lathe we herewith illustrate a sextuple thread screw, each thread being of two-inch pitch, and also a single-threaded screw, lately made for a large paper mill. This screw measured three feet, eight inches in length, six inches in diameter, and $1\frac{5}{8}$ inches on thread centers. Further details can be had by addressing the parties as above.



SUGGESTION FOR A "MAKE SHIFT" CRANK PIN.

Crank pins not infrequently break, and sometimes when there is no spare one on board. In such a case the following idea is suggested for a make shift:



Lay up a series of staves of bar iron all round the eye, as shown, in the same manner as an air pump is lined. A second series, breaking joint with the first is also laid up, and a third if necessary. In the center a solid bar is set to key against. The idea is that this impromptu crank pin would enable a ship in mid-ocean to get somewhere, and if the work was properly done, it would stand a very heavy strain. Everything would depend upon the character of the workmanship.

It goes without saying that the working surfaces of the pin would have to be chipped and filed, but if these were not exact or as accurate as lathe work, it would matter very little, in comparison with having no pin at all.

A make shift pin of this character could be made of any size.

Alligators' Teeth are worth $4 a pound.

WIRE.

No wire of consequence was made in England until late in the 15th century, and the art of drawing it was not introduced until the 16th was well nigh half ended. The growth of the industry in that country was rapid, and in Cromwell's time had attained considerable importance. One of the earliest mills for wire-making was built at Nuremberg about 1660, and a hundred years later the first English mill was put in operation at Mortlake. The idea of the draw-plate came from the East, but to whom the credit of its invention is due is not known. It was brought to France by Archal, and to England by Schultz. Its form has not materially changed, and is that of a cylinder flattened on one side and bored with holes of graduated size, through which the wire is drawn in succession by means of a wheel and crank until it has reached the requisite size.

For very fine gold and silver wire a perforated ruby is used. The holes taper to the side where the wire first enters. Small fine wires are drawn cold, being frequently annealed during the process. All wires in drawing require constant lubrication. The rapidity of drawing varies with the size of the wire and the ductility of the metal, the speed increasing to as much as 75 inches per second in very fine gold wire. Iron and brass wires range from 12 to 50 feet per second.

Single silver wires have been drawn to a length of 205 miles.—*Unknown Source.*

A Nine-Inch Whitworth Gun has thrown a steel shell through 18 in. of iron, 37 in. of wet sand rammed hard in an iron cylinder, $1\frac{1}{8}$ in. of steel plate faced with 7 in. of oak and angle irons, and finally penetrated 16 ft. into the ground.

Fired with 10 deg. elevation it attained a range of 7,876 yards.

As Regards Failure Of Belts, a manufacturer of them says, in relation to those who condemn them hastily:

After having purchased belting, they, in many cases, take very little care of it. They will see that the engine and all the machinery is kept nice and bright, and in good order, but belts are often put on in a careless manner, the ends cut at random instead of being cut with a square; for, unless the ends are squared, it will make a crooked joint, cause the belt to run crooked, and often run off the pulleys. Many run the flesh side next to the pulley, and with the ends of the laps pointing forward instead of backward, and seldom, if ever, clean or oil them.

All of which is quite true.

Samuel Rogers wrote of the *Pleasures of Memory*, but here is an instance of the pleasures of imagination. A dealer says:

> "There is a pencil in that case. It's a cheap-looking thing, isn't it? Don't look worth more than a cent, does it? Well, it would take a ten dollar bill to buy that. The cedar that surrounds the lead in that pencil was centuries old, I guess, before any cedar that is standing today began to grow. It was taken from a marl bed in Orange county, N. Y., at a depth of sixty feet, and near it was found a mastodon's remains. That bone knob on the end of the pencil was a piece of that mastodon's tooth. No, I don't think ten dollars would buy that pencil."

What of it?

E PLURIBUS UNUM.

We have pointed out in previous paragraphs that The Mechanical Engineer is addressed to the mass of the trade everywhere and not to classes in the trade anywhere. The Mechanical Engineer is not a "class paper" but a trade paper, and as such does not affect the language of pedants or have sympathy with hobbies. If such letters as this are any criterion the policy indicated finds favor:

> I have taken your paper now about two years and find it meets a demand on the part of the general mechanic for a cheap, comprehensive, and practical paper, devoid of lengthy and dull themes which many of your contemporaries are in the habit of inserting, and which furnish no information to anyone unless he is versed in all the sciences. Wishing your paper and yourselves prosperity, etc.

This is from Geo. A. Young, Grand Crossing, Ills., and the sentiments he expresses in common with those of a great many others, convince us that we have not misinterpreted the popular demand.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

REPAIRING A ROLL TRAIN.

Editors Mechanical Engineer:

I want to tell you about a roll train we took a contract to repair. They wanted to put a new foundation under the rolls and engine. The rolls had been kept running steadily for years. The foundation was originally of wood, and what was not burned was rotten. The roll housings were on iron shoes, which were worn very much where they stood. It was decided to change the location of housings on the shoes, then the shoes need not be dressed up again. The big planer had all it could do to plane the inside of the housings, which were worn so much as to require plating. I had to dress the foot of the housing with hammer and chisel to gauge. We found the seat for the bottom roll box so badly worn that it would take about four days to dress each one by hand. We had a Sellers slotter, 12″ stroke, and I proposed to do them on that, but was met with a shout of laughter from all who heard the proposal. It did seem ridiculous to put a casting of at least five tons weight on that machine. Remember, this was an 18″ train, three high rolls.

Somebody told me to put my head in a bucket of water and cool it!

Now see how easy it was done! One of the lathes in the shop had a saddle-plate about three ft. wide by four ft. long, and three inches thick; one side of this plate had grooves in it to fit the V's on the lathe; the other side was flat. This plate was turned upside down and laid on the floor in front of the slotter; it was then shimmed up level and we had a tramway in one direction. We then found another saddle about four feet long and twelve inches square, made like a box without top or bottom. This had two slots for ¾″ bolts on each side of it lengthwise. Between the slots, on one side, a circular groove was planed about ¼″ deep and of about 1½″ rad. The scrap pile furnished six rollers, four of which were turned to fit the grooves in the first saddle-plate; two were fitted to the circular groove in the other saddle. Four pieces cf bar iron, 2½″×1″.16″ long, with hole in each end made frames for the four rollers; these frames, bolted to bottom of saddle, made a carriage that traveled east or west on the tramway. Two more pieces of 2½″×1″, long enough to reach across the housing, were used as a frame for the rollers fitted to the circular groove. This frame was bolted to housing, after it was laid with the end we wanted to slot, near the right place on the slotter table, and being near the center, or middle, it carried most of the weight.

Now we had a carriage that would travel north and south, or about at right-angles with the other tramway. We then set the housing by the slotter frame just under the cutter bar guide, squaring up from the table to get level. I was not the only one surprised by the ease with which we could move that heavy piece after it was bolted to the slotter table. A housing was slotted out every ten hours, and when they were put up on the shoes again, a fine sea-grass line was run through from center of engine shaft to show that they were not 1/32″ out of line.
REPAIRS.

New Castle, Del.

[Thanks; this helps others possibly, who may have similar work.—Eds.]

◆

AN INTERESTING COMMUNICATION.

Editors Mechanical Engineer:

I don't know if your articles upon "*Optical Illusions*" are particularly instructive to the majority of your readers, but they were very interesting to me for they revived reminiscences of the past.

Many years ago when I was an apprentice, a strolling fakir had occasion to visit the shop where I was employed to get a little job done. If I remember rightly it was a screw to be fitted to an automaton. While waiting for the job the magician amused and astonished the apprentices by performing before their verdant eyes wonderful feats of legerdemain. He apparently swallowed nuts and bolts with lightning dexterity! I attended several exhibitions that the wizard gave and among the many tricks were numerous experiments in electricity, such as the glass clock dial, bell, and strong box. His mechanical experiments consisted of the suspension, inexhaustible bottle, automaton peacock and harlequin, etc. The performances caused an intense excitement among the workmen and apprentices in our shop, who were all anxious to know "how the thing was done." Among the boys in the shop was a smart lad who allowed his curiosity to get the better of his judgment. He resolved to find out how the magical apparatus was constructed. While his companions were asleep this lad fitted keys to the building where the apparatus was kept. He entered unobserved and examined to his heart's content the wonderful mechanism that had created so much excitement. In attempting to leave the building he was detected and arrested. His motive was not for gain, but only an intense desire to see how the thing worked. He was placed under bonds to appear when the court called him, but that day never came, for, by the advice of his friends and relatives who knew the circumstances of the case, he departed for the West, where, by his own exertions, he has now a position of trust and responsibility, and is to-day the master-mechanic of the largest road out of Chicago.

I have no doubt but that he reads your articles, or ought to, and I often wonder if he recalls to mind the youthful days when he wanted to be a magician.

The above mentioned tricks were the invention of Houdin, but Prof. Pepper, of the Polytecnic, claimed the optical illusions of the ghost, sphinx, floating-head, cabinet, etc. The camera obscura is as old as the hills, and the arrangement of mirrors to look through a brick must have been invented by the Chinese. Excuse me for trespassing upon your valuable time.

Boston, Mass.
JOHN H. MALDT.

[Our correspondent's communication is interesting. It is not claimed for the articles on *Optical Illusions* that they are new inventions, but that they are new to the mass, who may find in the simple tricks described amusement for an evening.—Eds.]

◆

GLOBE VALVES FOR "BOTTOM BLOWS" OF BOILERS.

Editors Mechanical Engineer:

A considerable experience in the care and erection of machinery in general, suggests to my mind the propriety of protesting against engineers, draughtsmen or others designing a boiler plant, fitting and using globe valves for blow-off valves. I would suggest an ordinary surface-cock instead.

I have seen more than one valuable boiler burned through that cause. Any engineer of experience knows a globe-valve may be shut apparently tight, but if the pipe from it leads away so the discharge cannot be seen, there is no absolute certainty of its being tight when closed; a small chip, a bit of waste, a piece of scale, or any other matter may settle upon the seat of the valve, and when steam is up the water will leave too fast for the health of the boiler. Should this occur when a competent engineer was present, probably no worse result than a temporary delay would ensue; but fires are often started by a watchman, or some one else who has too often no idea of what to do in emergencies.

The next thing heard of is probably a burned boiler; the man who started the fires says he is sure there was plenty of water when he lit the fires, and he thought no more about it until looking into the furnace he saw the crown sheets leaking like a seive, if not bulged down to the fires.

With surface-cocks for the bottom blow no such result could ensue; the cock could not be closed if any obstruction presented itself, and hence would surely tell tales if such was the case; further, if the opening was properly marked across the square of the key, there is always positive evidence as to whether the cock is open or shut. There can be no valid objection against a surface-cock; it will give but little trouble to the engineer to give it a complete turn in opening and closing, thus making the wear equal all around in both barrel and plug.

In course of time the cock may begin to leak a little, but a proper knowledge, combined with the use of a smooth file, and a little ground glass or emery, will quickly remedy that state of affairs.
CUT OFF.

New York.

◆

FLYING MACHINES. TO WHOM IT MAY CONCERN.

Editors Mechanical Engineer:

I address you through the suggestion of an engineer in New York. He tells me that there is an appropriation set apart for the advancement of air navigation and refers me to you for light on the subject.

To be brief, I have given the problem considerable study and have come to believe that the plans I have could be made successful if put into practice. My friend says there was an article published in The Mechanical Engineer on the subject some time ago.

I have made no demonstration with absurd complications as many have done, only to fail. I consider that playthings are of no use, and, therefore, have studied the possible accomplishment of air travel with comfort, safety and speed as a matter of business; embodying, of course, many pleasures as well.

Whatever information you may kindly give me will be appreciated, and if there is any object in it I would like to show to interested persons my plans, with my reasons for having made them.
FRED. N. ATWOOD.

Pope's Theater, St Louis, Mo.

[We give our correspondent the benefit of public mention, which is all that we can do for him. There is no appropriation that we know of, other than that said to have been left by William Maxwell, of Milwaukee, Wis., to a Bridgeport, Conn., experimenter. This amount is $100,000, and we have no reason to doubt that it was made. We are greatly interested in flying machines, but, we must add, exceedingly sceptical as to their possibility by any mechanical medium now known.—Eds.]

◆

SUPPRESSING NAMES OF MANUFACTURERS.

Editors Mechanical Engineer:

Why should "*Automatic,*" in your issue of the 9th inst., suppress the name of the engine builder and mill furnishing company who made such a botched job in this place? The engine builders have no right to mislead the public. The engine in question is badly built and set up; I have seen it.
MECHANIC.

Atchison, Kas.

["*Automatic*" did not suppress the name, but we did. Our correspondent must see that if we published the names of parties who made bad work we should get into no end of trouble.—Eds.]

◆

STEAM SIPHONS.

Editors Mechanical Engineer:

The sketch sent you by J. A. S., published in Number 4, is a pretty good representation of a jet made by myself several months ago to draw water out of my fly-wheel pit. I believe as good a jet can be made that way as any other. Mine lifts water about seven feet; I tried forcing it about eighteen feet above the jet, and it worked all right. I will describe mine as nearly as possible, as I think it will interest some of your readers: I have a 1 in. suction and 1 in. T, with ½ in. steam-pipe and ½ in. discharge for about five inches. It then enlarges to one inch. The steam and discharge pipes come within about ⅛ to ¾ths of an inch of meeting inside the T. I had the ends of both the steam and discharge pipes plugged up by welding pieces of iron in them, and then drilled about 3/16 and ⅜ holes in the ends of the steam and discharge pipes respectively. I find that if the discharge is too large it will not lift very far; a person who has never made one will probably need to "cut and try" some before he gets it to work just right.
J. B. BEATTIE.

Coulterville, Ills.

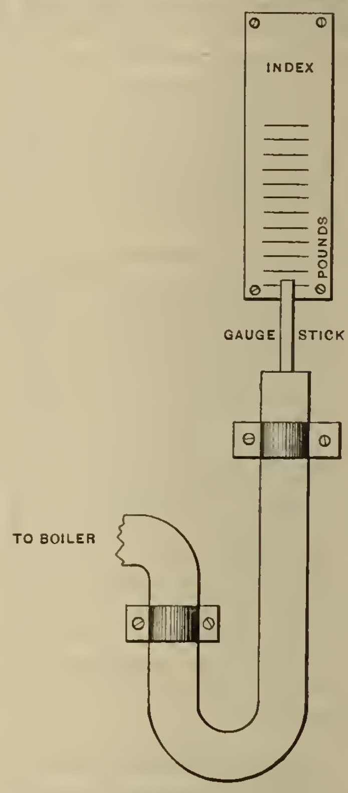
◆

SIPHON MERCURY GAUGE.

Editors Mechanical Engineer:

Please give me instructions how to make a steam gauge called a siphon gauge, in which mercury is used, and oblige a regular reader of your paper.

New York.
MARINE ENGINEER.



[The sketch shows the gauge in question. It is simply an iron pipe, bent as shown. The pipe should be of the same size throughout, usually one inch in diameter, but this is not so essential as to have it uniform. The pipe is filled with mercury up to the bottom of the bend on the steam side, and it will stand, of course, at the same height in the long leg. A rise of one inch indicates one pound. The siphon gauge is supposed to be absolutely correct, but if it gets hot on the steam side the extreme sensitiveness of mercury to heat will affect the register.—Eds.]

◆

CHECKING THE EVAPORATION.

Editors Mechanical Engineer:

Will you be kind enough to inform me the proper way to govern the draft of the furnace of a steam boiler—by the ash-pit doors or by the stack-damper?

The circumstances are these: The generation of steam is in excess of the consumption, and the object is to check the generation for a short time.

Please give a lucid explanation of your views and greatly oblige
STACK DAMPER.

Wichita, Kansas.

[If the object is to reduce the steaming capacity for a short time only, it is better to shut off the draft by the ash-pit doors than to close the damper to any great extent. If the boilers make more steam than is needed, brick up the fire grate on the side to reduce the area of it.—Eds.]

◆

BEST MOTOR FOR SMALL BOATS.

Editors Mechanical Engineer:

Please give me a description of good motive power to run a small boat (*row boat*). Can I buy a spring motor suitable for driving a propeller for a small boat that will carry from six to ten people? By answering the above in The Mechanical Engineer you will oblige a subscriber.
M. S. DALBERT.

Selma, Ala.

[The only satisfactory power for a propeller is a steam engine. No spring motor exists that will do the same work in the same space and time. The cost of a steam engine and boiler for the above would be about $250.—Eds.]

◆

INFORMATION WANTED.

Editors Mechanical Engineer:

I have been informed that there is in existence a device to be applied to pumps (lift pumps), by which water can be lifted 80, 90 and 100 feet without running the bucket-rod down to the water. In other words, it can be done by vacuum. Can you give me any information on the subject? By answering you will confer a very great favor.
JOHN CLINGMAN.

94 Betts St., Cincinnati, O.

[Water cannot be raised by vacuum over 26 feet, practically, 32 feet theoretically. We do not know of any device that will do what our correspondent requires.—Eds.]

Chippings and Filings.

The Buffalo *Courier* is lost in wonder at the trade paper of the period. It says:

> "The development of trade journals is something astonishing. Some of them possess real literary merit, while others are marvels of typographical excellence."

Well, why not? Trade papers inculcate good workmanship and excellence in all things; to be consistent, they should practice what they preach.

◆

The *San Diego* (Cal.) *Sun* says: "A party has made application for a patent for a new process of devulcanizing india rubber. By this discovery old rubber can be worked over several times. The discovery was purely accidental. A short time ago he desired to make a gas bag for a Drummond light and took some old rubber and attempted to devulcanize it. The experiment proved successful."

◆

The Marquis Of Worcester, who flourished in the reign of King Charles I., devised a lock containing a steel grip, which was perfectly harmless so long as the right key was used; but if a wrong key was inserted, the grip sprang out and caught the hand of the intruder. It is said that while the inventor was experimenting with this curious lock he was scarcely nimble enough in removing his hand, and was caught in his own trap.

◆

An Iron Dragon made in 1670, and valued at $3,500, belongs to the collection of Capt. Brinkley, R. A., of Yokohama. It is made with articulated scales and joints, and when grasped at any part of the body it moves along its whole length in a life-like way. Its maker was Muneaki, of the famous family of Miyochiu, the armor makers, who, sitting on the ground with pincers, could make an iron shirt that could be slipped on like an ordinary shirt. There is an iron eagle in the South Kensington Museum, made by one of the same family and purchased for that museum for $5,000.

◆

The *Popular Science Monthly* records the interesting fact that an Italian ship has been sheathed with glass plates, cast like iron plates, so as to fit to the hull, to take the place of copper sheathings. The joints of the plates are made water-tight by the use of a water-proof mastic. The advantages claimed for glass over copper, are its insensibility to oxidation and its exemption from incrustation. A contemporary adds: The suggestion strikes us very favorably, and we shall look for the result of the experiment with interest.

[If you were at sea in a good gale of wind you would see the results very soon.—Eds.

The Greatest Depth Of The Ocean.—On Oct. 30, 1852, Capt. Denham, of the British Royal Navy, sounded in latitude 36° 49′ south, longitude 37° 6′ west (about 1,150 miles due east of Cape San Antonio, S. A., the nearest land being the coast of Rio Grande, 900 miles N. W. by W.) and touched bottom at 7,706 fathoms.

An iron ball weighing 300 pounds was used as a sinker, and the line was nine hours and twenty-four minutes running out. The ball sank as rapidly the last mile as the first (allowing for friction and buoyancy of the line), showing there was no increasing resistance from increasing density. This is the greatest depth yet measured, being a trifle more than eight and three-quarters miles.

◆

German Coca Powder has been in use but a short time, but experiments have proved that it is the best which has yet been discovered for large guns. It is called coca because of its peculiar color. It differs from the ordinary powder in the construction of its grains. The density of the interior and exterior portions of each grain of the German powder is different. This causes it to burn progressively instead of instantaneously, as is the case with ordinary powder. The German powder in this respect resembles what is known as progressive powder. Powder burning in this manner is especially suited to heavy ordnance.

◆

Aerial Locomotion is a subject which the French treat in a serious scientific spirit, and the French Academy of Sciences have recently awarded three prizes to pioneers in this domain. M. Gaston Tissandier, the balloonist who now makes trips in the air with a ballon propelled by electricity, is one of the prizemen; another is M. Tatin, who designed the membrane propeller of Tissandier's electrical balloon. M. Tatin's prize was, however, obtained for an ingenious artificial bird of his design. This bird actually flies like a living bird by strokes of the wing, the power being derived from clockwork inside the body.

◆

Hypercritical remark:

> "The steamer *Lydian Monarch*, on July 26, broke the piston rod of the high pressure cylinder. The low pressure cylinder was *disconnected* and the engine operated by it alone. The speed of the vessel was of course materially reduced, yet fair progress was made."

With the high pressure cylinder disabled and the low pressure cylinder disconnected, the progress made must have been like that of the boy who was tardy.

"What made you so late?" said the teacher.

"It was so slippery," said the boy, "that for every step I took forward I slipped back two."

"How did you get here at all, then?"

"I turned around and walked backwards."

◆

Note Upon Indian Ink.—"It is not easy, however, to keep it, as it must be entirely protected from moisture; much depends upon the manner in which it is rubbed up for use. Some persons in rubbing it up make a circular movement. This soon ruins it and renders it hard and brittle, a circumstance for which no satisfactory reason has been assigned. The better way is to rub it in straight lines back and forth, using the least pressure possible. India ink is an absolute necessity to artists and draughtsmen, but there is no occasion to use the solid ink when such excellent fluid inks are in the market. Higgin's ink is far superior to any Chinese ink, in our opinion."

◆

In Addition to what we have said elsewhere about manufacturing by natural gas, this item is of interest:

"The cost of running a works by natural gas is not more than 10 per cent. that of coal. As an illustration: It would require $12,000 worth of coal a year to run a glass works at Tarentum, Pa., and $1,500 more for 'teasers.' As it is now, the gas well only costs them $2,500, and the cost of maintaining it is not more than $300 a year, and they have more than enough gas for all heating purposes. Unless gas is found at the other cities, East and West, where glass is manufactured, the manufacturers of those places will have to remove to Pittsburg, or else go out of the business. Our manufacturers, by the use of gas, can afford to sell ware at what it costs other manufacturers to make it, and still have a big profit."

◆

An "Artificial Moon" is the latest spectacular effect produced by the electric light. The arrangement is due to Dr. Brandt. It consists of a frame containing eight Edison incandescent lamps, and covered in front by a translucent disc. The light produced is about 2,000 candles, and gas-jets are quite unsuitable from the heat and fumes which would be produced in such a small space. Apparitions are also produced by suddenly lighting incandescent lamps concealed in such a way that they throw their light on an object which before was in obscurity. A fountain is lighted by incandescent lamps in such a manner that the water glows; and when it falls its spray seems to consist of golden drops. This fountain is also made to play up through a beam of the white moonshine light of the electric arc; and colored glasses are inserted in the track of the beam to diversify the beauty of the spectacle.

◆

The Distances, Often Many Miles, through which gas is transmitted before reaching an engine, are such that, with any other means of distributing power, they would considerably enhance the cost of the power. But in the case of gas it does not appear that these distances are at all a matter of consideration. Professor Osborne Reynolds thus explains this: It takes about ten cubic feet of gas to develop 1,000,000 foot-pounds in a gas-engine, whereas of air compressed in the ordinary way it would require something like 140 cubic feet to yield the same power. Hence the comparative cost of transmission is the cost of transmitting ten cubic feet of gas against that of 140 cubic feet compressed air, and these would be about as one to twenty-five; so, as a means of distributing energy, gas is twenty-five times more efficient than compressed air.

◆

HOW TO COLOR YOUR MEERSCHAUM.

"Smokers are continually writing to ask how to take care of their meerschaum pipes," said a dealer. "I infer that not half of the owners of meerschaum pipes know how to handle them. The most common complaint is that their meerschaum will not turn from the natural yellowish white color to a rich brown. If the pipe is of good meerschaum there is no reason why it should not take color. If it does not do so, then the fault lies with the smoker."

"In what way?"

"Why, the purchaser of a new meerschaum worth perhaps $50, thinks night and day about it, and is so anxious to color it that he overdoes it. He finds that he has 'burned' his pipe, as he expresses it. To explain why you can spoil a pipe in this way, you must understand how the meerschaum is prepared. After the artist has shaped the bowl, the finished pipe is boiled in wax; this penetrates the pores for a short distance beneath the surface and serves to keep the coloring matter in the pipe. The coloring matter is the oil of tobacco, not nicotine, as many suppose, and sinks into the meerschaum, which is simply a fine, porous clay, and is stopped by the wax before it is driven out at the surface by the heat inside. If it were not for the wax the coloring matter would pass out and get rubbed on and the pipe would never be colored. A glazing of glass would do as well as wax, but wax is the cheapest material that has been found for the purpose. Now, when anxious smokers try to hurry the process of coloring the pipe by smoking pipeful after pipeful of tobacco, the wax is driven out, leaving the pipe raw and dry. The nearer to the top of the bowl the wax is kept the finer it will look when colored. If this was more generally known you would not see so many meerschaum pipes with a dirty light yellow ring around the top where the oil has been forced out by oversmoking. The smoker should take long, slow pulls at the pipe, and after one pipeful is exhausted the pipe should be laid down to cool off before it is filled again."

"It seems to be an art with very little fun in it, this coloring a meerschaum pipe."

"Smoke temperately and there's no trouble or disappointment following. Next to coloring a pipe, I have most complaints about finding the pipe broken when no one has been using it. If smokers would take care not to take their pipes, while they are smoking, from a warm room into a cold room, or out of doors in winter, they would not find their pipes broken so often as they do. Another thing, they should not be laid on a marble mantel or other cold substance immediately after smoking. Fine meerschaums with delicate carvings are sure to crack. The reason is that when heated the pipe expands, and, in too suddenly contracting it snaps."

"It seems that a meerschaum pipe needs as much attention as a baby."

"That's a mistake. You can take too much care of it. Many smokers begin by making a close cover of chamois leather to fit the pipe, so that they will not have to handle the bowl. After they have smoked for a while, and are curious to see how the coloring is going on, they take off the chamois skin covering, and behold, the pipe is covered with blotches, and it is ruined. The chamois skin has absorbed the wax while the pipe was hot. It is dangerous to put any covering on the bowl."

"Must the bowl never be touched?"

"Not while the pipe is hot. Then the wax on the outside is disturbed, and if there is perspiration on the fingers a gray spot appears wherever the bowl is touched. As to the effect of perspiration on the bowl, I have two customers who cannot keep a pipe colored. It turns an ashy gray. I have even had bowls colored for them, but it was just the same. In a few months they turned the same color. In all my experience I have heard of only these two whose pipes served them such a trick."—*The Sun.*

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

PROBLEMS IN TECHNICAL BOOKS.

The author of a technical work reviewed in THE MECHANICAL ENGINEER some weeks since, objected in these columns to our opinion of his labors, and in the course of his objections showed that his views as to simplicity of treatment do not differ materially from those of too many others who write books for mechanics. These views are, in brief, that simplicity consists in propounding problems expressed in such a way that the average man cannot understand them at a glance. We have spoken upon this subject before, but we do not hesitate to speak again, for the interests of all concerned—authors, publishers, and lastly, but by no means the least, purchasers, are involved. In these allusions, let us say, we make the letter in question only the occasion, not the object, of this article. That is to say again, that so soon as authors recognize the fact that possibly one in a thousand has the mathematical faculty, they will, at the cost of some labor to themselves, express their calculations in simple arithmetic. When they do that, their pecuniary returns will be much greater.

We speak positively on this subject, for our experience entitles us to. In the course of thirty-five years' association, as boy and man, with mechanics in nearly every part of this country, we have met with but one general expression on this point, and that is embodied in the previous lines. Briefly reiterated, mathematics—by which we mean any processes beyond ordinary arithmetical calculations, are unpopular, and the mass have no desire to investigate them.

It seems necessary to some, on reading such opinions as the above—flatly expressed—to impugn the intelligence of persons without mathematical aspirations, and to allude to them in terms which are certainly not courteous, but we deem this a side issue, and quite beyond the question. Intelligence, if we may use the word in such a connection, is comparative, and is no more peculiar to, or akin to, the study of mathematics than any other branch. Some of the most illiterate and untutored persons have developed wonderful mathematical abilities; children, for example, of whose intelligence it is not necessary to speak. Intelligence is simply the cultivation of the mental faculties, not necessarily including the mathematical. To our mind it would seem more polite to say nothing of the respective intelligences of those who have and others who have not mathematical ability.

While we are trained upon this target let us fire one shot more, and that one hits the object we are all aiming at—success. Judged by this test mathematical ability is not indispensable to the engineer. Those who dissent from this proposition must take our word for the fact that leading works in engineering have been erected, and are now running, by men whose mathematical abilities are confined to ordinary processes, of which, let us say, cube root is not one. We hope no one will expect us to point out these works, for if we did the persons we allude to would be confessed as to their identity. A liberty of this kind we have no right to take.

Technical works, to be profitable to the maker and vender, must sell widely. To do this they should not be above the comprehension of the average man. This is plain common sense. No writer makes books for those who know as much as he does, because such are not buyers. In the case of technical works involving computations, put the arithmetical solution forward, and let the mathematician construct his formula therefrom, if he needs one. Then all parties will be satisfied.

The connection of mathematicians with steam engines or machinery is very slight indeed. We challenge the defense to point out any one improvement or change for the better which has been brought about by calculation pure and simple. Calculations relate to time in arriving at proportions, not to the proportions themselves, for the size of a shaft can be arrived at quite as certainly by 2×2 as by $x \times y$.

We have no quarrel with mathematicians. or persons who wish to express their calculations by methods which the majority do not comprehend, or even care to investigate, but when they impugn the intelligence of others who have no interest in their labors, and imply that they are inferior, we must respectfully disagree with them.

BOOMING INVENTIONS.

A contemporary said recently that it was becoming harder for a fool to live every day, and the corollary to his remark is that the species itself is by no means necessary to the welfare of mankind. However this may be, there is no scarcity in the crop itself. The race does not disappear. Indeed it seems at times as though they increased and multiplied. The grosser the bait offered them the more readily it is swallowed.

We hear of inventions that are manifestly impracticable and impossible, having been proven so repeatedly in years past, put upon the market and companies formed for their exploitation with unheard of capital. In one instance this is announced as $25,000,000. If one keeps a worthless thing long enough it will become useful, and there seems to be a parallel in the case of impossible inventions. Some of them are not only impossible, but absolutely dangerous.

On the other hand, inventions or improvements which have practical value are slow of sale. Unless the man who promotes a company has something new and startling to tickle the ears of capitalists, he gets no money. Unless the prospective scheme promises millions in a short time, it is not taken up. Ventures are purely speculative, with the hope of throwing stock on the market, and realizing great returns in a short time. The actual mechanical value of any given scheme is the least important detail.

These views have been often presented before, but they do not lose force by reiteration. What we desire to convey to our friends who have useful devices that require the aid of capital to develop, is, that they should not be led away by the prospects of forming stock companies, or the specious representations of those who form them. Part with no property upon the strength of promises, or verbal representations of any kind. Take only black and white drawn up by persons who are competent to make contracts, and do not affix signatures to any papers not wholly comprehended. It is very difficult sometimes to substantiate these, but a verbal agreement in most states is absolutely worthless.

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THE ADRIATIC AND THE AMERICA.

Old engineers and shipwrights in this port when they first saw the *America* SS., the new English ocean flyer, thought she looked strangely familiar, and subsequent observations of her have confirmed the suspicions first formed. These are that the *America* is our old *Adriatic* of the famous Collins line, as regards her model. This vessel was one of the last works of George Steers, and on the breaking up of the Collins line was sold in England and breathed her last there.

Whether the *America* is or is not modeled after the *Adriatic*, she is very like her, and is an instance of two different designers arriving at the same conclusions as to form and dimensions; only the American designer is the originator.

◆

NATURAL GAS AS FUEL.

What seems like an impending change of great importance in manufacturing operations is described at some length on another page. This change lies in the substituting of gas for fuel in lieu of coal. Although the existence of gas has been known for years, and in some portions of the country—Bradford, Pa., for instance—has been used both for heating and lighting, it is only recently that general attention has been turned to it in other cities where it is known to exist. In Pittsburgh the supply seems to be practically inexhaustible. The gas is found underlying the whole city, and companies are being formed to supply it for public use.

The obstacles in the way of its introduction are fully set forth elsewhere, and we need not traverse them here. The main trouble as regards low prices seems to lie in the greed of promoters of companies, or the corporations themselves, who wish to establish monopolies. The companies desire to control the natural product and sell it at a price which will render them enormous profits, without attendant risks of loss. It is to be hoped that sensible views will prevail, and that the people will reap some value from cheap natural fuel.

QUESTIONS.

When were you last inside of your boiler?

When did you raise the safety valve last?

Do the safety valve and the steam gauge agree?

Do you know whether the steam gauge is correct or not?

Do you know of your own knowledge that your boiler is clean?

Is the blow cock tight, or are you blowing hot water out of it constantly, insensibly?

Are the gauge cocks tight?

Do you ever try them, or merely depend upon the water glass?

Are you sure the latter is properly connected?

Do you know how much coal you are using daily?

Do you consider that it is valuable, or do you merely throw it in without regard to cost?

Have you any soft patches on your boiler in the furnace?

Are the braces in good condition; do they all draw alike?

Have you ever calculated the strength of your boiler yourself?

Do you know that, allowing for its age and time of service, it is reasonably safe?

Is the water supply regular or intermittent?

Do you sometimes run the boiler full of water, and then shut the feed off entirely?

Are you troubled with priming or foaming?

Do you recognize the difference between these actions—that a priming boiler carries water over with its steam, while one that foams may not prime?

What would you do with a boiler that primed regularly?

Have you notified your employer in writing when repairs were needed and kept a copy of the notice for your own safety?

Do you recognize the value of good grate bars and how essential they are to economy?

Do you know that if you keep the furnace full of blue flame, when burning anthracite, that you are developing the greatest heat?

Do you pay any attention to the air supply, or do you run with the draft on all the while?

Have you a damper in the smoke stack; if so do you ever use it?

Do you throw in a heavy fire and then check the heat by opening the doors?

Is the coal you use of a size that is advantageous and economical, with reference to your draft?

Do you know the difference between a live fire and a dead one? That the latter may look red but has no life, or steam-making virtue?

Do you ever reflect that you have magazines of tremendous force in charge which will not take care of themselves?

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WHY CAR VENTILATION FAILS.

A writer in the American *Railroad Journal* says: "The heating appliances for cars are very imperfect; the ventilating arrangements, especially in cold weather, might be deemed not to exist, so far are they from being perfect. There are plenty of ways of roasting one's feet and having a draught about the head, or freezing the feet and heating the head, but to make a pure, warm, evenly distributed atmosphere in a car is unknown."

This is true, but the problem is by means easy of solution. So long as there are movable windows in a car any system of ventilation can be set at naught. On the most inclement day the little boy who must see the engine, or the old lady who is always ill, will have the window wide open. After that anything may happen. So long as one individual controls the rights of sixty others, just so long will any system fail.

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THE BUSINESS PROSPECT.

The outlook for fall trade is encouraging, and the prospects are that 1885 will be better than its predecessor. Press dispatches say:

"Confidence seems to be returning in a measure, and iron men speak more encouragingly of the prospects than they did a week ago. Andrews Brothers & Co., of Hazleton, report business as picking up a little. Some of the mills of Cartwright, McCurdy & Co. will be on double turn next week, and the rest on single turn. At the office of the firm business was reported as picking up a little. The Youngstown Rolling Mill Company are figuring on a big contract. One member of the firm said: 'Trade is bound to pick up.' If we all keep believing and acting on the belief, it will."

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OVERHAULING AN ENGINE.—Number II.

"You have stated in a former article on this subject that you would dress up the valve faces if they needed it and overhaul the piston, or rather send it to the shop to be overhauled. What else would you do toward putting the engine in perfect order?"

"Supposing the cylinder to be in good condition I would line up the guides truly with the bore of it, but if the engine had been long in use I should probably find the cylinder so badly scored that reboring would be a necessity."

"Will you describe the process of reboring the cylinder?"

"No sir, I will not, for the very good reason that it would be superfluous. A man who doesn't know how to do it cannot acquire the experience necessary to make a good job by reading an article on the subject. The man who does know how needs no instructions."

"Suppose the cylinder overhung, as most modern engines do, would you take it off of the frame to rebore it?"

"Not unless it were absolutely impossible to do it in any other way. If I did I would take care that the flanges were square with the bore when it came back."

"Why do you make this point?"

"For the reason that I have seen shims stuck in between the cylinder and frame to bring the bore square with the guides, or the guides square with the bore of the cylinder. I don't know which was out, but one or the other was. It is the easiest thing in the world to make a blunder, or a bad job in this part of the work, and a good many are made, even by those who preach the doctrine of infallibility."

"The reason bad jobs are made is because there is some special rig in the shop that always brings the work just right. All you have to do is to put the work on the planer, or in the lathe, and start up; then everything thinks for itself, and you don't have to try the work to see if it is what it should be. I don't like this sort of thing, for in too many cases men get so cock sure the machine does it all that they never take care to verify their work, and see that the machine has done it. Special rigs are all right, but so is especial common sense. There is no mechanical appliance extant which will run itself. The more perfect the jig, the better the man has to be to use it. Jigs save time, they don't save brains."

"When you get through sermonizing, or lecturing us, perhaps you will be so good as to confine yourself to the subject in hand, which is, as we understand it, giving us your ideas of overhauling an engine."

"If you don't like the way I am giving it to you don't ask me any more questions. If I make a statement I want you to understand that the reason for it goes along with it—gratis, one is of no use without the other."

"How thick were the shims you have spoken of as inserted between the cylinder and frame?"

"They were, in some cases, pieces of stout paper, and in one other a piece of tin."

"How was the joint made in such cases?"

"With thick paint."

"Well, you must have struck some queer work in your time. How would you proceed to line up the guides?"

"I don't know any better way than by short lines; straight edges and levels are good where they can be used but in many cases they cannot be to any advantage. A tight line, properly used and put up, is certain to be right."

"Where do guides wear the most?"

"In the center, where the heaviest pressure comes. The amount of wear will surprise many who think there is little or none, because the surfaces are not cut and look true. A straight edge from end to end tells the story."

"Should the guides be overhauled when the cylinder is rebored?"

"When you begin to overhaul an engine you must—to make a good job—go over it thoroughly. If you bore the cylinder out and don't dress the guides up in line with it you are as bad off as you were before. The piston follows the guides, and if they are amiss trouble begins. You will never be able to locate it exactly."

"Your idea is, then, that in overhauling an engine every part should have attention!"

"Overhauling an engine is in the nature of rebuilding it and is an expensive job. If you begin it go through with it. The guides of steam engines are of so many different kinds that I cannot give any instructions to repair them. If they are cast solid with the frame there is no alternative but to have the frame taken to the shop when badly worn or cut. If they are independent it is an easy matter to straighten and re-set them."

"Suppose that you found the guides were out on one end, or wanted changing as to their original positions. Suppose, further, that the holes in the frame were rimmed out and the bolts fitted them, and were either tapped into the guide or went through them, body bound, what would you do; how would you change them?"

"I would bush the guide and make a new hole in it."

(To be continued.)

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THE PROFESSOR IN THE MACHINE SHOP.

NUMBER LXXII.

I don't know how others are affected by it, but I have sometimes speculated upon what becomes of all the time in the world. This sounds rather pointless and silly, but there is a kernel in it, awkward as the expression is.

I know what becomes of my time, for I keep an account of it, but unfortunately it is not always in my possession. In the interchange of business I am sometimes forced to loan it out. I have to tail it on to the time of others. I have to fit it into their engagements and make connection with another piece of time which I have never seen. Mine is the right length and dimension, but the other man's isn't and the result is a hitch.

The years of a man are three score and ten; in that period he has to do all that there is to be done. There is a great deal to do and there is time enough to do all that is required of us if we only apportion it properly, and it seems rather a hard case that having so apportioned it, a come-by-chance man should swoop down on a good part of it. This man does not use his time and mine, he simply steals and wastes it. He fritters his and mine away, and leaves me mourning a lost opportunity. I do not overestimate the value of time or the dishonesty of those who waste it. I am convinced that when the final reckoning comes we shall have to show what we have done with it, and I decidedly object to being a scapegoat for others in this respect.

Of course in the imperfection of all human achievement calculations sometimes misfire. That is excusable, and we must be lenient under such circumstances, but when the same gun misses fire all the while, we are very apt to get out of patience with it and throw it away.

I said I wondered what became of all the time, and by that I mean all the lost opportunities. I think I know what becomes of some of it.

I go to Coal, Lime & Co., and tell them to send us ten tons of coal right off, as we stand in need of it. I had previously told Lamb, whose province it is to look after this matter, not to wait until the last bushel was in sight before he ordered more, but to give a little leeway to the coal man so as to be sure and not get left. Lamb is one of these do-it-to-morrow chaps himself, and so he always waits until the coal is nearly gone before he orders any.

When he goes for it the coal people say "yes; be right around with it in five minutes." We wait fifteen, thirty, sixty minutes, and no sign of the fuel appears. Then we get a little mad—all of us—and start for the coal office red-hot. We find Mr. Clerk sitting on a high stool smoking a cigarette. Mr. Driver reposes in the shade. Mr. Dog is lying on the mat, and a general air of calm unsolicitude for the things of this world is over all. As is generally the case where a man is somewhat at fault himself, this aspect of things awakens Lamb's wrath, and he becomes furious. Violent language ensues; the clerk protests, and says he didn't suppose there was any hurry; the driver grumbles because he is implicated, and the whole place is thrown into a frenzy of activity for the time being. If this was only once it wouldn't matter much, but the same thing is repeated as a regular entertainment, when occasion serves. No one seems to learn anything by experience, and none of the parties have any idea that now does not mean any time in the future. Out of all this comes loss; not alone in the present but in the miserable habit, confirmed and fastened on, of procrastination.

Every day has its own duties, and every hour, for that matter, and if we run one into the other, it does not require great sagacity to tell the result.

One of the most exasperating features of procrastination is, that no matter how much inconvenience he may cause others, and how many times he has sinned himself in this respect, the procrastinator always expects others to be on time. He will loaf until he has to lie down and rest, but he will not tolerate the least delay in his own affairs. Suppose you say to him that he is the cause of this particular hitch by throwing the work of yesterday into to-day; that he has deranged the whole work by stealing six hours from the front end of it! If you tell him this you tell him too much, for you ask him to catch an idea that he cannot reach up to, much less lay hold of.

The man who is always in a violent haste is just as bad as the one who is never in a hurry, for neither of them make connection; the hasty man runs by and has to back up, and the slow one never gets there. If it were only their own concerns that suffered it would not matter, but when the rest of us have to run faster to allow for loafing on the part of the shiftless, I enter protest. Protest *not* waived.

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OPTICAL ILLUSIONS.—Number VII.

By Egbert P. Watson, Jr.

For the following illusion the performer calls attention to a plate of oranges, lemons, or other fruits. These he takes among the audience for examination. Upon returning to the stage he takes a slip of paper, somewhat similar in shape to those mentioned in article V, and asks some one to write a word or so on it. The person who complies carries it back to his seat and writes a sentence or sentences, keeping it in his possession.

When the performer has finished speaking, he asks the person who wrote to destroy the written paper by burning the same.

This he does, first showing to those nearest what has been written, so that they may identify it. The paper is then burned on a china plate sent down by the performer, the ashes preserved thereon, and sent up to the stage.

The performer, with the plate of ashes in one hand and the plate of oranges in the other, comes to the front of the stage, and says:

"Perhaps many have often heard of the great care necessary in handling burned papers after a fire. You also know that in handling them some of the burned sheets which were rolled before the fire, have been unrolled after they were reduced to tinder. After this unrolling the printed matter was restored by methods beyond my knowledge, and thus made legible. Lead-pencil writing, on the contrary, stands out in silver-gray lines on the black background. All these things have been done in cases where valuable papers have been lost by fire, but in no case has the paper itself been restored to its original condition. This is because those who have achieved success in discovering what they have are not conjurers. I have many times restored burned papers whole and perfect, and it is this that I propose to try now."

He then slides the oranges from their plate to the one upon which the ashes rest. Then the plate, ashes and oranges are placed on a tripod standing in the front center of the stage.

Bringing down an ordinary silver fruit-knife among the audience he asks them to examine it, telling them he does so to show there is no groove in the blade wherein to put a duplicate sentence.

Going back to the stage, he passes his wand between the legs of the tripod to show that no mirrors exist there. Turning to the front, he says: "Now, ladies and gentlemen, what is your pleasure? From which orange shall I extract the sentence which was written and burned, in the same condition as it was at first?"

"The middle one," some person says.

"Very well, sir," replies the performer; and picking it up, takes it to the edge of the stage. He asks some one to come on the stage and cut the orange open before the audience. The performer tells him to cut it in two at right angles to the sections, and shows him how. The orange is cut by the auditor, and as it opens the cutter's face generally takes on an expression which calls forth laughter from the spectators. Finally the orange comes in two, and in its center lies a piece of paper. This is taken out by the same person who did the cutting.

The performer asks him to read it aloud, which having been done, the person who wrote the slip is requested to verify it.

It is stated to be the exact sentence.

"Is that your handwriting?" asks the performer again, passing down the slip.

"Yes, sir."

This illusion needs a confederate. He is the man who wrote the slip. He writes two, one of which the performer places in the center of the orange by first driving the knife dagger-fashion to the center. He then folds one of the written sentences crossways, puts the knife in it so the paper lies on each side of the blade, with the end of the knife in the center of the fold. It can be slid in the cut in the orange and the blade withdrawn, leaving the paper hidden. This is done before the performance.

This orange is marked in some way so that it can be found easily, and to prevent its being given to the audience for examination.

When the performer calls for an auditor to write a sentence, the guileless and lamb-like confederate comes forward, takes the offered slip to his seat and writes the identical sentence again, the original of which is quietly reposing among the fruit on the table. The rest is obvious. The paper is burned, sent up on a plate and the oranges placed on the ashes. The performer tells the audience that the chosen orange absorbs the ashes, and the natural acids of it restores it to its original form. "If you doubt it, try it when you get home."

The audience, from where they sit, cannot tell which orange he picks up after they express their preference.

The knife is inserted in the cut made before the performance by the conjurer, under the plea of showing the auditor how to cut it. The orange thus appears to have been intact.

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INTERESTING FACTS ABOUT PLATINUM AND ITS PECULIARITIES.

The New York *Sun* has these interesting facts about a metal whose peculiarities are but little known:

"Our firm practically does all the platinum business of this country, and the demand for the material is so great that we never can get more than we want of it. The principal portion comes from Russia. It is refined and made into sheets and wire before it comes to us; but we have frequently to cut, roll, and re-draw it.

"A popular error respecting platinum is that its intrinsic value is the same as that of gold. At one time it did approximate to gold in value, but never quite reached it, and is now worth only $8 to $12 an ounce, according to the work expended upon it in getting it into required forms and the amount of alloy it contains. The alloy used for it is iridium, which hardens it, and the more iridium it contains the more difficult it is to work, and, consequently, the more expensive. When pure platinum is as soft as silver, but by the addition of iridium it becomes the hardest of metals. The great difficulty in manipulating platinum is its excessive resistance to heat. A temperature that will make steel run like water and melt down fire-clay has absolutely no effect upon it. You may put a piece of platinum wire no thicker than human hair into a blast furnace where ingots of steel are melting down all around it, and the bit of wire will come out as absolutely unchanged as if it had been in an ice-box all the time. No means have been discovered for accurately determining the melting temperament of platinum, but it must be enormous. And yet, if you put a bit of lead into the crucible with the platinum, both metals will melt down together at the low temperature that fuses the lead, and if you try to melt lead in a platinum crucible you will find that as soon as the lead melts the platinum with which it comes in contact also melts and your crucible is destroyed.

"A distinguishing characteristic of platinum is its extreme ductility. A wire can be made from it finer than from any other metal. I have a sample in my pocket, the gauge of which is only one two-thousandth of an inch, and it is practicable to make it thinner. It has even been affirmed that platinum wire has been made so fine as to be invisible to the naked eye, but that I do not state as of my own knowledge. This wire my son made."

The sample spoken of looked like a tress of silky hair, and had it not been shown upon a piece of black paper could hardly have been seen.

"The draw plates, by means of which these fine wires are made, are sapphires and rubies. You may fancy how extremely delicate must be the work of making holes of such exceeding smallness, to accurate gauge, in these very hard s ones. I get all my draw plates from an old Swiss lady in New York, who makes them herself. But, delicate as is the work of boring the holes, there is something still more delicate in the processes that produce such fine wire as this. That something is the filling of a long point on the wire to enable the end of it to go through the draw plate so that it can be caught by the nippers. Imagine filling a long tapering point on the end of a wire only one-eighteen hundredth of an inch in diameter in order to get it through a draw plate that will bring it down to one two thousandth of an inch. My son does that without using a magnifying glass

"Our greatest consumers of platinum are the electricians, particularly the incandescent light companies. I supply the platinum wire for both the Edison and the Maxim companies, and the quantity they require so constantly increases that the demand threatens to exceed the supply of the metal. Sheets of platinum are bought by chemists, who have them converted into crucibles and other forms."

The reporter's curiosity was awakened by the mention of the old lady who made those very fine draw plates, and on his return to the city he hunted her up. The lady was found in this city in neat apartments. The old lady said:

"I have been in this business for thirty years. Very few in this country know anything correctly about it. Numbers of people experiment to do it by machinery, but without success. It is no longer a business that is anything worth. Thirty years ago many stone draw plates were wanted, for then there was a great deal done in filigree gold jewelry. Then the plates were worth from $2.50 up to as high as $15, according to the magnitude of the stones and the size of the holes I bored in them. Now, however, all that good time is past. Nobody wants filigree gold jewelry any more, and there is so little demand for fine wire of the precious metals that few draw plates are desired. The prices now are no more than from $1.25 up to say $8; but it is very rare that one is required, the cost of which is more than $4. And of that a very large part must go to the lapidary to pay for the stone and for his work in cutting it to an even, round disk. Then, what I get for the long and hard work of boring the stone by hand is very little."

"By hand?"

"Oh, yes. That must always be the only good way. The work of the machine is not perfect. It never produces such good plates as are made by the hand and eye of the trained artisan. How are they bored? You must excuse me that I do not tell you that. It is simple, but there is just a little of it that is a secret, and that little makes the vast difference between producing work which is good and that which is not It has cost me no little to learn it, and while it is worth very little just now, perhaps fashion may change, and plates may be wanted to make gold wire again to an extent that may be profitable. Oh, we of course do not use finely-colored ones. They are too valuable. But those that we employ must be genuine sapphires and rubies, sound and without flaws. Here are some. You see they look like only irregular lumps of muddy-tinted, broken glass. Here is a finished one."

The old lady exhibited a piece of solid brass about an inch long, three-quarters of an inch in width, and one-sixteenth in thickness. In its center was a small disk of stone with a hole through it, a hole that was very smooth, wide on one side, and hardly perceptible on the other. The stone was sunk deep into the brass and bedded firmly in it.

"You will find, if you try, that you can with difficulty push through that hole a hair from your beard. But, small as it is, it must be perfectly smooth, and of an accurate gauge. How long does a draw plate last? Practically forever. Except by clumsy handling or accident it does not need to be replaced at least in one lifetime."

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THE PRINCIPLE INVOLVED IN FLYING MACHINES.

The following paper was read by Mr. F. W. Breary at the general meeting of the Aëronautical Society of Great Britain: Protection was solicited for an improvement upon a previously patented mechanical aërial machine, the success of which had been proved by the inventor through the action of a model. The patent was refused in America on account of the alleged impracticability of the invention, owing to the absence of gas as a supporting, or partly supporting, medium.

Total misapprehension of the principles of flight is displayed whenever the balloon is recommended to take off part of the weight of any mechanical arrangement. However successfully the pure mechanical action may have proved itself in the conveyance of weights in the air while in the model form, the principle seems to be distrusted by some when proposed for extreme weight. But it fortunately happens that the resistance of the air to a body in motion, upon which we depend for success, bears a greatly increasing ratio to the extent of surface which that body assumes. Twelve square feet in a single surface will be considerably more effective in the manipulation of the air than 12 separate square feet, for the all-sufficient reason that with the single surface the opposing air cannot so readily be dispersed, so as to make way for the advancing body. The commotion which is caused in the vicinity by the effort of the air to escape from the pressure of an intruding body may be witnessed, and the pressure even may become so great that for the fraction of a second the compression of the air may be equal to solidity, as the following experiment will show:

Set up on end such an object as a barn door on a dusty level ground, and let it fall by its own weight. In falling, the behavior of that dust will evidence the violent efforts of the air to escape. But even then, the rapidity of the falling body being greater than the rate of escape of the compressed and imprisoned air, there will remain for an appreciable instant of time a layer of air upon which the door will fall, and the end which had until then rested upon the ground will be tilted up, and thus, by pressure of the air, afford a further outlet for escape before final rest is attained. It is quite certain that if this door, say 80 square feet, had consisted of 80 squares of 1 foot each, with intervals of vacancy, although occupying a much greater extent of surface, the fall would be less resisted, because the intervals would facilitate the escape of the air. The effective action of models carrying weights in the air should, therefore, be looked upon with hope. The conviction then would arise that strength of material, consistent with elasticity and power, alone are required, and that buoyancy is to be deprecated, more especially if it be attained by the incumbrance of a bag of gas, which, whatever the shape, must enormously exceed in bulk any apparatus for the attainment of support and propulsion in the air by mechanical means.

According to Mansfield, it requires 50 cubic feet of coal gas to sustain a pound weight, or about 14 cubic feet of pure hydrogen. The envelope for containing the latter quantity, according to Mansfield's tables, if in the shape of $2\frac{1}{2}$ prolate spheroids (cigar shaped), would be 1.669 feet in diameter—its largest sectional area would be 2.19 square feet, and its extreme length in feet 10.013. Let us say that a baloon of that capacity would convey $\frac{3}{4}$ pound independently of its own weight. Let us attach it to a grouse, for instance, which I have weighed—$1\frac{3}{4}$ pounds—so that the bird's weight would be reduced to 1 pound. It would be a fair estimate to attribute to a grouse a velocity in flight of 35 miles per hour. But at that rate, by Rouse and Smeaton's tables, the resistance of the air would be just over 6 pounds per square foot, or upward of 12 pounds upon the greatest sectional area of the balloon. This resistance would be reduced, supposing the bird flew in the direction of the 10-foot length of the gas-holder, because of its shape. In all probability the resistance would be only one-fourth of the above-mentioned 12 pounds, say 3 pounds. In a perfect calm, therefore, the grouse would be retarded in its flight by the pull of 3 pounds. Now, velocity, is the condition necessary for its successful flight. If it could maintain such velocity it would drag the balloon in its rear. If, on the contrary, it could not maintain its velocity, then its weight, being a pound more than the gas could support, the bird must finally come to the ground.

I am aware that the resistance due to the sectional area should be reduced, according to some authorities, much below the comparative estimate which I have imagined as due to the shape given to the object propelled, but even with the drag upon the bird of one-third of my supposition, say 1 pound, the effect would be destructive to flight. The same conditions must attach to the man as to the grouse. The envelope which contains the gas, whatever be its shape, must always be of such magnitude as to dwarf into insignificance the apparatus, necessarily of two dimensions, which the ingenuity of man may devise, and it is certain that if his apparatus possessed any propelling power it would be spent in dragging the balloon. More likely, however, the man and machine would be helpless, and be entirely at the mercy of the balloon. The attached incumbrance would destroy the effect of momentum. As a little heat will keep on boiling that which has already boiled, so a little power will keep on moving that which has already moved. Velocity is a condition of flight, and without it the grouse could not fly. Nature has provided it with a total wing-surface of only 86 square inches, and these must be manipulated with proportionate rapidity to make up for want of surface.

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NATURAL GAS AT PITTSBURGH.

The great importance of the new fuel which has been recently developed in this city by the discovery and utilization of natural gas makes a very interesting chapter in industrial history. Pittsburgh has long been noted for its cheap coal, which has given it its prosperity and at the same time its undesirable character as a smoky and sooty city. When a community of 350,000 people has been built up on the possession of that fuel, it is hard to place a limit on effects of the discovery that by drilling a hole into the earth at certain points a gas can be obtained which by actual experiment has been shown to do nearly all the work of coal, does away with the smoke and ashes, and can be furnished to consumers at a cost ranging from one-fourth to one-half that of coal, even at the low figures which the latter has taken on account of the competition of gas. So far all the discoveries of natural gas necessitated its conveyance from fifteen to twenty-five miles to the manufactories in Pittsburgh or of locating the factories at the wells. This year, however, Mr. George Westinghouse undertook to drill a well for gas on the grounds near his residence at Homewood, within the city limits, and his venture was rewarded by striking one of the largest and most powerful veins of gas yet known. This discovery suggested to manufacturers the possibility of obtaining a supply of fuel by merely drilling a well in their own yards, and at present nearly a dozen derricks are at work in putting down such wells in the immediate vicinity.

The extent of the enterprises in supplying the natural gas to the city and the magnitude of its effect on the leading manufacturing industries can be seen by a few statements. Although the business is comparatively in its infancy the capitalization of the companies engaged in the ownership and development of wells, the laying of pipes and selling of gas to the city is placed at over $12,000,000. × × × The value of the gas as fuel may be comprehended from the statement of the superintendent of the Edgar Thomson Steel Works, that the gas furnished them by an eight-inch pipe from the Westmoreland county wells makes the steam to run 4,000 horse-power of engines, and does the heating for 600 tons of rails daily, representing a daily economy of over 400 tons of coal. The same authority states his opinion that this supply can when the art of handling it is fully understood, be made equal to 800 tons of coal daily. This is a part of the product of four wells controlled by the Acme Gas Company. The escape of gas from the Westinghouse well at Homewood is stated by engineers to be 8,000,000 cubic feet per day, which in heating power is estimated to equal from 375 to 400 tons of coal daily. The varying volume of gas produced by the different wells makes it impossible to obtain an exact estimate of the fuel produced by all the gas wells now in operation, but a rough approximation puts it at from 5,000 to 7,000 tons of coal daily, or from 1,800,000 to 2,500,000 tons of coal in a year.

The gas discharged by these wells present some variations due to the character of the rock through which it passes. In its essential characteristics, however, it is simply the dreaded fire-damp of the coal mines controlled and utilized in larger quantities than was ever known in any mines. It has been struck in lerge veins at depths of 1,000 to 1,800 feet, although surface veins and small pockets have been found only a few hundred feet down. In its natural condition it is wholly odorless, as well as entirely invisible. The gas that is discharged from the wells in the oil regions, from having permeated through oil-bearing strata and become charged with parafine, has an odor, but if kept standing in tanks or reservoirs loses the smell. Analyses of seventeen different samples from as many different localities show that they all agree in containing a large share of marsh gas, which is one-fourth hydrogen and three-fourths carbon, with varying quantities of nitrogen, hydrogen, carbonic acid, ethane butane, oxygen and hydrocarbons. Its specific gravity is a little more than half that of air. It is highly explosive when mixed with the air in the proportion of one part of gas to six of the air, but in higher or lower degrees burns rapidly or explosively according to the mixture. The velocity with which it issues from the wells is variable, having been 4,000 feet per minute in some experiments, and as high as 23,400 feet per minute in others. Wells have been struck as far south as Steubenville, O., and as far west as Youngstown, O. To the north they have been found at Erie, Pa., and Fredonia, N. Y., while in the east and northeast they exist at Murraysville and in the oil regions. In the northern field the gas seems to become exhausted more rapidly than in the southern, a number of wells having given out after flowing for periods varying from six to twenty years.

In its practical application for manufacturing purposes it has been demonstrated by its use here that it can be put to almost any purpose for which coal can be employed, with one notable exception, viz., for smelting purposes in blast furnaces, and some engineers have expressed the opinion that a furnace can be devised which will enable it to smelt ore. Its freedom from all deleterious substances, and especially from sulphur, makes it better for use in the manufacture of steel, bar iron or glass than coal. It makes steam more regularly, as there is no opening of doors to let cool air in, and when properly applied can be made to regulate the steam pressure, while boilers will last longer, owing to the greater equality of expansion and contraction secured by the use of the gas. In addition to these points there is a vast economy of labor. These results have been demonstrated by the use of the gas in the mills of the city, although the full economy of the discovery has not yet been attained, either as regards the price or the use of the fuel. A committee of engineers who investigated the subject reported that consumers used it by such crude methods that they failed to obtain the best results. The Union Iron Mills were mentioned as economizing the full heating power of the gas by using it in Siemen's regenerative gas furnaces.

The application of the gas for domestic use in heating dwellings and furnishing fire for cooking has been made in some instances, but it has not yet become general. It makes a very even fire, and does away with the necessity of carrying coal, is free from dust and ashes, and when universally used will relieve Pittsburgh of smoke. But two objections to its use in dwellings have not yet been overcome. The first is that competition has not yet brought its price to domestic consumers below 50c. per 1,000 feet; at that price it is more costly than coal. The next is that the penetrating nature of the gas renders it somewhat hazardous to introduce into private residences. At the pressure with which it is forced through the main pipes to the mills it will leak through joints and valves, and even escape through the pores of ordinary cast-iron pipes and wrought-iron casing. Being odorless, its presence in a cellar or a closed room could not be detected, and if generally introduced into private residences without precautions, leakages might occur which would result in disastrous explosions. This occurred in two instances. To guard against this it is proposed to pass the gas over some substance which would impregnate it with a smell, so that a leakage could be observed as in the case of coal gas. An invention has also been patented to convey the gas to the mills at high pressure through a main pipe, which will be surrounded by another pipe. The latter will form the receptacle for the leakage of the high-pressure main and will be a low-pressure main for the supply of residences. When these precautions are adopted, and burners, ranges and grates are adapted to the use of the gas, a reduction of the price to 10c. or 15c. per 1,000 will make a decided saving.

The adoption of a new fuel to take the place of coal would result in the indefinite expansion of manufacturing, and great domestic economy, if competition can insure the supply of the gas at a low rate. Such cheapness has not yet been attained. It is difficult to estimate the first cost of producing the gas. The actual cost of drilling a well is stated at from $3,000 to $5,000. A greater element is in laying the pipes from the wells to where it is consumed. It may be conjectured that, allowing for this cost and the number of holes that are drilled without striking gas, $75,000 is a full average for the first cost of a producing well. At that cost a well like the Westinghouse would pay for itself in about a year by selling all its gas at 2½c. per 1,000 feet; allowing ten years as the average life of a well, it would pay a net profit of 900 per cent. That would make the fuel cost about one-fourth as much as the coal required to produce the same results. No such rates have been made by the companies supplying the gas. Their method of selling the fuel has been to contract with mills to supply them with gas at a saving of 20 or 25 per cent. on their coal bills, while the price charged for domestic consumption—50c. per 1,000—is practically prohibitory except for people who can afford to pay a high price for convenience and freedom from smoke. This is due mainly to the fact that competition is imperfect. Three leading companies are engaged in the supply of gas. One of them claims that by the terms of its charter it has an exclusive right to supply the city, and its claim was sustained by the lower courts on the ground that such a grant "does not establish a monopoly." As it very evidently would establish a monopoly to grant exclusive privileges in the supply of a fuel of such universal utility, this matter will be contested in the higher courts, and the fact that since this decision has been rendered the company in whose favor it was given has formed an alliance with its principal competitor indicates that it has not much confidence in the enforcement of its exclusive rights. This alliance, however, has delayed the reduction of prices; but a third competitor has come into the field with the ownership of the Westinghouse well within the city limits.

Another influence tending to prevent the reduction of prices is that the corporations are largely overcapitalized, one corporation, the Philadelphia or Westinghouse Company, putting in a single well and leases on a large amount of undeveloped territory at $2,450,000, while the Penn Fuel Company is reported to be earning dividends on $5,000,000, while its capital paid in is perhaps one-fifth of that amount. Unless competition is shut off, there is reason to believe that the price of gas will be reduced to five cents per thousand feet to large consumers, or about half the cost of coal. The present great difficulties in the application of the gas lie in the variations of the pressure when it is piped directly from the well; in the fact that a high pressure is required for its use in the mills and a low pressure for domestic use, and in the need that the gas should be odorized in order that any leakage may be promptly detected.

These questions illustrate the difficulties that arise from the rapid growth of a new and imperfectly understood agency and the tendency to consolidate its control into the hands of powerful combinations. If the gas supply proves permanent, as it seems likely to do, and the legislative power of the city councils is not able to prevent that tendency, its result will be to force the manufacturers to drill gas wells on their own property, or if that fails, to transfer their works to the immediate vicinity of the more powerful wells. On the other hand, if competition can be given full play, the result will be the universal employment of the gas, the cheapening of the cost of fuel to a point that, compared with the price of coal, will amount to its practical extinction, the abolition of smoke and cinders, and the indefinite expansion of our manufactures.—*Bradstreet's.*

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AT THE NORTH POLE.

From press reports we extract some facts of general interest regarding this unknown land.

"In December the temperature sank from 50° to 65° below zero, and so remained for days at a time, but even in that weather the cook's favorite amusement was dancing, bare-headed, bare-armed, and with slippered feet, on the top of a snow drift. During the day the men dressed in ordinary outside clothing, but their flannels were very heavy.

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"The quarters were heated by a large coal stove, the average heat maintained being 50° above zero. Playing checkers, cards, and chess, and reading were the amusements of the evening. The life was said by Lieut. Greely to be far from a lonely one, and many of the men said they had never passed two happier years than those spent at Fort Conger. On Oct. 15 the sun left them for 135 days, and a twilight, varying from half an hour to 24 hours, succeeded. For two months it was so dim that the dial of a watch could not be read by it. On April 11 the sun came above the horizon and remained there 135 days, giving the party a great sufficiency of midnight sun. During three months the stars were visible constantly. Over everything was dead silence, so horribly oppressive that a man alone is almost tempted to kill himself, so lonely does he feel. The moon would remain in sight for from 11 to 12 days at a time.

"The thermometer registered on June 30, 1882, the highest temperature at Lady Franklin Bay which they knew during their stay. It was 52° above zero. The lowest was in February, 1883, and was 66° below zero. In this February the mercury froze and remained solid for 15 days, so intense was the cold. The electrometer, an instrument used to ascertain the presence of electricity, was set up; but, to the astonishment of Lieut. Greely, not the slightest results were obtained.

"In the course of the tidal observations made a very interesting fact was discovered, that the tides at Lady Franklin Bay come from the north, while those at Melville Bay and Cape Sabine come from the south. The temperature of this north tide is 2° warmer than that of the south tide at Cape Sabine. Why this was Lieut. Greely would not venture to state. He used in measuring the ebb and flow of the tides a fixed gauge, an iron rod planted in the mud. The average rise of Spring tides at Lady Franklin Bay was found to be eight feet. At Cape Sabine the highest tides rise twelve feet. Surf was only observed twice during the two years. At Lady Franklin Bay the average temperature of the water was 29° above zero, or 3° below the freezing point.

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"Sir George Nares reported in 1876 that no shadow was cast by the aurora, but Lieut. Greely says that he distinctly observed his shadow cast by it. There were no electrical disturbances save those manifested by a rumbling of distant thunder, heard twice, far away to the north.

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"Of fish there is a wonderful scarcity. Perhaps the greatest surprise to the expedition was the taking from Lake Alexander, a fresh water lake, 15 feet above the sea level, of a 4-pound salmon. From the bay or sea only two very small fish were taken during the entire two years, and very few are to be found north of Cape Sabine. The vegetation at Lady Franklin Bay is about the same as at Cape Sabine and comprises mosses, lichens, willows, and saxifrage. Snowstorms are, of course, most frequent, and rain falls very rarely. The highest velocity of the wind was registered during a terrific snowstorm, 70 miles per hour.

Lockwood's trips to the north in 1882 and 1883 were productive of the most valuable results. Standing, on May 19, in each year where Dr. Hayes had formerly stood at about the same days, Lockwood, from an elevation of 2,000 feet, using his strongest glass, could discern nothing but ice packs. Here it was Dr. Hayes claimed to have seen his open polar sea. On the trip of 1882 Lockwood reached the highest latitude ever attained—83° 25′ north. This was about 300 miles directly north of Lady Franklin Bay, but to get there he traveled over 1,000 miles, the open water and broken packs frequently causing him to retrace his steps 50 miles. Lockwood sounded the sea both years between Cape Bryant and Cape Britannia, but could not touch bottom with 135 fathoms of line. Markham, a few years before, about 100 miles to the west, got bottom at 72 fathoms. Lockwood found at his furthest north about the same vegetation as at Lady Franklin Bay, but no signs of a polar current or open polar sea. In 1883 he was stopped near Cape Bryant, 125 miles from Lady Franklin Bay, by an open channel extending west to the coast of Grinnell Land. The width of this channel varied from 200 yards to 5 miles, but on the north the ice packs extended as far as could be seen with a glass.

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"The only sea animals seen by Lockwood at 83° 25′ were the walrus and seal, and, strange to say, the walrus is not to be found at Lady Franklin Bay. At 83° 25′ the deflection of the magnetic needle was 104 degrees west—more than one-quarter of a circle.

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"Lieut. Greely, when asked as to his ideas upon the probable results of arctic explorations, said: 'I do not think the north pole can be reached unless every circumstance hitherto found to be unfavorable should prove favorable to the party attempting to reach the pole. If it is to be done at all it will be done by way of Franz Josef Land. It could never have been reached by the Jeanette's route. That there is an open polar sea I am well-nigh certain. This is proved by the ice drifting out of Muscle Bay and Spitzbergen in midwinter, and the northern drift of the polar pack experienced by Pavy and Lockwood in 82° 83′. Men can stand two winters very well at Franklin Bay, but physical strength rapidly deteriorates. If we had had every supply and necessary of food we could have lived perhaps eight or ten years at Lady Franklin Bay.'"

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THE MECHANICAL AND PRACTICAL ENGINEERS' BUREAU, OF THE CITY OF NEW YORK.

A society of engineers, under this general title, was organized on June 1st, 1884, and is now in active operation. We append the constitution and by-laws, which show very clearly its purpose and intent. Information as to membership can be had by addressing the secretary.

PREAMBLE, CONSTITUTION AND BY-LAWS.

This Bureau shall at no time be used for the furtherance of labor organization, or in any way interfere, or attempt to interfere, with its members and their employers in regard to wages, recognizing the identity of interests between employer and employee, carefully guarding against antagonisms, discountenancing any project or enterprise that would conflict with the perfect harmony of the same. Its objects are the mutual elevation of its members, the interchange of thought and opinion, and to devise the best means to promote the interests of our profession, that we may fill our respective stations in life with honor and dignity, remembering that co-operation is the foundation of strength, and forbearance the greatest of virtues.

We are not capable of thinking alike; therefore, as freedom of speech is guaranteed each one, our utterances should be guarded and our intercourse fraught with charity, always abstaining from religious or political discussions.

CONSTITUTION.

NAME.

Article 1. This organization shall be known as the "Mechanical and Practical Engineers' Bureau," of the City of New York.

OBJECTS.

Art. 2. The objects of this Bureau shall be to unite all practical and mechanical engineers in the city of New York for their mutual improvement and benefit, and to enact laws and rules to govern the same.

NECESSARY QUALIFICATIONS FOR MEMBERSHIP.

Art. 3. *Section* 1. The necessary qualifications for membership are that the applicant shall be known to be a man of good character, and recommended as a good practical engineer, qualified to perform the duties as such, and has followed the occupation at least one year.

APPLICATIONS FOR MEMBERSHIP.

Sec. 2. All applications for membership shall be made to the Secretary, and be recommended by one member of the Bureau in good standing, and said application shall be referred to a committee on application, to be appointed by the President.

MEMBERSHIP FEE.

Sec. 3. Every applicant for membership shall pay the sum of five ($5) dollars, which shall be returned to him in case of rejection.

HONORARY MEMBERSHIP.

Sec. 4. Honorary members may be elected with all privileges of the Bureau, with the exception of the right to vote and hold office, and shall pay for such privileges the sum of twenty ($20) dollars per year in advance.

ELECTION OF MEMBERS.

Sec. 5. All election of members shall be by ballot, one (1) black ball appearing, another ballot shall be called, two (2) black balls shall reject for six months, three (3) black balls appearing, shall debar the applicant from membership forever.

ELECTION OF OFFICERS.

Art. 4. The Bureau shall be governed by a Board of Directors, consisting of fifteen (15) members, five of whom shall be elected at each annual meeting, for three years and five (5) shall retire on the first day of July of each year. Said election shall be at the annual meeting in June, and a President, Vice-President, Secretary and Treasurer of the Bureau shall be elected at the same time by ballot, and also three (3) Trustees, who shall hold office for one year. All elections for officers and directors shall be by printed or written ballot.

DUTIES OF THE PRESIDENT.

Art. 5. The President shall preside at all the meetings of the Bureau and Board of Directors, and preserve order therein, sign all orders drawn on the Treasurer and attested by the Secretary. He shall appoint all special committees, and perform all the duties pertaining to a presiding officer.

DUTIES OF THE VICE-PRESIDENT.

Art. 6. In the absence of the President the Vice-President shall preside, and perform all the duties of that officer.

DUTIES OF THE SECRETARY.

Art. 7. The Secretary shall keep a record of all transactions of the Bureau. He shall receive all moneys due the Bureau, giving his receipt for the same, and shall pay over to the Treasurer all moneys as soon as received. He shall send all notices and communications directed by the Board of Directors or the President. He shall make a statement in writing at each regular quarterly meeting of the Bureau of the number of members in good standing, resigned or stricken from the rolls. Also of the number of applications for membership since the last quarterly report; this statement shall also include a full exhibit of moneys received from all sources and amount paid to the Treasurer during the same period. He shall also make a full report in writing of the transactions of the Bureau, and condition of the same at the annual meeting in each year, and at such other times as the Board of Directors shall direct, and shall deliver to his successor in office all moneys, books, papers and other properties belonging to the Bureau, a receipt being given for the same.

The only proof of moneys paid to the Secretary, which shall be recognized by this Bureau, shall be the receipt of that officer for the same, or the entry of the amount on his books. The Secretary shall receive any amount of money a member may see fit to pay on his account in excess of all charges or dues that may be against him, and the said amount be placed to his credit.

DUTIES OF THE TREASURER.

Art. 8. The Treasurer shall receive all funds from the Secretary, giving his receipt for the same, and keep a correct account thereof. He shall pay all drafts which have been passed by the Board of Directors on the order of the President, attested by the Secretary. He shall pay to the Trustees upon the order of the Board of Directors all sums in excess of fifty ($50) dollars, taking their receipt for the same.

He shall have in his charge the bank book of the Bureau. He shall keep a correct account of all receipts and disbursements, with vouchers therefor, and report the same when called upon by the Board of Directors, also the balance in his possession. He shall deliver all moneys, books, papers, etc., belonging to the Bureau to his successor in office. He shall furnish a bond of one hundred ($100) dollars as security.

DUTIES OF THE BOARD OF DIRECTORS.

Art. 9. *Sec.* 1. The Board of Directors shall meet on one evening of each week at 8 P. M., at such place as may be designated. They shall have full power and authority to decide on all applications for membership (as provided for in Article 3, Section 5 of the Constitution). They shall have general charge and supervision of the affairs of the Bureau.

Sec. 2. If any Director shall fail to attend three consecutive meetings of the Board, without tendering a reasonable excuse, his position shall be declared vacant.

VACANCIES OCCURRING IN THE BOARD.

Sec. 3. Any vacancy occurring in the Board of Directors by death, resignation, or otherwise, shall be filled by the Board, by a two-third vote, from the members of the Bureau, until the succeeding annual election, at which time a successor shall be elected for the unexpired term.

DUTIES OF THE TRUSTEES.

Art. 10. The Trustees shall hold all funds on deposit, and transfer or deposit the same, or any part thereof, when required by the Board of Directors. They shall deposit all moneys received from the Treasurer in such savings bank as the Directors may order, and no part shall be drawn or used except upon an order, passed by the vote of the Directors, endorsed by the President and attested by the Secretary, and all drafts shall be signed by a majority of the Trustees. They shall audit the books of the Bureau and make an annual report upon the evening of the annual election of the financial transactions of the past year and the condition of the Bureau, also a semi-annual report to the Board of Directors.

They shall sign all bonds, leases or contracts for the Bureau when required by a vote of the Directors.

They shall have, at all times, access to the books of the Secretary and Treasurer, and have power to provide the necessary books for those officers.

No Trustee shall hold the office of President, Vice-President, Treasurer or Secretary, without first resigning his trusteeship.

Vacancies occurring in the Board of Trustees, from any cause, may be filled as provided for in the Board of Directors.

DISSOLUTION OF THE BUREAU, TWO-THIRD VOTES.

Art. 11. When, from any cause, the Bureau shall become reduced to less than thirty (30) members in good standing, such members may, at a meeting called for that purpose, and by a two-third vote of the entire membership, either present or by proxy, dissolve the Bureau and appropriate any funds of the Bureau to such purpose and use as they may deem proper but such action shall not take place or attempted, unless each member is duly notified of such meeting and intent.

BY-LAWS.

STATED MEETINGS OF THE BOARD OF DIRECTORS.

Art. 1. *Sec.* 1. The stated meetings of the Board of Directors shall be on Wednesday of each week at 8 P. M. Five (5) members shall constitute a quorum for the transaction of business.

SPECIAL MEETINGS OF THE BUREAU.

Sec. 2. Special meetings of the Bureau may be called when, in the judgment of the President, the necessities of the Bureau shall require, and upon the request of ten (10) members of the Bureau, made in writing, the object of said meeting shall be stated in the call, which shall be bulletined or posted in the meeting room.

DUES AND PENALTIES.

Art. 2. Each and every member shall pay as dues the sum of one ($1) dollar per quarter, to be paid in all cases in advance, and any member in arrears for dues for a period of six (6) months shall, after thirty (30) days' notice from the Secretary, be debarred from all privileges of the Bureau, and if in arrears for a period of twelve (12) months, shall be stricken from the rolls.

DONATIONS TO MEMBERS IN SICKNESS OR DISTRESS.

Art. 3. *Sec.* 1. The Bureau may donate to a member in sickness or distress such sum as the Board of Directors shall order, or the necessities of the case may require.

DUTIES OF MEMBERS IN ASSISTING TO SECURE EMPLOYMENT.

Sec. 2. It shall be the duty of every member of this Bureau to assist any member in securing employment, and for that purpose shall notify the Secretary, or inform a brother member where he can obtain said employment.

CLUB ROOM OR HOUSE.

Art. 4. *Sec.* 1. A club room or house shall be kept open for the use of all members as soon as there are one hundred (100), to be under the control of the Board of Directors. Such books and papers shall be furnished as will be beneficial to the members, and at stated times papers may be read before the Bureau, and lectures given on such subjects as will be instructive and beneficial.

BUREAU BULLETINS.

Sec. 2. Reports of the condition of the Bureau may be bulletined, if so ordered by the Board of Directors.

EXPENSES NOT TO EXCEED REVENUE.

Art. 5. The expenses of this Bureau shall at no time exceed its revenue.

PROFANE LANGUAGE FORBIDDEN.

Art. 6. Profane language is positively prohibited in the club room, under a penalty of twenty-five (25c.) cents for each offense.

TEMPERANCE ENJOINED.

Art. 7. No intoxicated person shall at any time be allowed in the club room.

FIVE MINUTES LIMIT.

Art. 8. No member shall be allowed to speak more than five minutes on any one subject, except by consent of the chair.

SECRECY OBLIGATORY.

Art. 9. All business of this Bureau shall be strictly private, except such as the Board of Directors may see proper to make public.

PENALTY FOR VIOLATION OF BY-LAWS AND RULES.

Art. 10. Any member of this Bureau who shall in any way violate any of its by-laws or rules, may be subject to such discipline as shall be ordered by the Board of Directors after due trial.

AMENDMENTS A TWO-THIRD VOTE.

Art. 11. No addition, alteration or amendment can be made to this constitution or by-laws; neither can any part of them be repealed without a two-third vote of the Bureau, and two weeks previous notice.

ORDER OF BUSINESS.

1. Calling roll of officers.
2. Reading minutes of last meeting.
3. Reports of Investigating Committees on previous proposed members.
4. Proposals for membership and reading communications.
5. Balloting for candidates.
6. Initiation.
7. Bills or accounts.
8. Unfinished business.
9. Reports of special committees.
10. New business.
11. Has any one anything to offer for the good of the Bureau—vacant situations, &c.
12. Proceed to close.

The presiding officer shall have power to change the order of business should circumstances require.

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◆

TOO MANY ENGINEERS IN ENGLAND.

There are too many engineers in England at the present time, the result being that young engineers, especially, find it hard to get employment, while those who have it are poorly paid. This state of things is naturally unsatisfactory to those immediately interested, and they are discussing the remedy in the London *Engineer.* Our contemporary makes these sensible remarks:

"Young men, more or less entitled to call themselves engineers, not only complain that they have fallen on evil days, but suggest means by which others may escape similar disasters.

The substance of the complaint is, that after receiving a more or less expensive special education, they are unable to earn their livelihood. They cannot get employment at all in some cases, and in others the work they do is very badly paid for. They contend that those whose pupils they were have been guilty of distinct breaches of faith. They denounce the pupilage system; but they have not been quite successful in devising a substitute. Now the whole matter really lies in a nutshell, and a little attention being paid to the broad principles involved, there can be no difficulty in arriving at definite notions as to the reason why so many find engineering a failure as a means of even earning bread and cheese. The world buys the services of those whom it wants, and who are able to serve it; and the price is settled, like that of all commodities, by the quality and quantity of the thing bought. At the present moment, and for some time past, the supply of young men who have just served their apprenticeship is in excess of the demand. It would be mere waste of time to explain minutely why; but it is principally due to the circumstance that young men have become engineers without asking themselves whether it was likely they would be wanted. This is not peculiar to engineering.

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The mechanical engineer is a manufacturer. He may make lace machines, or power looms, or steam engines, or turbines; but there is no difference between him and the cotton spinner, or the weaver, or the pottery maker. Now the manufacturer knows that the making of the thing sold is only part of the business of his life. He must make and sell at a profit; and no amount of engineering skill—using the words in their abstract sense—will enable him to do this. He must know how to buy everything he wants in the cheapest and sell in the dearest market, and he must understand how to cut down the cost of production to the lowest limit. This is not peculiar to engineering. Such things cannot be learned from books; they are not taught at science classes; and the ordinary pupil never learns them at all. The mechanical engineer who employs young men estimates their worth by what they can do, and he knows that, as a rule, they can do very little.

Let us consider for a moment what a man, who has served his time in the shops of a good firm, passed through the drawing-office, and studied science, can give in exchange for a salary. He is an indifferent fitter, worth, say, £1 a week; he can run a planer or a shaping-machine, if the work is fixed for him, as well as a boy of sixteen who has been brought up to run planers and nothing else. He can do a little at the lathe, but is not to be trusted with really accurate jobs. He is a fair draughtsman, in the sense that he can put lines neatly on paper, and can use a box of colors with some judgment. He knows a good deal about the theory of the steam engine. He can calculate volumes of air from weights, pressures, and temperatures. He can tell one end of an indicator diagram from another. He has more than a smattering of algebra, and the first six books of Euclid are at his fingers' end. He is a fair arithmetician, and possibly knows something of electricity, magnetism, and chemistry. This is about the sum and substance of his attainments. How far are they likely to be saleable? how much are they likely to fetch in the market? The list of what he does *not* know would be more extended. We shall not attempt to reproduce it. It will suffice to point out one item. He cannot, for the life of him, tell what anything he makes, or sees made, costs or ought to cost. He is totally unable to make even an approach to an estimate. Take him into the yard in which he has worked, show him a fly-wheel, and ask him what it weighs, how much pig iron was needed to make it, what the coke that melted it measured, how long it took to turn and bore it, and it will be found that he knows none of these things. Put him in the drawing-office, give him an old engine then in the yard to re-build, and see how he will set about it. How much of the old work will he bring in? How many new patterns will he want? Test him in any possible way connected with manufacturing for a profit, apart from abstract scientific engineering, and he will be found utterly ignorant, and being ignorant he is practically useless to the engineer outside a very narrow groove, and yet he expects to find plenty of employment at a good salary.

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It will be found, and we say it with regret, that one reason why so many men are failures as engineers is that they do not take saleable goods to market; and this opens up a very large question indeed. The question is one of education, the consideration of which we must reserve. We must, however, before taking leave of the subject, say that enthusiasts are just now teaching young men intended to be engineers a great deal that has no direct money value whatever. Unfortunately, far too exalted an idea has been formed of the worth of so-called science to the steam engine maker. All the science in the world would not keep him out of bankruptcy unless he can sell engines for more than they cost him to make. We are not deprecating the teaching of science; we only insist that, in practical mechanical engineering, science does not of necessity, mean money. We often hear German and French engineers extolled for the results of their scientific training. What are the locomotives or marine engines which have resulted from it like? The Americans have been the least scientific engineers in the world; yet they have modified engine-building practice all over the world. Germany and France have been unable to compete with us without buying engines from us to copy. Science may prevent a man from making enormous mistakes; it cannot tell him how to produce even moderate commercial successes. Standing alone, it is entirely helpless in commercial mechanical engineering—combined with sound practice it is useful. We have said quite enough now, we think, to open the eyes of some of our correspondents, to startle others, and to put a few, perhaps, in direct antagonism with us. We have said nothing, however, which any employer of labor, any practical mechanical engineer, will refuse to allow. Unfortunately, one of the first things a pupil discovers when out of his time, is that, according to the world in which he seeks employment, he has really learned to do nothing which is worth substantial remuneration; and all the while employers are at their wits' end to get really good and valuable men."

These are sound sentiments, and apply to this country as well as to England.

◆

Essays Upon What Constitutes a Mechanic, what he should do and should not do, written by men who know nothing about the matter from personal knowledge, are curious exhibits of ignorance. How can a man who cannot drive a nail instruct others as to their needs?

This Is From The *Tribune*. It relates to an alleged smoke-consumer on the Hudson River R. R.

For ten years the New York Central R. R. Company have been trying to perfect some plan for the consumption of smoke in their locomotives. It is believed that success has been attained in No. 85, and those who travel behind that big locomotive the present summer will not have to close the windows of their cars, either in the tunnel or elsewhere, so far as smoke is concerned. The smoke consumer is in itself simple enough, being merely two pipes, one in front of the firebox and one in the rear, each of which admits jets of steam into the flames, rising through the burning coal. The steam effects perfect combustion, and while completely consuming the smoke, makes a gain also in the heat obtained. In the whole trip to Albany (where the engine was taken off) nothing that was visible came from the chimney except the escape steam. The improvement was wonderful, and the Central officials seem to be justified in feeling that they are a little ahead of the rest of the world with their new device. So far only two or three locomotives have been supplied with the smoke-consumers, but others are to be soon.

This is one of the oldest devices extant. We saw it in use over thirty years ago in the Morgan Iron Works. It would be curious to know the number of patents extant on it.—Eds.

◆

In One Detail, Canadian banks have a positive safeguard against overdrafts. No check is cashed till the holder has presented it to the ledger-keeper, who reports by initialing the check, or returning it with the answer that there are no funds to meet it. A sorry life is that of a cashier in some banks where this practice does not prevail. He is supposed to know when a check is presented to him whether he ought to pay it without reference to the ledger-keeper. If he is in doubt and refers to the ledger-keeper, he probably meets the malediction of the holder, especially if the holder happens to be also the drawer. If, on the contrary, he pays without reference he is held personally liable should there not be funds to the credit of the drawer sufficient to cover the amount. All this is avoided in a Canadian bank. The holder of a check, when he enters the bank, goes to the ledger-keeper first and the cashier afterwards. Once the check is initialed it may be taken away by the holder and the money is retained in the bank till it is called for.

The discounting of one-name paper is a practice almost wholly unknown in Canadian banks. This rule is that there must be two names, and, except in some extraordinary case, it is never departed from. This precaution has, no doubt, been the cause of preventing many losses which would otherwise have been made.—*Bradstreets.*

◆

This Warning is from the *Railroad Gazette:*

A locomotive-type boiler exploded lately, killing several persons. On examination, it was found that the safety valves had been purposely jammed hard down, and the pressure-gauge, showed only 140 lbs. pressure when the actual pressure was 280 lbs. to the square inch. When a pressure of 800 lbs. was put on a standard gauge, the gauge of the exploded boiler showed only 179 lbs. Probably this is an uncommon if not an extreme case; but few pressure-gauges are reasonably correct after a few months' use, and it is important to compare their indications periodically with those of a standard gauge, the latter being tested by a column of mercury. Safety valves are frequently altered and adjusted when the real fault lies in the pressure-gauge.

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The Morgan Envelope Company, of Springfield, Mass., are now testing a petroleum gas-heater under one of the 80-horse power boilers which furnish steam for their engines, and a six weeks' trial has recently been satisfactorily finished. With this apparatus, in which crude oil will be used, 80 pounds of steam can be raised from cold water within 55 minutes, or about half an hour less than is needed with coal as fuel, and a saving of 20 per cent. in all expenses is expected. A heavy oil is used in apparatus so designed as to entirely prevent oil explosions.—*Oil, Paint and Drug Rep.*

In The Trinity House, England, experiments are now in progress to determine the relative advantages of gas, oil and electricity for lighthouse illumination. The carbons used in the electric arc lamp are of a compound nature; that is to say, each carbon instead of being solid, is a collection or sheaf of small rods forming one thick rod. This arrangement is found to give a better light than the solid rod, which is apt to "crater," or become hollow in its burning end. Compound rods, which are patented, do not crater in this way.

◆

The Magnitude of railway travel in England is forcibly summarized in a paragraph in the *Engineer*.

In Great Britain alone, 654,000,000 people travel annually. There are 14,000 locomotives, and the rolling stock would form a train nearly 2,000 miles long; whilst the number of miles traveled in a year by trains is more than 10,000 times round the world; and the passengers would form a procession 100 abreast, a yard apart, and 3,700 miles long.

◆

An Old Railroader says: "I thought I had heard of all the technical terms in railroading, but I learned something new the other day. I was on a train with some English railroad men, when suddenly the train stopped. One of the Englishmen went out to learn the cause. On his return he said: 'Oh, it's nothing but an ot ob.' I had never heard of an ot ob, and it took me some time to discover that what he referred to was a hot box."

◆

If An Iron Wire be twisted during or soon after the passage of a voltaic current through it, the wire becomes magnetic. When the wire is twisted in the manner of a right head screw, the point at which the current enters becomes a south pole; in the opposite case it becomes a north pole. If during the passage of the current the wire be twisted in different directions, the polarity changes with the direction of the twist.—*Engineering Review.*

◆

It Is Said that a new illuminating gas has been produced which can be manufactured for 16c. per thousand cubic feet. A paragrapher sees in that fact a millenium of cheap light just about to arrive. He is fatuous; if gas could be had for nothing, the company which sold it would pretend they were losing money in selling it at all.

◆

Foreign Dispatches say that M. Hervé Mangon has presented a report to the Academy of Sciences concerning a recent balloon ascension at Meudon. The balloon was under the direction of Capt. Renards, and, although it moved against the wind, easily followed the course along which it was steered. It was veered around and brought back to the point from which it started.

◆

Futile Objection.—"Will you have this bush made of phosphor bronze?" said the superintendent to a party wanting some repairs made.

"No, sir," said the party. "You put phosphorus into matches to strike fire; of course if you put phosphorus into brass it will get hot. Don't want any."

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

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THE MECHANICAL ENGINEER.

New Series. Vol. VIII.—No. 6.
Enlarged 1883.

New York, September 20, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

THE BLAKE IMPROVED PUMPING ENGINE FOR SMALL WATER WORKS.

A large number of our small western cities have been, and are now, turning their attention to the question of water works. The increased healthfulness and cleanliness thus secured to a city, the advantages to manufacturers, and protection in case of fire, are considerations that cannot be overlooked. In most cases, small first cost is the primary consideration, and the motive power, in particular the engine itself, must combine the most practical advantages with the least cost. Such an engine must require no expensive boiler plant, foundations, buildings, nor expert engineers for their proper erection and management. Of the three systems in general use—the reservoir, standpipe, and direct pressure, the latter has some points of advantage in first cost. Independent engines are costly in themselves, and in the necessary foundations and buildings. For these and other reasons, the horizontal direct acting pumping engine has come to be the standard, except where special conditions sometimes necessitate the adoption of other types. The duplex arrangement is also generally used, as it insures uniformity of discharge, ease of movement, noiselessness, and ample time for the valves to seat.

We present herewith a handsome illustration of the Blake Improved Duplex Pumping Engine, plain, non-condensing, which is well adapted to meet this demand. One serious defect in the duplex motion has been the liability of the piston to stop short of making its complete stroke, so that full capacity could not be obtained from the engine. By the use of the improved adjustable valve motion, which the Blake company is now putting on all its pumps, this difficulty is obviated, and the pistons make the full stroke under all circumstances. Thus made, these pumps are easy of management, work effectively, and with economy of fuel, and little or no liability to derangement. No better fire protection could be asked, as it is no uncommon thing to furnish a pressure of 125 to 150 lbs. per square inch in the city mains.

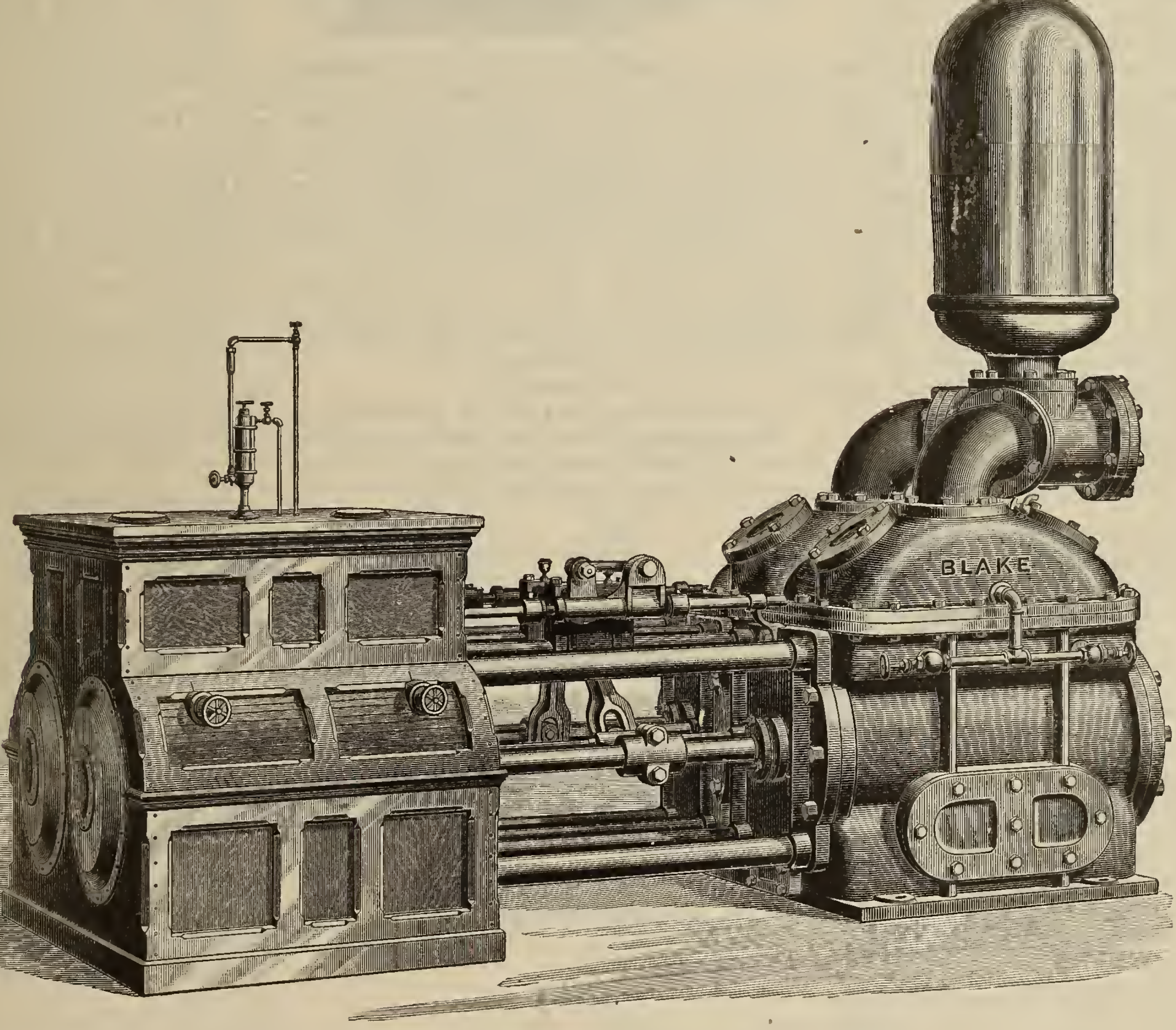
When some economy of fuel is desirable, a low pressure cylinder can be added, thus making the engine compound, and securing the advantages of expansion in the use of steam. The saving in fuel is dependent upon various conditions, but has been known to reach as high as thirty per cent. A serious difficulty in many compound engines is that one piston rod runs through both steam cylinders, with a stuffing-box between the low and high pressure chambers. To keep this tight is difficult, it being almost impossible to get at this stuffing-box without taking the whole steam end to pieces. If it is not kept tight there is a constant leakage of steam from the high into the low pressure cylinder. On the Blake compound engine this difficulty is entirely removed by the use of *outside* piston rods running direct from the heavy crosshead to the low pressure cylinder, with stuffing-boxes adjoining the other for the high pressure cylinder. They can thus be gotten at immediately, without inconvenience, and there is no internal opening between the two cylinders. This is a point that engineers in charge will appreciate.

Where still higher economy is aimed at, the greatest efficiency is secured by the addition of a condenser. The Blake Company make for this purpose, and for attaching to *any* style of engine, an *independent* air-pump and condenser. The advantages of an *independent* over a connected condensing apparatus are many. There is no drag on the engine. It can be started, and a vacuum secured, before the main engine starts. Its speed can be adjusted to the temperature of the injection water, and can be increased in case there is a leakage due to gritty water or any other cause, thus securing the maximum vacuum under all conditions. The apparatus can be placed immediately under the engine or in any convenient place.

The Blake Company have lately patented a device, which they apply to their duplex engines when desired, by means of which either set of cylinders can be run independently of the other. It is perfectly reliable and mechanical in all its parts, and can be thrown into operation in a few minutes. This is a great advantage, especially where there is no additional pumping machinery, or in case of accident or repairs to one set of cylinders.

The pumping machinery made by this company is from new designs and patterns, of ample strength. It is finished in first-class shape, and the steam end is covered with a handsome walnut lagging, which can readily be removed when necessary to get at the working parts. The water end has inside plungers, packed with fibrous packing, and the water valves are of the best vulcanized rubber. The company have complete sets of patterns, and are building engines from one to fifteen million gallons daily capacity.

Among the western cities which they are now furnishing their engines, we mention Danville, Ill.; Rich Hill, Mo.; Columbus, Texas; Duluth, Minn ; Maquoketa, Iowa; Sedalia, Mo.; Wyandotte, Kas., and others. More than one hundred are in operation in towns and cities in this country, and many in cities of Europe, including the capital of Russia.



The Blake Improved Pumping Engine For Small Water Works.

This Is A Singular Confession for the *American Machinist* to make:

> "A genius in the hardware line has devised luminous door-knobs, which he advertises will 'shine all night.' Anybody can find the door-knob in the dark, but the keyhole is what bothers most men who stay out late. A luminous keyhole would 'fill a long felt want.' Where is the hardware manufacturer that will bring out luminous keyhole trimmings?"

We never should have suspected it.

Cassel's Family Magazine, and Cassell's *Magazine of Art* for September well sustain the high character they have earned. The first mentioned is a most excellent work for family reading, at a very low price—15 cents per copy.

NOTES ON THE PHILADELPHIA ELECTRICAL EXHIBITION.

The Edison Company have a high structure in the shape of a hollow truncated cone, with a large number of incandescent lamps of various colors. The cone is sprinkled with mica on the outside, and when fully lit up by the lamps will present a gorgeous appearance. There will be no experiments like those made by M. Deprez in Paris for conducting high tension currents long distances by means of conductors, or "leads," as they are called, of fine wire.

The Time Telegraph Company has on exhibition a set of their apparatus, consisting of clock dials, connected by electricity with a fine large clock. The telemeter system is also exhibited in working order. This system includes a series of instruments for indicating and recording automatically and continuously temperatures and barometric, steam, water, electrical, and all other pressures at a distance. By the aid of this system a man is enabled to sit in his office or counting room and tell by looking at the indicators what the temperature is out of doors or at his country seat; what the pressure is on the gas and water mains or on the steam boilers under the sidewalk; how the barometer stands in town or out of it, and to acquire similar information of more or less practical value. The heights of water in reservoirs, lakes, dams, tanks, canals, etc., are also determined and recorded. Deep sea temperatures and those on mountain peaks may be ascertained; the heating of cargoes on board ships and the proximity of the Gulf Stream may likewise be discovered by these instruments, and fire alarms may be made to ring whenever the temperature in any structure rises above a fixed point.

An ingenious electric valve is shown by another exhibitor which may be applied so as to control all passages for steam, water, gas, or air. By its use the temperature of a room may be regulated automatically to the fraction of a degree, pumps may be started or stopped, draughts may be controlled, and whistles blown. The usual caution given to visitors at electrical workshops is announced here, that such of them as have valuable watches should not get too close to the machines, lest the works of the timepieces be magnetized.

In the way of lighting, electricity is not to be allowed to be unchallenged even in this exhibition. The lunch rooms, which form part of the old Pennsylvania station, and are connected by a covered bridge with the main exhibition building, are lit by means of large gas jets, consuming nearly 50 cubic feet each per hour and giving a light of 250-candle power or more. The gas is burned in the Siemens regenerative burners, examples of which are to be seen at the corner of Irving place and Fifteenth street and elsewhere in New York. In point of cost gas can, when burned in this manner, fully hold its own with electric arcs, and the light is more diffusive and less dazzling.—*Times.*

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An Engineer Asks The *Railroad Gazette* if it does not show the decadence of the engineering profession when one of its most distinguished members, even a Past President of its representative society, keeps a "pool room" on Broadway. That we may know that this is true, he refers to the number.

Keeping a pool room may show that that particular individual is decayed, but how it can affect engineers at large is difficult to see—unless they frequent the place.

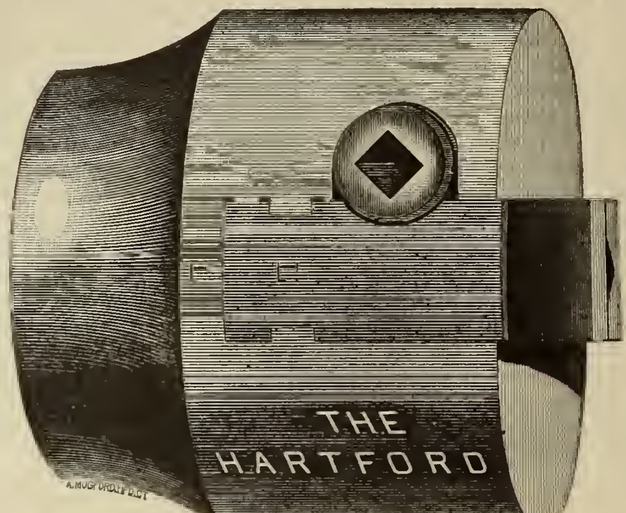
◆

Since The Franklin Institute reported on the metric system of weights and measures, and showed plainly the enormous expense and incalculable inconvenience that would be endured in this country, in changing from our established standards to the French system, the enemies of our weights and measures have been very quiet, but it is said they are striving quietly but vigorously to commit this country authoritatively to the metric system.—*Am. Machinist.*

For many years past the friends of a standard system of screw threads have been striving vigorously to have it adopted, but with no very great success. We fancy no clique can "commit this country" to anything. It is not against the law to use a two-foot rule.

THE HARTFORD NEW DRILL CHUCK.

Drill chucks are indispensable in all branches of the machine business, but a great many are such only in name. A vexatious fault is that they are efficient only on some few sizes of drills. Another is that they are too delicately made for everyday use, and soon give out. We have examined this tool carefully for some evidence of the defects mentioned above, but fail to find them. As may be seen, it is very substantially constructed, and is of the simplest character. The jaws are opened and closed by the screw shown, and hold very firmly anything between them. This chuck holds from 0 to $\frac{3}{4}$ths of an inch, and has a hole of that size clear through it; both jaws and screw are cast steel, properly tempered. It is made to fit a tapered plug, or can be screwed on to the spindle, if so required. Every chuck is tested thoroughly before being sent out.

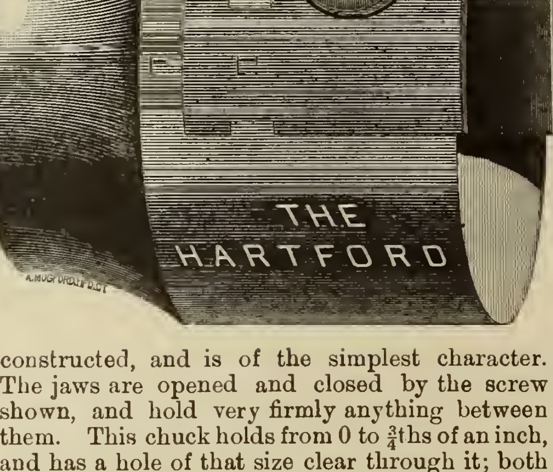


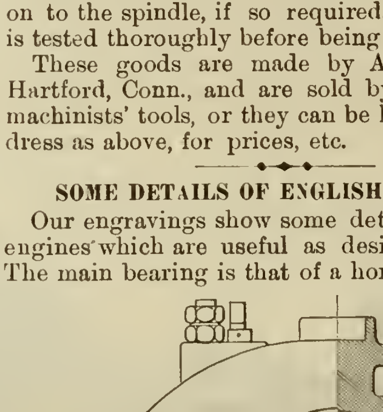
These goods are made by A. F. Cushman, Hartford, Conn., and are sold by all dealers in machinists' tools, or they can be had direct; address as above, for prices, etc.

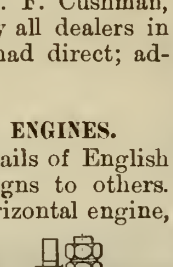
◆

SOME DETAILS OF ENGLISH ENGINES.

Our engravings show some details of English engines which are useful as designs to others. The main bearing is that of a horizontal engine, which may be adapted to any size. The crosshead is of the cap variety, which admits of ready examination, and simplicity of construction as to the connecting rod; no straps or gibs and keys being needed on that end of it.







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Watch Jewels, it is said, can be imported for one dollar a dozen.

LETTER FROM A MARINE ENGINEER AT SEA.

We are permitted to publish portions of a private letter from an engineer to a friend in this city. This letter has interest for our readers in some parts, for it gives a vivid idea of the perils of the sea, and the trials and tribulations, to say nothing of danger, engineers are exposed to through breakdowns.

Steamship *Al-Ki*, at Sea, July 27th, 1884.
In sight of the lighthouse off Bahia, Brazil.

Dear Friend: We are now running under a half-speed bell. We made this light about one hour since, and as we cannot go into the harbor until daylight, must circle around the balance of the night. We are crippled. At midnight, on the 23d of July, without any warning, the radius bar that works the main links broke short off near the saddle. She made a few strokes, and we shut off without further damage. It was blowing hard at the time, with a heavy head sea running down on us.

I took down the broken bar, made one of spruce plank, and with rope, ratling stuff and marlin patched up and started ahead again at 3:30 A.M.; time of job 3 hours and 30 minutes; rather ticklish work, but I have got used to it by this time, and think I could run her to San Francisco if they did not ask me to back her. We were between Rocos Island and Pernambuco. I told the captain to head her for the nearest port (Pernambuco) for repairs, but when we got abreast of that place it was blowing a stiff gale of wind, with a heavy sea running. We made signals for a pilot to come and take us in, but no one made a show of coming to help us, so I told the captain we had better move on for a quieter place, as I could not do a job riding at anchor in a gale of wind. We poked her nose off shore again and started for this port, Bahia, where I hope to be safely at anchor by 7 A.M.

Perhaps it would make you sick to see your pet's limbs tied up, as I have one of them, but she is all right at present. We have come over 700 miles in this condition. I think an engine made up of wood and rope yarn almost as good as one made of bad iron! The flaw was in the weld. The second night out from New York was the worst I ever saw. She was deep in the water and shipped sea after sea and rolled both rails under all night long; washed me out my berth twice, and filled my room with water. The engine and fire rooms filled with water, and all the rooms around the engine house were useless for a human being to stay in; no more of that for me, my friend! I've had my share, and am content with this last dose. The *Al-ki* can roll deeper, quicker and easier than any ship I ever had my feet on.

A water pitcher stood for 20 days on the dining-room table and never slid off. Talk of 30° roll! I sometimes thought she was going 60° and bottom up. Mr. H—— used to be afraid to stand on the engine platform. He was looking up to the sky and the cylinders were lying on top of him! But they are where you placed them, yet; not a bolt has given out or a nut come loose so far.

I write these few lines to let you know just how things are; I may not get another chance in this port. I want to do my job, clean boiler and get up and get out of this as soon as possible; not more than two days' delay I hope.

Yours truly, H. V. Freeman.

◆

"OBEY ORDERS IF IT BREAKS THE OWNERS."

A mechanic who had built up a large business from small beginnings was asked how he did it.

"I made a rule for one thing, he said, to mind my own business, and never tell customers what they wanted. I think that has helped me greatly."

Building relates an instance which is quite opposite to this sensible practice.

The writer says:

"One of my masons misconceived the specifications in regard to the chimneys. After a week's absence I found he had built them up to the roof with four inches of brick on the outside of flues. The specifications called for eight inches.

"'You did not notice that it called for eight inches, I suppose?'

"'Yes,' was the reply, 'and I wondered what it meant, but concluded t'want no use making it eight when four would answer just as well—and so I figured on four. I've worked in this place for over thirty years, an' built most of the best houses, and I haint never heard tell of a chimney with solid eight inches of brick work. I s'posed it was a slip in drawing up the specifications, or I should ha' spoken of it, for I never figured on it.'

"Of course the chimneys had to be taken down and rebuilt. I advised my client to partially reimburse the builder, but he declined, in such a way as to leave no doubt but that he looked at my advice with a little suspicion. After this I became chary of giving such advice."

A friend of ours recently had his house painted, and before leaving mixed a tint for the painter the shade he required. When he came home at night he found his house a totally different color. On asking the painter what it meant, he was told that the shade he wanted was all nonsense; "there wasn't a house around painted that color!"

◆

It Will probably surprise many, says an exchange, to learn that now even the finest and most delicate wheels of watches are made from paper-pulp.

It surprises us, and we don't believe it.

ACTION OF ALCOHOL ON THE HEART.

Dr. N. B. Richardson, a noted physician, says he was recently able to convey a considerable amount of conviction to an intelligent scholar by a simple experiment. The scholar was singing the praises of alcohol, and saying he could not get through the day without it, when Dr. Richardson said to him:

"Will you be good enough to feel my pulse as I stand here?" He did so.

I said, "Count it carefully."

"Your pulse says seventy-four."

I then sat down and asked him to count again. He did so, and said, "Your pulse has gone down to seventy."

I then lay down and said, "Will you take it again?"

He replied, "Why, it is only sixty-four; what an extraordinary thing!"

I then said, "When you lie down at night that is the way nature gives your heart rest. You know nothing about it, but that organ is resting to that extent; and it is a great deal of rest, because in lying down the heart is doing ten strokes less a minute; within a fraction it is 5,000 strokes less in eight hours; and, as the heart is throwing 6 ounces of blood at every stroke, it makes a difference of 30,000 ounces of lifting during the night.

"When I lie down at night without any alcohol, that is the rest my heart gets. But when you take your alcohol you increase the number of strokes, and, instead of resting, you put on something like 15,000 extra strokes; the result is, you rise unfit for the next day's work till you have taken a little more alcohol, which you say is the soul of man below."—*Unknown Source.*

◆

COST OF MAKING A BARREL OF FLOUR.

The cost of the manufacture of a barrel of flour, aside from the wheat, includes fuel, labor, oil, repairs, interest, insurance, and depreciation of plant. Mills are supposed to be manufacturing, in some localities, at a cost of 24 or 25 cents a barrel, but the safest figure to count on is in excess of 35 cents a barrel. Fuel is the most variable of all items. A mill in Milwaukee makes a barrel of flour out of 19 to 21 pounds of coal. They have a compact mill, machinery in good order, a compound, condensing Corliss engine, and a water-tube boiler of the Babcock & Wilcox type. Thus they are able to operate under the most favorable conditions.

The amount of wheat used in making a barrel of flour plays an important part in the ultimate cost. Many millers claim to make a barrel of flour out of less than four bushels and 30 pounds of wheat; there are very few who do it. The average may be placed at between four bushels and 36 pounds and four bushels and 40 pounds. There is another element to be considered in estimating the cost, which is the unaccountable loss of about 8 or 10 pounds per barrel in manufacturing. To illustrate this point we will take a yield of four bushels and 35 pounds and tabulate the result according to the above statement:

A yield of four bushels and 35 pounds would be equal to..........	275 lbs. wheat.
One barrel of flour equals...............	196 lbs.
This would indicate a remainder of.....	79 lbs.
In practice with such a yield there would be of bran and screenings..........	69 lbs.
Thus there would be an invisible or unaccountable loss of.............. ...	10 lbs.

The cost of the barrel in which the flour is packed is usually from 35 to 40 cents in the winter-wheat section. Export sacks cost about 20 cents per barrel less.—*The Millstone.*

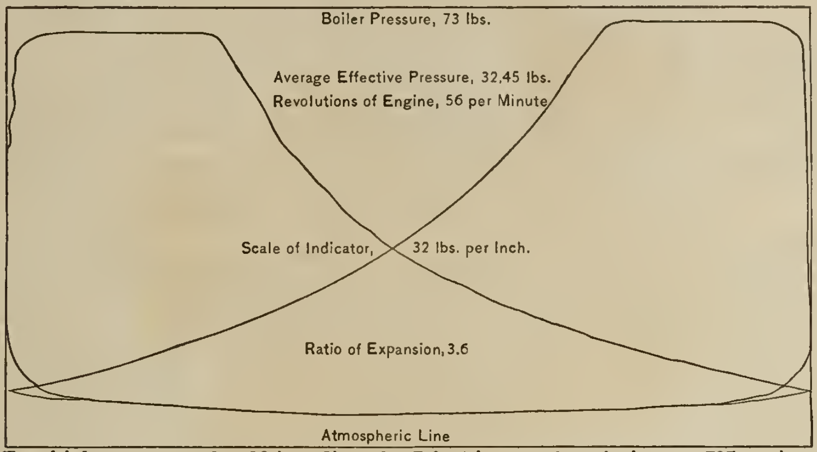
◆

To Make A Machine Watch 3,746 distinct operations are required.

INDICATOR CARDS FROM THE SS. "LOUISIANA'S" ENGINES, AND SOME REMARKS REGARDING THEM.

The illustrations are copies of indicator diagrams from the engines of the "*Louisiana,*" taken at a time when developing a larger amount of horse-power than usual (2,082), to maintain a desired average speed of 14 knots against a very strong wind and moderate sea, lasting only a few hours.

The voyage was from New Orleans to New York, 1,780 miles. The time occupied was 124 hours from wharf to wharf, including all detentions, and ending August 25th, 1884.

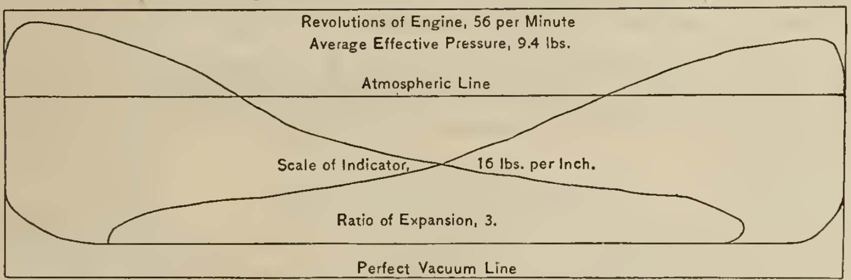


Two high-pressure cyls., 30 ins. diam. by 7 ft. 4 ins. stroke of pistons; 707 sq. ins. × 32·45 lbs. × 821 ft. ÷ 33000 = 570 I. H. Power.

The load displacement at the time of taking the cards was 4,180 tons.

For the voyage:—the average load displacement was 4,205 tons, the average horse-power indicated 1,700, the coal consumed, 170 tons (semi-bituminous), or 31.9 tons per 24 hours=3,071 lbs. per hour, and a horse-power for 1·8 lbs. per hour.

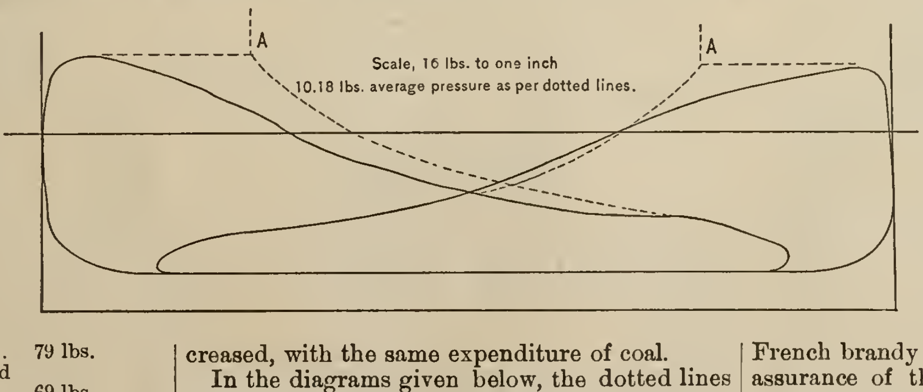
The "*Louisiana*" has double engines, with vertical cylinders and overhead working-beams; all four cylinders are fitted with poppet-valves and Dickerson & Sickles' cut-off gearing.



Two low-pressure cyls., 56 ins. diam. by 6 ft. stroke of pistons; 2463 sq. ins. × 9·4 lbs. × 672 ft. ÷ 33000 = 471 I. H. Power.

There are two points very plainly demonstrated by these diagrams, that the *high-pressure cylinders* are proportionately *too large,* and that the engines should have *more receiver capacity.*

Had the former been made according to the rules of proportions for compound engines, as shown in a former communication (Vol. VII., No. 7) in The Mechanical Engineer, with the addition of receiver capacity as there advised, the horse-power would have been appreciably increased, with the same expenditure of coal.



In the diagrams given below, the dotted lines show the *power* that would have been gained through a receiver of 10 times the capacity of the high-pressure cylinders. The average pressure would have been raised from 9·4 lbs. to 10·18 lbs., which, at the piston speed given, increases the horse-power of each low-pressure cylinder from 471 to 510, adding 78 horse-power to the engines for the same coal consumption. M. C.

◆

Read "Personal Appearance of Noted Scientists."

THE DIRTY SHOP.

A writer in the *Lumber World* draws this faithful picture of the dirty shop:

The machines are so totally besmeared with dust, pitch, resin, and grease, that when you start you are in great doubts as to whether there will be anything left of the machines if all these superfluous coatings are taken off. The belts are thicker by reason of an extra coating of dirt; the pulleys may perhaps be out of balance by reason of a preponderance of dirt accumulated on one part; hangers so greasy that you never dare place a ladder against them lest it slip from under you and make a job for the doctor or undertaker; timbers covered with the dusty gathering of years; corners made round by piles of refuse; tool room littered with old broken saws hanging on pegs; worn out cutters of all kinds, broken saws, screws, old worthless bolts, misfit nuts, odd sized washers on the shelf, broken files and ends of played-out belts and old fastenings tucked away under the bench in old nail kegs, boxes, etc., and broken gauges. Antiquated patterns may be hanging up in spare corners and sides of the mill, and all corners and sides are generally spared for such purposes. In the engine room you can find all the old broken wrenches, bolts, castings, and perhaps fire-grates, that have been replaced for the last twenty years, to say nothing of odd nails, screws, chunks of tallow, rubber packing, and broken and leaking oil cans stowed away in some old soap box that is blue-moulded with age and perfume. These are but a few of the points to consider before starting, and you have got to screw your courage up to go at it and do yourself proud, and the establishment justice. It won't take but one of these cleaning crusades to convince you that these things are not always worn out by honest work, but are often broken and then thrown under the bench. Right here I might add that the secret of keeping a clean, tidy factory is to have each workman responsible for his part; make it a rule that each person must keep his machine, floor, or bench in a reasonably clean condition every day. It will suprise employer and employee to find how little time it takes, how much more easily and better it will be done, and how much more comfortable every one will be.

I have been through factories and mills where one could roam at will after stopping time, and not get any more dirt on his clothes than if he were in a parlor. I have observed that the clean factories, generally speaking, are the most successful, less subject to fires, pay less for insurance, and are also the shops where most do congregate the intelligent mechanics, for the reason that such men like a clean place in which to work, where they pass the greater portion of their lives.

Did you ever notice a lot of men coming out of a dirty shop? They are away before the echo of the alarm has died away; they run up the street slipping on their coats, sling their dinner pails on their elbows and thrust their hands deep into their coat pockets, looking neither to the right or left, but sneaking home by the nearest and most unfrequented route. What need is there for a man to carry all the dirt of his trade on his back or hands? There is no necessity. If you earn your bread by the sweat of your brow, you are not obliged to peddle said sweat on the streets, or hide your hands because you are dirty, or take the back streets. You should be clean before you leave for home, and as far as suitable washing conveniences are concerned, at your employer's expense. Take a few minutes before you emerge on the street; appear at least neat and clean and you will feel a great deal better for it.

◆

A Gentleman Of Our Acquaintance recently went into a large down-town drug store and asked for a pint of French brandy. The clerk produced a bottle, and stooping down poured a reddish extract into it, and handed the bottle to a boy, telling him to go down-stairs and fill it up. The gentleman said he didn't care about that kind of brandy, and left. The reddish extract was "Cognac essence," and the intention was to fill the bottle with alcohol (or possibly water) and produce French brandy while you wait for it! The cool assurance of the transaction showed that it had been practiced a long time.

◆

A Pie Factory in this city makes 20,000 (twenty thousand) of them daily. It uses 300 bbls. of flour a week, and every day works into pie 25 bbls. of apples, other fruits in proportion; 6,000 pounds of sugar, 840 dozen eggs, 2,640 pounds of lard, 1,400 quarts of milk and 100 bushels of berries. The loss in pie-plates alone is $5,000 a year.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

MR. HUGO BILGRAM'S VIEWS.

Editors Mechanical Engineer:

Your frequent assertions that mathematical formulæ are distasteful to the American mechanic, and that there is no necessity for their use in technical publications, is very apt to induce the notion that for a mechanic mathematics is a very useless attainment. Will you permit me to enter a plea for this science?

Algebra is very little more than arithmetic generalized and taken out of its narrow sphere of definite numbers. An intelligent man should find little difficulty in mastering it.

If mathematics were of no other use, it would be invaluable in teaching a man how to think and to draw logical conclusions. But I think I am not far from right if I say that any one who desires to obtain a more than merely superficial knowledge of mechanics (theory of the action of forces) that it will take him less time to first master, at least, the lower branches of mathematics, and then study mechanics with their aid, than to try to master mechanics without the use of mathematics. The fact that any one acquainted with mathematics will never attempt to examine a mechanical phenomenon, or principle without reverting to this science, is in itself a proof that mathematics is the handiest tool for analyzing such problems. You pay the American mechanic a poor compliment if you maintain that he cannot understand the $x \times y$ as readily as the 2×2.

You say that "leading works of engineering have been erected . . . by men whose mathematical abilities are confined to ordinary processes." . . . . Such men are rare exceptions, and even if they have not acquired the customary way of working with formulæ or diagrams, they have a way of their own to work out their mathematics, and have an ability to draw logical conclusions by natural tact, which is not inborn in the majority of men, but may be developed by the study of mathematics.

Most technical subjects are far beyond the comprehension of men who will not comprehend the simple rules of algebra. Your plea for avoiding mathematics in such books falls naturally to the ground.

You certainly underrate the connections of mathematics with steam engines or machinery. If you come to this city I shall be pleased to show you a machine-tool whose success, nay, its very existence, is directly due to the solution of intricate mathematical problems. I send you a sample of the product of this machine, and challenge you to produce work in the same line approaching the same degree of perfection.

Some time ago you criticized the definition of "pitch circle" of some writer, and propounded a definition of your own, consisting of only six words (p. 200). Will you allow me to criticize your definition? Yours is no definition at all. In the first place, I do not know, without your further explanation, what the "working center" of a tooth is, and how to find it, although I flatter myself with knowing something about gearing. It is possible to make a pair of correctly gearing wheels, on one of which the pitch-line is outside of the tops of the teeth, on the other below their base line. I cannot see how your rule could be applied in this case, as the center of a tooth can certainly never be outside of it. I have frequently occasion to make gears in which the pitch-line is nearly outside of the teeth of the wheel, and near the base of the teeth of the pinion. In the second place, there is only a definite number of teeth in each wheel, and the working center of each tooth is a point; how a definite number of points can be called a line is beyond my comprehension.

The denounced definition leaves no doubt as to the identity of the pitch-line; your definition leaves the determination of the pitch-line doubtful in every respect. It was his familiarity with mathematics which cautioned the writer of the first definition to so formulate the same that it cannot possibly be misunderstood.

Philadelphia. Hugo Bilgram.

[We are glad to hear from Mr. Bilgram, who is, we believe, a mathematician of some ability; albeit, he rings the changes upon the respective intelligences of persons with and without mathematical aspirations. As this is purely a question of taste, or to speak precisely, courtesy, we will not discuss it with him. In other parts we disagree with him, especially in the first paragraph. We do not think that any such inference can be drawn from our article. We have never said or intimated that mathematics was a useless study, or that there was no necessity for higher mathematics. We have questioned, and still question, the propriety of introducing intricate mathematical problems where simpler demonstrations would suffice. Particularly do we object to them in technical works which are supposed to be elementary. Works on gearing are in demand. We know this because we have sale for such books. Pattern-makers are especially glad to purchase them. Mr. Bilgram can answer from his own experience as a machinist how many mathematicians are to be found in this trade.

Mr. Bilgram objects to our definition of the pitch-line and says it is incorrect. That may be; if so, we are under obligation to him. We have always considered the pitch-line of a gear as the one from which the teeth are constructed, or laid out, and upon which they should work when properly set up. We therefore define the pitch-line as the working centers of the teeth. We learn for the first time that the pitch line is sometimes outside of the teeth, and sometimes below their bases. Merely to show that others have made the same mistake that we have, and that it is inculcated in text-books, we quote from the first work at hand and without search for it. This is "*The Mechanics of the Machinery of Transmission,*" by Gustav Herrmann, Prof. at Royal Polytechnic School, Aachen, Germany, etc. On page 279 the author says (fifth line from bottom, right hand page):

> "The distance of two teeth from center to center, or the distance between two homologous surfaces, measured along the circumferences of the circles, passing through *P*, is called the pitch of the teeth, or simply pitch; consequently the oft mentioned circles of equal velocity on which the pitch is laid off, are known as the pitch circles. From what has been said we know that these circles are not realized in actual construction, but are ideal circles, so situated between the addendum circles A' and B^1 and the root circles A^2 and B^2 of the wheels (in the diagram these letters show top and bottom of teeth.—Eds. M. E.) that the ratio of their radii is inversely proportioned to the angular velocities of the wheels." * * * It follows that the pitch circles of the wheels must be regarded as the centroids which represent the relative motion of the two wheels, the point of contact *P* being the *instantaneous center*, and the straight line through *P* parallel to the axis the instantaneous axis."

Mr. Bilgram remarks that a certain machine, samples of work from it sent in verification, depends for its correctness, or existence, upon intricate mathematical calculations. We are certain that Mr. Bilgram does not mean that he can originate a machine by calculation. He must design or conceive of it first, after which he may verify it; but are we to understand that the results could not have been arrived at in any other way? That is a good deal to say. Mr. Bilgram is aware that some of the best mechanics in the world—he knows our use of this word—have been self-taught. We know a marine architect, for instance, whose name would be recognized at once, and whose work has spoken for itself; that man cannot add up two columns of figures of any length, and make the same result twice. He is devoid of the mathematical faculty; just as many good mathematicians are as poor as Job's turkey, because they have not the acquisitive faculty. The man who originated the differential pulley block in this country—John Doyle—was a laborer in the Novelty Iron Works, at one dollar per day; he had the calculus at his fingers' ends. Mathematics to some persons is almost a function of the mind, but it is of no use to them unless they have constructive ability also.

We must content ourselves with this response. Our remarks are already far more extended than we meant them to be. Mr. Bilgram—as well as all our other readers who dissent from our views—surely knows that we have more sense than to put ourselves on record at this day and time, as declaiming against the utility of a mathematical education.

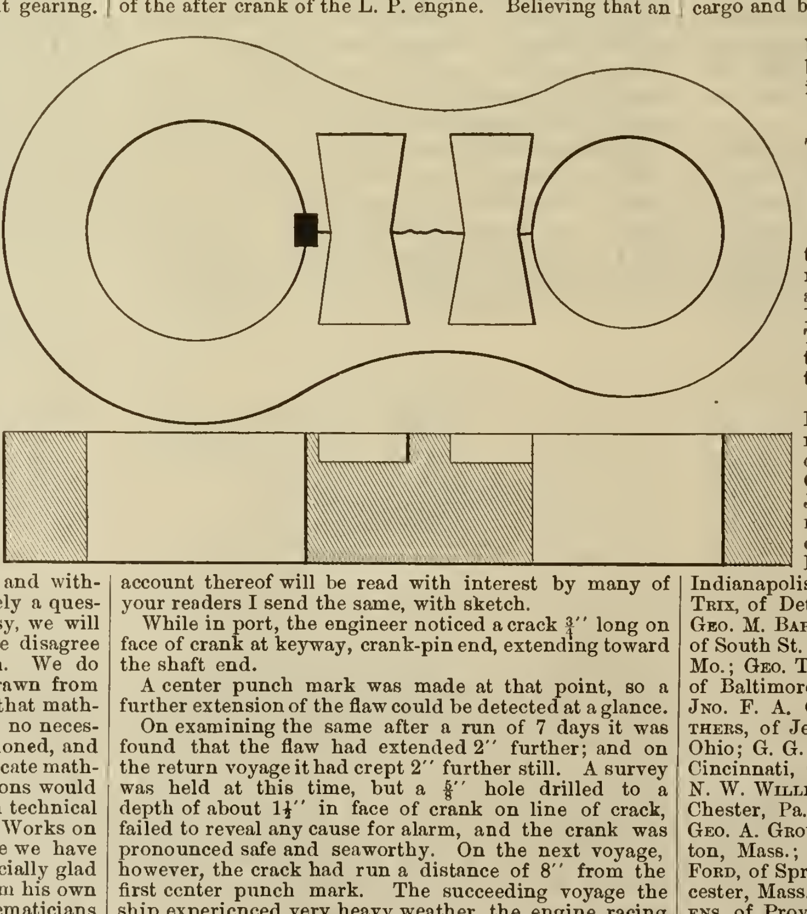
Our correspondent's letter is welcome, as all criticism is, and our hasty reply is necessitated by the fact that Mr. Bilgram's favor arrived on Saturday noon, Sept. 7th, just as we were closing the paper.—Eds.]

◆

FISHING A CRACKED CRANK.

Editors Mechanical Engineer:

A short time ago my attention was called to the ingenious manner in which the efficient chief engineer of one of our coastwise steamers—a vessel of some 2,600 tons—repaired a serious flaw that developed itself on the face of the after crank of the L. P. engine. Believing that an account thereof will be read with interest by many of your readers I send the same, with sketch.



While in port, the engineer noticed a crack $\frac{3}{4}''$ long on face of crank at keyway, crank-pin end, extending toward the shaft end.

A center punch mark was made at that point, so a further extension of the flaw could be detected at a glance.

On examining the same after a run of 7 days it was found that the flaw had extended 2'' further; and on the return voyage it had crept 2'' further still. A survey was held at this time, but a $\frac{5}{8}''$ hole drilled to a depth of about $1\frac{1}{2}''$ in face of crank on line of crack, failed to reveal any cause for alarm, and the crank was pronounced safe and seaworthy. On the next voyage, however, the crack had run a distance of 8'' from the first center punch mark. The succeeding voyage the ship experienced very heavy weather, the engine racing badly. On arriving in port it was found, on examination, that the crack had run into the keyway on shaft end of crank, and loosened the keys in both ends of same.

The chief engineer then made, of the best wrought iron, dovetail pieces as per sketch, and let the same into face of crank as shown. These pieces were well fitted and sledged into the recesses in crank, so that the wedge faces of the piece had a bearing their whole length. About 3-16'' of the outer edge of dovetail piece was chamfered off before driving home, and the projecting metal of the crank face was then fullered over the piece, thus securely holding it in place. The return voyage was made without trouble, and upon the recommendation of the surveyor a similar piece was let in below the first. A number of voyages made with the crank so repaired, developed no further flaws, and proved very satisfactory.

New York. Cut Off.

◆

THE REVENUE SERVICE FOR ENGINEERS.

Editors Mechanical Engineer:

Being a subscriber to your paper I would like to ask you a question and would feel obliged if you will answer it in The Mechanical Engineer.

1st. Could a Stationary Engineer get into the Revenue service if he could pass examination?

2d. To whom should he apply? Engineer.

New Bedford, Mass.

[1. Yes.

2. You should address the Secretary of the Treasury, Washington, D. C., making application for position as 2d Ass't Engineer U. S. R. M. We do not know if there are any vacancies at present, but a letter to the Secretary will bring all needed information.—Eds.]

◆

NEW STEEL STEAMSHIP ON LAKE ERIE.

Editors Mechanical Engineer:

I send you an account of the new steel vessel built by the Detroit Dry Dock Co., which will show the readers of The Mechanical Engineer the class of vessels that are now building for freight carriers on the Western Lakes.

Quite a number of Detroiters visited Wyandotte yesterday and were rewarded by seeing a highly satisfactory launch. The steamship belongs to the Western Transit Company, of Buffalo. She was built by the Detroit Dry Dock Company after designs by Frank E. Kirby, under the supervision of F. A. Kirby, Superintendent of the Wyandotte shipyard, who has stood over the ship since her keel was laid. Much credit is due him for bringing her out so promptly and in such good shape.

The *Albany* is built of mild steel, and she is 282 feet long over all. Her beam is 39 feet and depth of hold seventeen feet six inches. The space between the main and promenade decks is nine feet. Her plating varies in thickness from one-half to three-quarters of an inch in different parts of the ship. She has six watertight bulkheads. She is expected to register about 1,900 tons and to carry 2,250 tons on a draught of fourteen feet of water.

The engine, which was built by the Dry Dock Engine Works, is a fore-and-aft compound. The cylinders are twenty-eight and 48×48 inches and have steam jackets similar to those in ocean steamers. Her main shaft is eleven and one-half inches in diameter and will turn a propeller of twelve feet six inches in diameter with sixteen feet pitch. She is furnished with steam reversing gear. She has two boilers, each nine feet shell by sixteen feet in length, capable of working at a pressure of 110 pounds to the square inch. With this machinery she is expected to make an average of twelve miles an hour. She has three spars rigged with standing gaffs, similar to those in the *H. J. Jewett*. The whole cost of the ship is about $200,000. It will require about three weeks' work to make her ready for sea. The object aimed at in the *Albany* has been to secure a good business ship. She is not expected to make high speed, but will carry a large cargo and be economical in fuel.

The *Syracuse*, similar in all respects, and belonging to the same company, is being built at the same yard and will be launched in a few weeks. J. H. Reid.

Detroit.

◆

THIRD ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS AT BALTIMORE.

The third annual convention of the National Association of Stationary Engineers met in the city of Baltimore, September 2d, and at 10 A. M. was called to order by the President, James G. Beckerleg, of Chicago. The usual committees were appointed and the following delegates were admitted to their seats:

Thos. Arkell, of Denver, Col.; Frank A. Foster, of New Haven, Conn.; Fitzroy Willard, of Waterbury, Conn.; John Croscup, of Wilmington, Del.; M. M. Walbridge, of Chicago, Ill.; P. Mahon, of Chicago, Ill.; M. J. Tirney, of Chicago, Ill.; James G. Beckerleg, of Chicago, Ill.; J. B. Smith, of Chicago, Ill.; E. C. Dicey, of Chicago, Ill.; J. C. Henry, of Peoria, Ill.; Chas. Bruce, of Indianapolis, Ind.; Frank Kirn, of Louisville, Ky.; John Trix, of Detroit Mich.; A. M. Davy, of Detroit, Mich.; Geo. M. Barker, of Nashville, Tenn.; R. J. Kilpatrick, of South St. Louis, Mo.; Geo. W. Davisson, of St. Louis, Mo.; Geo. Trindle, of Kansas City, Mo.; K. H. Shultz, of Baltimore, Md.; Jas. Mullen, of New York, N. Y.; Jno. F. A. Cullinan, of Rochester, N. Y.; J. A. Cruthers, of Jersey City, N. J.; C. C. Miller, of Canton, Ohio; G. G. Miner, of Cincinnati, Ohio; J. W. Ross, of Cincinnati, Ohio; John Caldwell, of Cleveland, Ohio; N. W. Williames, of Philadelphia, Pa.; John Frigar, of Chester, Pa.; Edwin A. Beezley, of Providence, R. I.; Geo. A. Grover, of Boston, Mass.; R. F. Gerald, of Boston, Mass.; Fred. R. Low, of Boston, Mass.; John H. Ford, of Springfield, Mass.; Geo. F. McKnight, of Worcester, Mass.; Chas. Hare, of Salem, Mass.; H. D. Cozens, of Providence, R. I.

The associations of Pueblo, Champaign, Jeffersonville, New Albany, Muscatine, Atchison, Owosso, Minneapolis, Carthage, Warrensburg, St. Joseph, Cartersville, Sedalia, North St. Louis, Omaha and Toledo were represented by delegates from other associations. The records of the convention of 1883 were read and approved.

The President then read his annual address.

Gentlemen Of The National Convention, Of Stationary Engineers: You have again assembled for the purpose of transacting the business of the National and Subordinate Associations intrusted to your care, and in accepting the positions of representatives from your associations you are placed in positions of responsibility and trust. To you has been delegated the power of making suitable laws for the governing of the national and subordinate associations. This is a sacred trust that you will faithfully discharge.

Upon your wisdom, gentlemen, depends the success of the Engineers' Associations in the future as in the past. To-day, my brothers the engineers of the country are anxiously watching and waiting for the glad tidings that shall go forth from this convention, proclaiming the success of the National and subordinate Associations of Stationary Engineers of the United States, which to-day is an established fact, instituted for the purpose of educating and elevating the engineers of our country mentally and morally, that they may respect themselves and their occupation, and command the respect of their employers and the communities in which they live. That, gentlemen, was the object we had in view when we first met two years ago, and to-day we meet again for the same purpose, that of doing the greatest good to the greatest number of men who follow our profession. Your presence here to-day, gentlemen, is the evidence of our success. You come here as the representatives of the engineers of the United States—let us carefully watch and guard the interests that our brothers have confided to our care Let us remember that our words and actions will be closely watched and criticised, in the future, as in the past. To the criticism we do not object, conscious of the fact that you have no selfish or personal motives in view, that your only object is to legislate in the interest of those whom you represent. One of the most important subjects for your consideration is that of an examination and license law for the stationary engineers. It is not only the engineers who ask for such a law, but their employers. Manufacturers and steam users recognize the necessity of such a law for the protection of life and property. As you are all aware the fact is that the National Government does not allow an engineer to run any vessel propelled by steam, until the said engineer has been regularly examined and licensed by the government officer appointed for that purpose. The only object the government has in view is that of protecting the lives and property of its citizens, and we know no reason why our municipal and State authorities should not protect the lives and property of our citizens in our large cities and manufacturing establishments with the same fidelity that the National Government watches and guards the lives and property of the citizens when afloat. There are many reasons well known to you all why the State authorities should enact suitable laws for governing the examining and licensing of stationary engineers. It has been said that to license stationary engineers would assist in extending an odious feature of trades unionism. This cannot apply to the stationary engineers associations, for they are not a trades union in any sense of the term. The engineers associations are schools of instruction for their members, in all branches of engineering, and engineers becoming members of these associations surrender none of their rights. Let us here reassert the fundamental principles on which our associations stand, namely, that these associations shall at no time be used for the furtherance of strikes, or in any way interfering between the members and their employers in regard to wages. Recognizing the identity of interests between employer and employee, not countenancing any project or enterprise that will interfere with perfect harmony between them.

The Secretary's report will convince you that the National Association has been successful during the past eleven months, in instituting many new associations in different parts of the country. The receipts for the past year have been $861.42. Expenses, $665.52. Balance on hand, $295.90.

To the officers of the National Association I extend my sincere thanks for the able and willing manner in which they have assisted me in the discharge of my duties; the same to subordinate associations for the kindness and courtesies extended to me.

The Secretary reported that 25 new associations had been chartered during the past year, and that two (Brooklyn and Lynn) had withdrawn from the association. There are now 58 associations tributary to the National Association, and 2,000 members.

The Committee on Boiler Insurance submitted a report which we are not able to publish; the report of the meeting comes to hand so late that we have had to delay the press to get it in at all.

The Committee on the "Good of the Order" submitted the following:

Resolved, That all associations in each State labor to secure legislation to provide for inspection of boilers and to license engineers, and keep the office out of politics; to have all applicants for positions under the law, or ordinance, pass examination before a board. Also that a committee be appointed to memorialize Congress to enact the same requirements, professionally, of stationary engineers as are required and exacted of marine engineers under the U. S. laws.

The above resolution was carefully canvassed, and passed by a unanimous vote.

Each association shall be compelled to report all boiler explosions which come to their knowledge, and the cause of the same, to the Secretary of the National Association, which shall be read at the next annual convention of the National Association, and handed to the press for publication.

The convention proceeded, September 3d, to amend the constitutions of the National Association and subordinate associations, and adopted one which can be had by addressing the Secretary. It will also appear as a separate document in our next issue.

GENERAL BUSINESS.

The ritual work of the order was changed Sept. 4th, and the objectionable parts amended.

It was decided that no association should furnish any one a complete list of its members and their addresses.

The Mutual Aid branch has a membership of 103. The officers for the coming year are: President, K. H. Shultz. Secretary and Treasurer, Jno. F. A. Cullinan. Trustees—Bros. Cruthers, Davisson and Kirn.

The following officers of the National Association were elected for the ensuing year:

President, James G. Beckerleg, Chicago, Ills.
Vice-President, R. J. Kilpatrick, So. St. Louis, Mo.
Secretary, Geo. G. Minor, Cincinnati, Ohio.
Treasurer, Geo. M. Barker, Nashville, Tenn.
Cond., John Trix, Detroit, Mich.
Doorkeeper, N. W. Williames, Philadelphia, Pa.

They were installed, and at once entered upon the duties of their respective offices.

No association will be permitted to print the constitution of the National Association or subordinate associations, but all constitutions and other formal printed matter shall emanate only from the National Association.

The session closed at 3 P. M., and the delegates were, through the courtesy of Messrs. Bartlett & Co., furnished carriages, and visited the new Johns Hopkins Hospital, and inspected its heating arrangements, one thing in particular attracting much notice, viz.: a slip joint on a 26-inch pipe. A drive through Druid Hill Park was enjoyed by every one.

The convention reassembled at 8 A. M., September 5th, and proceeded to fix the place of the next meeting, at St. Louis, Mo., after which the body proceeded to informal session. The different delegates expressed themselves upon matters which have lately caused trouble, and the conclusion arrived at was, that there had been misunderstanding on both sides.

The delegates return to their respective associations with a full determination to work only for the welfare of the National Association.

The delegates were the recipients of many courtesies at the hands of the citizens and engineers of Baltimore, and will look back upon the convention of '84 with pleasure.

◆

STEAMSHIP RACES.

Racing between ocean steamers is common enough. Every captain feels that his own credit and the credit of his employers is at stake, and that if he slacken speed in a fog or goes an hair's breadth out of his direct course in order to avoid accidents he will be deservedly set down as unfaithful to his trust. The glory of having made the best run of the season is enough for him, and if he can secure this he is quite willing to take his chance of what may happen. Nor is it always the most rapid passages that are the most unsafe. The Cunard line claims the credit of distancing every other line in safety and in speed. The stimulus of competition will act most usefully if it turns the thoughts of ship owners in the direction of making improvements in their vessels. Size, it has been found, is an element of cheapness no less than of speed. The line which owns the largest and best appointed ships will be the winner in the long run, and will not be driven to disregard the most obvious precautions in the hope of gaining a few minutes or a few hours in a passage of as many days. Those who wish to beat the Cunard performances must first address themselves to beating the Cunard ships. From a rivalry so conducted the public has everything to gain. Speed by itself is a somewhat doubtful merit, for it may have been attained by an unfair risk to the vessel and to all on board. But as long as the performances of ships are chronicled like the performances of race horses the risk will be run, whatever it may be.—*London Times.*

◆

ELECTRIC LIGHT SPECTACLES.

Dr. W. H. Stone, F.R.S., has devised a pair of spectacles or eye protectors, for persons who are in the habit of working by or with electric light. The spectacles consist of front glasses of blue with attached side glasses of red glass. The danger to the eye from the incandescent lamp is likely to arise from the red or heat rays, that from the arc lamp is due to excess of blue or actinic rays, hence the use of two glasses. In looking at the incandescent light through the blue glasses, the glare is removed and irritation from the intense yellow and red rays prevented, while after folding down the red side glasses over the blue front ones, the arc light can be looked at with safety through the joint media. The tints of the glasses are selected and combined by help of the spectroscope.—*Engineering.*

LOCOMOTIVE OF NEW DESIGN.

A locomotive having many novel features has lately been completed at the Lehigh Valley shops at Wilkes Barre. It was designed for working fast passenger trains over heavy grades between Wilkes Barre and Manunka Chunk. The engine has 18 in. × 24 in. cylinders, and 66 in. wheels. The boiler is 54 in. diameter and has 236 tubes 10 ft. 5 in. long. The fire-box is adapted for burning anthracite coal, and is 11 ft. long and 43 in. wide. The crown-bars do not rest on the sides of the box, but are bolted to vertical tee irons riveted to the outside fire-box.

The principal novelty is, however, in the valves and valve-gearing. The motion of the latter is derived from the main connecting-rod, no eccentrics or sliding-blocks being used. The reversing is effected in a manner which, it is believed, will remove the objections hitherto experienced in this direction, with all the existing forms of valve-gearing which dispense with sliding-blocks and eccentrics. The valves are of a gridiron pattern and work vertically at the ends of the cylinders. The steam and exhaust valves are distinct, and as the steam-passages are very short, little steam is wasted and plenty of compression can be obtained, even when the exhaust is kept open till nearly the end of the stroke. This valve-gear is the invention of Mr. Geo. S. Strong, of Philadelphia.

On a recent trip the engine hauled a train of 14 passenger cars up a grade of 50 ft. to the mile at the rate of 20 miles an hour. The weight of the engine is stated to be 103,000 lbs. in working order, the tender weighing 73,000 lbs., and the whole train 850,000 lbs. Reckoning the total tractive force required at 11,000 lbs., the average pressure on the pistons would be about 93 lbs. per square inch, which, at 20 miles an hour, would give 587 indicated horse-power.

Numerous indicator diagrams were taken during the trial trip, and are remarkable for the late closing of the exhaust, and the small and uniform amount of back-pressure.—*Railroad Gazette.*

◆

HOW IS THIS?

Assistant master mechanic Bergo, of the Wabash road at Springfield, resigned a few days since, and the shop-men concluded to make him a present. A watch and chain worth $700 were given him. Speeches of regret, etc., followed, and he was visibly affected. The Lafayette *Journal* says: "Imagine the surprise of the boys, the next day, when Mr. Bergo resumed charge of the shop, having concluded to withdraw his resignation. He did not return the watch, however."

Probably it was the boys' turn to be visibly affected.

◆

Apropos Of Timber Testing, Captain Green, one of the best lumbermen in South Carolina, says the appearances of timber may mislead if they are not in accordance with well-understood characteristics of soundness. Uniformity of substance is one of the chief characteristics of good timber; dead knots, flaws and shakes are, of course, prejudicial, and affect the strength. In sawn timber the architect should see that the surface is not woolly, and that it does not clog the teeth of the saw. A bright, silky luster ought to be apparent when planed, while "a dull, chalky appearance is a sign of bad timber." When the annual rings are porous, the wood is weak. Good timber is sonorous when struck, while a dull, heavy sound betokens decay. "Star shakes," "cup shakes," or splits in the direction of the rays and rings, are to be avoided, especially heart-shakes, which prevent large scantling being cut.—*Lumber Journal.*

◆

Stove Manufacturers And Dealers say the greatest difficulty they have to contend with is the ignorance of some who use them. This is illustrated by a Pittsburg house. One of their standard ranges was placed in the house of a physician, and the complaint came that it was impossible to bake with it or heat water by the water-back. A representative investigated the matter and says he didn't do a thing to the range but build a fire in it. When he started the fire and baked potatoes in twenty minutes, the people became convinced that the range was not in fault. There was nothing the matter with the range or with the chimney. The trouble was that the parties had been trying to make the range consume coal instead of to do its duty in baking. People are slow to learn that a stove can be made to do efficient service with a small amount of fuel. This is especially true in the use of hard coal.—*Tinner and House Furnisher.*

◆

If A Man Lights A Match in France he has to pay 18 cents for doing so. This is because the manufacture of matches is a government monoply there, and the result a miserable imposture, warranted not to ignite upon the box, nor anywhere else, unless it is thrust into a gas jet, or held in the center of a hot fire. When, therefore, the authorities see a man strike a match and light his cigar or pipe at the first attempt, the irresistible inference is that he is the possessor of contraband goods. The next thing is to arrest him and fine him one franc for every match.

◆

The Blevney Mfg. Co., at present at 56 Academy street, Newark, N. J., will soon break ground for a new factory for the manufacture of their friction clutch-pulleys and shaft-couplers.

THE

Mechanical Engineer,

FORTNIGHTLY.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

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TWO GREAT FORCES.

Expansion and contraction are terms often used in engineering, sometimes appreciatively but at other times with only a vague comprehension of their importance. There is no question as to the forces themselves, however, and the tremendous influences they exert. We do not always value these, or estimate them as we should.

An engineer of long experience, who is a frequent contributor to THE MECHANICAL ENGINEER, said to us lately that he was once erecting a line of shafting out of doors, where a line was inadmissible, or could not be used by reason of the wind. He employed a surveyor's level, and brought all the centers of the boxes on the hangers in line with the cross-hairs in the instrument. This being done, he called the proprietor to see how correctly the bearings were centered on the cross-hairs; the whole being in one dead line. The proprietor looked, and exclaimed that the bearings were out of line one-fourth of an inch. The engineer sighted himself, and found the statement fact; the bearings were out, at that time, one-fourth of an inch, when previously they were exactly in line. For a moment he was puzzled, but looking again, he saw that the sun was shining on one side of one column (the hangers were erected on iron columns 18′ high) and he had an explanation of the distortion. When the alignment was first made the sun was behind the clouds, and its sudden appearance caused the columns to spring. When the sun disappeared again the shaft-line went back.

This statement may appear improbable to some, but it is unquestionably correct. It is verified, in its general application to the sensitiveness of metallic structures to minute changes of temperature, by the testimony of other machinists at other times.

F. A. Pratt, Esq., of the Pratt and Whitney Company, which individual we cite because he is widely known, said to us a short time ago, in allusion to cutting long lead screws for lathes, that a window open near the tail stock of a certain lathe would cause a most perceptible change in the chip cut from a given screw when the window was not open. That is to say, if a cut was taken from the thread—finishing cut—with the window open, and the tool run over the screw again with the window shut, the tool would not traverse the original path. He also cited the case of the registering-wheel or index on a gear-cutter, which would not come in the same place exactly in a given revolution, or number of revolutions, unless the room was at a certain temperature. If we want any more examples of the extreme sensitiveness of metals to sudden changes, we have only to look at plug and collar gauges to find them. Every one knows, who has handled them, that these instruments show instantly, differences of temperature, by firm seizure.

In heavy work and rough structures we make ample allowance for expansion and contraction, but it is a question if we always truly estimate their insidious effects on machine tools. These forces are always present; and to their unequal distribution, or to ignoring them, many breakdowns and erratic actions are undoubtedly attributable.

◆

PAY EXPERTS WHO MAKE TESTS.

A professional friend advised us recently that he had been requested to serve on a public test of machinery of some importance, but that in reading the invitation carefully he could not discover any mention of payment for his services.

Perhaps in this special instance the omission was unintentional; but it is not unusual for committees to call upon professional men to perform such work without payment. This is clearly unjust, and, upon its face, improper, unless the object is a charitable one, where all, without distinction, give their services for some ulterior object of a deserving character. An engineer who is capable of making reliable tests, whose name is *prima facie* evidence that the results obtained are correct, should not be expected to serve gratuitously. His information has cost him a great deal of money, so has his apparatus, and if he is expected to furnish these without charge, in order that any given exhibition may be benefited, we say again that an injustice is done. Liberal payment should be made for all such service, and there is no doubt but that a jury would award it, whether a contract was made or not, if a test case was set up.

Tests are of the very greatest value and public service, equally so to the engineer and the consumer. The former learns by them what is being done in his calling; the latter knows where to get the best value for his money. With such issues pending it is manifest that absolute honesty and the highest professional ability are indispensable. These qualities are valuable, and those possessing them should not be asked to bestow them gratuitously.

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GOOD, CHEAP TOOLS.

In an article upon Honest Work the *Industrial World* says:

> Two gentlemen were recently talking about the letting of a contract for making a special machine. The one for whom the machine was to be erected remarked that his machinist demanded $800 for the work, but he thought the latter could be induced to take considerably less, but was afraid to ask him to accept a smaller sum, for fear that in such event the machine would not be made to his satisfaction. The other gentleman remarked: "I should not think you would fear this, because the machinist must maintain his reputation by turning out finished work." The other replied: "While this is true, it is a sad fact that not a few are willing to suffer a loss of reputation by doing bad work if thereby money can be saved on the immediate job in hand."

It would seem that buying machine tools is governed by the same law that controls all other commercial transactions. If houses and lots are offered at prices under their market value, the purchaser generally satisfies himself as to the propriety of the purchase. So it is with cheap machine tools, the price is not always a guarantee or any evidence of the quality. Prices do not range the same all over, and there may be underlying reasons why one concern in one section can sell as good a tool as another in a different section for much less money.

We cannot agree to the statement that parties who have reputations are willing to risk them for a certain specified sum. Reputation is capital, and no sale or contract can compensate for its hazard. In this view our contemporary concurs, for it says:

> "It is surprising how rapidly bad reputation spreads. If this be doubted, let the inquirer step into any large shop and ask about this and that machine; he will soon learn that there are some makers whose names are a voucher for the machines they send out, and that there are others whom the trade look upon with suspicion. The foreman will say: 'The machines made by such and such a firm are always reliable, while those made by another concern we invariably have trouble with.'
>
> "If a man desires a really fine machine he goes to the maker having the best reputation. He does not go to the man whom the trade accredit with making slopwork, or with indulging in underhanded contrivances whereby he may keep the letter of his contract and avoid its spirit."

Parties who make cheap work which is not good, roll a stone up hill; it comes back on them sooner or later.

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COAL "SLACK."

One of the most interesting of the many problems in life is how to get something for nothing. All of us attempt the solution of this at times without any very great success, unless we discover hitherto unworked fields which are waiting to be reaped. An opportunity of this character has existed for years; attention has been repeatedly called to it, but little or no advantage is taken of it. This opportunity for steam users lies in the immense amount of coal slack, culm, so-called, now in the coal regions waiting for purchasers. Millions of tons of good fuel can be had at merely nominal prices, if steam users choose to avail themselves of it. Culm cannot be used in ordinary furnaces, but appliances exist whereby it can be. To some extent it is used, but practically it is unknown as fuel in the market. The only element which militates against its cheapness is the law of supply and demand; so soon as any product is in general use it becomes a commodity, as such is an article of merchandise, and the price rises. The sand from the sea-shore is a staple in this city for many uses, and brings a high price—for sand. Various attempts have been made to use coal slack in other lines of trade, but in comparison with the mountains which exist, the consumption is not worth mentioning.

It would seem that steam users at any rate should avail themselves of the benefits of coal slack, and obtain cheap fuel, the cost of alterations to an ordinary furnace being very trifling in comparison with paying for commercial coal.

OUR BOOK DEPARTMENT.

Our readers will observe, upon perusal of our list, that we have revised and added many new works to it, including some more suitable to the wants of our connection than those which were contained in the old list. We by no means begrudge the space occupied by it, for the sales have been large for the time occupied, and much beyond our expectation. The season of study and investigation approaches, and there is nothing which will give greater returns for the amount expended than a useful technical work. We believe that there is not one in our list which is not clear and comprehensive on the subjects of which it treats.

GUESS NOT.

A paragraph going the rounds says:

> Many persons fail in business because they have no practical knowledge of it. There is truth in that statement. We have known men to furnish the money to purchase the machinery and start a saw-mill, who had no practical knowledge of the business, but were forced to depend on others to look after details for them, and then wonder why they made a failure of it. It takes a saw-mill man to run a saw-mill successfully, just as it takes a dry goods man to successfully run a dry goods business, or a grocer to run a grocery and make money.

A great many persons have the same views as those quoted above, but to us they seem fallacious. It is better, of course, that a man should be familiar with every branch of the business he conducts, but it is by no means indispensable, or any passport to prosperity if he does. One of the most successful technical papers in this country is managed by three men, not one of whom has had a scintilla of practical experience of any sort or kind. They are not mechanics, and personally know nothing of the subject, but they are a big success all the same. We call to mind, also, several mechanics who started in business relying upon their trade knowledge, but they failed because they were not business men. A miller may know all about grinding wheat, but unless he knows how to buy it, and sell the product thereof, he turns up among the tailings.

The facts are that men who have spent all their lives, or a good portion of them, at work for others have some things to learn before they can embark in business on their own account successfully, and it is for want of mercantile training, or a knowledge of business methods, that men fail, even though their practical knowledge be perfect.

This very possession is sometimes a very great objection, in that men who are good mechanics, and insist upon having everything exactly so before it leaves their works, spend all their margin of profit in that way. Their work is too good for the price they get for it.

The ledger tells the story of success or failure, and it never inquires whether the manufacturer knows anything about the practical part of his business or not.

STATIONARY ENGINEERS IN COUNCIL.

The third annual convention, recently held in Baltimore, is reported elsewhere as fully as the space and time at our disposal permits.

The report gives only the bare outlines of the transactions, and says nothing at all of the spirit and intent which informed the whole proceedings. The reporter, who is one of the body, could not judge of that so well as we could; being an outsider, we had the advantage of observing the sincerity and utter absence of anything but the good of the trade at large. No delegate came cocked and primed to capture the body, but one and all labored together sincerely. The National Association of Stationary Engineers deserves success; they have attained it through wise counsel, consistency, and adherence to their constitution, and they are fast becoming one of the most important of our associations for mutual improvement.

* * *

In A Suit For Wages, brought in Brooklyn, several witnesses considered they were doing remarkably well if they made $3.50 a week the year round. They were shirt makers.

* * *

In The Opinion of the librarian at Harvard College a great library should preserve every book and pamphlet printed. The worthless tract of to-day may prove invaluable to the historian writing in the year 2000.

This is soothing to some of us who are piling up literature by the square yard.

OVERHAULING AN ENGINE.—Number III.

"In the last conversation we had upon this subject you left us at the guides. Suppose you had the cylinder all right, as regards the bore and valve seat; the guides, with true faces, lined up in place; if all these things were done satisfactorily the principal part of the work would be over, would it not?"

"No, sir; it is hardly begun. The cylinders and guides are important details, but as much depends upon the others as upon them, for correct action."

"Name some of these."

"The connections all over, and the main bearing and shaft; the crank-pin and eccentric, or eccentrics; these all need attention; so does the feed-pump and its pipes, particularly the suction."

"What attention would the connections need?"

"Where an engine has run for a long time the pins get very much out of round. The brasses in the crosshead end often get cockbilled from being strained by keying them too tight, and are no longer square with the strap in any way. They are twisted, and must be refitted."

"You would do this by liners of thin sheet metal between the strap and brass, I suppose?"

"If I wanted to make a botched job I would; but if I meant to do it 'shipshape and Bristol fashion,' I would make the brasses fit the strap just as good—perhaps better—than the day they came out of the shop."

"Explain this in detail; it may give us a new idea."

"When I found that the brasses in the crosshead end were cockbilled or askew in the strap, the first thing to be done is to pene the brass out so it will not go into the strap. Then if the strap itself was true I would fit the old brasses to the strap as if they had grown there."

"So tight as that?"

"Yes, sir; and for this reason: A connecting-rod should be one solid piece with two holes in it, one at each end. This cannot be, for reasons that everybody knows; therefore, it has to be made in several pieces. The more there are of these the more joints and chances of derangement there are; as a matter of course, every separate piece that can be should be fitted just as closely and as snugly as possible. The fewer joints there are the less the repairs will be."

You would pene the brass from the inside of the bearing, I suppose, that would spoil it."

"I would not care for that, for it would have to be rebored in any event."

"If you refitted the brass and re-bored it, that would be likely to alter the length from center to center, would it not?"

"Not necessarily. It would want shortening, doubtless, in any event, for most connecting-rods are so made that they get longer as they are keyed up."

"What would you do to the wrist-pin in the crosshead?"

"If it was a solid spade handle, cast-iron crosshead, I would file it or have it turned up true in the lathe, and I would file flat places on the top and bottom of the pin so that the brasses would not wear a shoulder on the pin by their oscillation through part of a circle. I would refit the crank pin end very carefully, dress up the gibs and keys and make them as good as new. When I got to the crank-pin I would take it out if I could, and if badly worn make a new one. A crank-pin is not a costly piece of work unless it is a very large one."

"What about the shaft and main bearing?"

"These would require careful attention. The shaft ought to go in the lathe and be skinned over in the journals, but few proprietors would care to incur this expense if the engine was a large one. Taking off the fly-wheel and putting it back again is a costly job, in point of time, and I should undoubtedly make the best I could of the shaft as it was. In any event I would get it up out of the brasses and true these by a line at right angles with the cylinder bore, and with a spirit level."

"If you lined up the brasses and bored them out true wouldn't that make some trouble with the old bearings of the shaft?"

"The bearings might heat a little at first, but I should not expect them to long. I would use the top brass for the bottom one, and then would not need to get new brasses, for the top brass does little work unless the main belt is straight up and down."

SOMETHING ABOUT METALLURGY.—Number III.

By Norman W Wheeler.

Now we may consider the manner in which the conditions of reduction—viz., the exposure of hot metallic oxide to the action of hot reducing gas—is brought about in a bloomery fire.

This fire is contained in an open topped box made of cast iron plates set in brick work, and the plates are hollow slabs which are kept cool by water circulating through them. At one side of the box, or hearth, a tuyere is inserted which is connected by pipes with a blowing machine of some sort, and inclined so that the blast from the tuyere is directed upon the bottom plate, but the tuyere is so made and connected that the blast may be elevated or depressed from its normal position. The space about the hearth is enclosed by walls on three sides, and covered by a hood connected with a chimney to carry off the products of combustion. A tap-hole is made near the bottom of the hearth to draw off the slag.

The fuel used is charcoal, because it is free from earthy impurities—whereas, mineral coal would block the process because of the clinker which would form in the hearth were it used. The ore is, by preference, a rich magnetic oxide, which has been finely granulated by stamps, and washed to free it as much as possible from silica and other impurities commonly found in the form of minute crystals disseminated through the mass.

To set the bloomery fire in operation charcoal is heaped in the hearth, kindled, and the blast turned on. When the coal is ignited the blast is reduced and a thin layer of ore is spread upon the top of the fire. This produces three sorts of combustion, viz.: a hot zone of CO_2 combustion near the bottom, a backward combustion of CO_2 to CO in the body of the fire, and a combustion of CO to CO_2 at the top, where air meets the gases as they escape from the coal.

The first effect of this arrangement upon the ore is a roasting, by reason of the heat of the flame immediately above it; this roasting expels the natural and chrystaline water of the ore, and makes each granule spongy.

As the fuel is consumed more coal is put upon the fire, and above that another charge of ore, the first charge being now in the body of the fire and permeated by the CO gas, which is robbing it of its O and turning it into "iron sponge."

When a molecule of CO takes an atom of O from the ore it becomes CO_2, but upon contact with hot coal gets another atom of C and we have two molecules of CO, which takes two more atoms of O from the next layer of ore and become two molecules of CO_2, and so on.

When the first layer of ore reaches the lower part of the fire by the burning away of the fuel below it, it is in the form of sponge, which is nearly pure iron in minute particles; and as the hot CO_2 combustion zone constitutes the lowermost part of the fire, the heat then is great enough to soften the iron particles so that they may be pressed together with an iron bar, and as the successive charges come down they are pressed upon and welded to the first nucleus.

At this stage, although each particle of iron may be pure in itself the interstices are filled with the silicious and clayey impurities of the ore, which must be got rid of.

Now it happens that silica [quartz] and alumina [clay], although neither can be melted by ordinary means, by itself, yet a mixture of them will run together under an ordinary CO_2 combustion heat, and form a liquid slag—a rough sort of glass—which being liquid or at least pasty, may be hammered or squeezed out of the hot lumps of iron, carrying with it many particles which are in themselves infusible, and to be got rid of in no other way.

If silica and alumina are not present in proper proportions, the slag is still made, taking a part of the iron for that purpose: that is burned iron—protoxide—which will combine with silica and make a good slag—but with an obvious waste of iron. A portion of the iron becomes burned to the condition required for making slag during its passage through the CO_2 combustion zone, where the air is greatly in excess, and the heat great.

Below the CO_2 combustion zone the iron is exposed to a very hot atmosphere of carbon gases which tends to convert it into steel and cast-iron, for the heat is sufficient and the carbon gas is present. The slag protects a great part of the lump from the C gases, and when the final heat is to be given the lump is raised above the slag, or the slag drawn off, so that the whole lump is exposed to the heat of the CO_2 combustion zone and to the oxidizing action of the hot free O, of the blast before it has got its charge of C, so that a part of the iron itself is oxidized, or burned. This burning of some of the iron seems to be necessary in order to get the heat high enough for the welding of the molecules together under a tilt hammer, when the lump is taken immediately from the fire.

We see that two distinct operations are performed in the bloomery fire: First, the ore is reduced by a light blast and a large production of CO in the body of the fire; second, the feeding of ore with the coal is stopped. and the blast increased so that the CO_2 combustion zone extends to nearly the whole depth of the fire to get the final heat. The same operations are requisite for each lump of from one to three hundred pounds.

(To be continued.)

THE PROFESSOR IN THE MACHINE SHOP.

NUMBER 64.

I read in THE MECHANICAL ENGINEER a few issues back an article entitled "*Causes of Failure,*" setting forth why so many men achieved mediocrity instead of fame. I suppose others have read the article also. My reflection was that the whole summary was a mistake, and that the opinions there given were not worth the ink expended upon them. What is success and what is failure? Merely words without weight, unless used by some standard of comparison. John Smith starts in life with an indifferent pair of breeches, a level head, a pair of hands, and the usual intermediate gear which works these appendages. When it comes time he learns a trade, and works at it. He marries and raises a family; he hoes his row, owes no man aught, does not bear false witness, and is, in a few words, a good citizen and a good father. "His children rise up and call him blessed." When he dies he leaves a record behind him of an honest, faithful, God-fearing man. He has done no wonderful things. He has not overturned and overturned. He has revolutionized nothing; he was merely an atom in the scheme of creation, and as such he bore his part. He did his level best. He worked out what was in him. The world was the better for him, in the sense that he set an example of honest industry to his fellows, and thereby incited others to follow the same road.

Did that man fail? Not at all. Don't talk to me about success and failure, because such words mean nothing, unless we know how they are applied.

If I had a son, and said to him: "John, you must go into the shop and learn my trade; it is a good business; if you stick to it and follow it faithfully it will get you honest bread, and more beside. With what you have to start on, I don't see how you can do any better, so into the shop you go."

John says, possibly: "I don't want to be a machinist. I don't like the business. I would rather be a clerk, or a bookkeeper, or a printer, perhaps."

I answer him, brusquely: "Oh, nonsense; you don't know your own mind. Clerks are dudes; bookkeepers starve to death—I can hire one for $6 a week; printers are always on strike; you had better be a machinist than any of the other callings. You see how we live; you have always had a good home. You see me constantly at work; what more do you want than this?"

John says nothing, presumably; being a dutiful son, he takes my advice and goes into the shop, but his heart is not in it. He doesn't like the business, and takes no interest in it. To him it is all nothing, and the result is a failure; that is, one pure and simple.

I am responsible for it alone; perhaps my son would not have been any better book-keeper or printer than the machinist he turned out to be; but that is begging the question. I insisted that I knew what was the best for him, when I had no means of knowing anything about it.

To gauge success or failure of the mass by the brilliant achievements of individuals is unjust. The people who lead honest, temperate lives, are not failures, they are the reverse. Before we can say a man failed, we must know what he attempted to do. If I announce myself as a builder of flying machines, and don't fly worth a cent, I am certainly a failure; or if I state that I build steam engines that will do certain things, which the said engines never do, then, also, am I a failure.

On the other hand, as to success, do I succeed simply because I am prosperous in business, because I pay my debts, and am a shining light socially? I don't know whether I do or not. It seems to me, sometimes, that I don't. If we are going to calliper everything in this world by mere money-getting and money-holding, I think it is a false standard. In some such cases the popular verdict should be something like this: John Jones achieved success in amassing money, but he was also an eminent failure as a man, morally: he was mean beyond the possibilities of the word; he never encouraged or helped any one, he lived for himself alone; good riddance of him.

Viewed by the popular interpretation of the word, not many of us are successful. Not many of us rise from poverty to riches, or struggle through hardships to easier berths; but if we make the most of our opportunities and go through life leaving a clean record behind, it cannot be said of us that we have failed.

This is the sort of failure I am trying to make.

SINGLE DRIVERS vs. COUPLED DRIVERS.

Concerning the advantages and disadvantages of locomotives with one pair drivers, and others with two pair, the *London Engineer* has this to say:

As to the question of single or coupled engines, there is great diversity of opinion. Mr. Stirling conducts his traffic at a higher rate of speed, and certainly with equal punctuality, with his single 8 ft driver engines, as Mr. Webb with coupled engines, and the economy of fuel of the former class over the latter is very remarkable. This is, no doubt, owing, to their ample cylinder power, which permits of the steam being worked at a high rate of expansion. There is no doubt that if single engines can take the load they will do so more freely and at a less cost than coupled engines, burning on the average 2 lb. of coal per mile less with similar trains. With regard to loads, it is a question whether any express train should be made up with more than twenty-five coaches. The Great Northern engine will take twenty-six and keep time, and the Brighton single engine has taken the express from London Bridge to Brighton, consisting of twenty-two coaches, at a speed of forty-five miles per hour. Of course where heavy gradients have to be surmounted, coupled engines are a necessity. Single engines are said to slip more than coupled, thus a single engine with twelve coaches at the rate of sixty miles an hour was found to be making 242 revolutions per mile instead of 210; and in an experiment tried on the Midland Railway it was found that a coupled engine with ten coaches at fifty miles an hour made seventeen extra revolutions a mile, but when the side-rods were removed it made forty-three.

One noticeable feature in modern practice is the increased height of the center line of boiler; formerly it was the great aim to keep this low, and numerous schemes to this effect were propounded, but now it has become generally recognized that a high pitched engine will travel as steadily and more safely round a curve—given a good road—than a low pitched one; while in 1850 the average height of the center line of boilers varied between 5 ft. 3 in., and 6 ft. 3 in., now it lies between 7 ft. and 7 ft. 6in.

The general adoption of cabs on the foot-plate for the men is another improvement of late introduction, although at first not universally appreciated by those for whose comfort it was designed. "I felt as if I was in my coffin," said an old driver when asked how he liked the new shelter. Mild steel fire-boxes, which have been employed in America, are not in favor here, copper being universally used; they have been tried on the Caledonian, Great Southern and Western, North London, and North Western, and found not to succeed. Brake blocks of cast iron have now generally superseded wood; steel is being more and more used, especially on the North-Western. There is less use of brass work for domes and fittings, although it is claimed for brass that it looks brighter and can easily be kept clean. There is greater simplicity of design generally, and the universal substitution of coal or coke for fuel, with its consequent economy; and last, but not least, the adoption of standard types of engines are amongst the changes which have taken place in locomotive practice during the past quarter of a century.

THE FAST LOCOMOTIVE OF THE FUTURE.

Time is money, and it may be in the coming years that a demand will arise for faster means of transit than that which we possess at present. How can we meet it? With our railways laid out with the curves and gradients existing, and with our national gauge, and our present type of locomotive, no great advance in speed is very probable; the mean speed of express trains is about fifty miles an hour, and to take an average train of 200 tons weight at this speed over a level line requires between 650 and 700 effective horse-power, within the compass of the best engines of the present day. But if instead of fifty miles an hour seventy is required, an entirely different state of things obtains. Taking a train of 100 tons, with engine and tender weighing 75 tons, or 175 tons gross, the first question to determine will be the train resistance. With reference to this we want careful experiments. The long and heavy bogie, Pullman and other coaches, have the reputation, rightly or wrongly, of being hard to pull. The resistance of an express train on the Great Western Railway at seventy-five miles an hour was 42 lb. per ton, and taking 40 lb. per ton for seventy miles an hour would give a total resistance on the level of 7,000 lb., corresponding to 1,400 horse power—about double the average duty of an express engine of the present day. The weight on the driving wheels required would be $18\frac{3}{4}$ tons, allowing one-sixth for adhesion. Allowing $2\frac{1}{2}$ lb. of coal per horse-power per hour would give a total combustion of 3,500 lb. per hour, and to burn this even at the maximum economic rate of 85 lb. per square foot of grate per hour would require a grate area of 41 square feet and about 2,800 square feet of heating surface. Unless a most exceptional construction combined with small wheels is adopted, it appears almost impossible to get this amount on the ordinary gauge.

It is true the Wooten locomotives on the Philadelphia and Reading Railway have fire-boxes with a grate area of as much as 76 square feet, but these boxes extend clean over the wheels, and the heating surface in the tubes is only 982 square feet; but although these engines run at a speed of forty-two miles an hour, they are hardly the type to be adopted for such a service as is being considered.

The whole question of the future introduction of trunk lines, exclusively for fast passenger traffic. is fraught with the highest interest, but it would be foreign to the subject matter of this paper to enter more fully on it, the author merely desiring to state his opinion that if the future trade and wealth of our country requires their construction, and if a very high rate of speed much above our present is to be attained, their gauge will have to be seriously considered and settled, not by the reasons which caused the adoption of the present gauge, but by the power required to carry on the traffic—in fact, to adapt the rail to the engine, and not, as at present, the engine to the rail. High speed requires great power, and great power can only be obtained by ample fire grate area, which for a steady running engine means a broad gauge.—*London Engineer.*

ON THE BURNING OF IRON AND STEEL.

Iron that has been raised to near its temperature of fusion and slowly cooled, is designated as "burned" or over-heated metal. It is both red-short and cold-short, and exhibits a coarse, crystalline structure, and a bright glistening fracture. Such iron contains oxygen. But this oxygen is not, as is commonly believed, derived from without during the heating; but it was previously contained in the iron itself through the medium of the scoria or slag-impurities mixed with it. When the iron is raised to the fusing heat, or near it, a chemical reaction takes place; the metallic iron reduces the sesquioxide to protoxide, which, by being dissolved in the iron, alters the properties of the latter. The coarsely crystalline quality of iron so treated is not due to the presence of the oxygen. The metal usually contains a notable quantity of phosphorus, which is well known to give a coarse grain accompanied by the quality described as cold-short. The crystallization takes place during the slow cooling while at rest. The greater the proportion of phosphorus present, the lower is the temperature to which the iron may be raised without being burned. Pure iron should not take up more than 0·25 per cent. of oxygen in solution. Though this substance does not greatly affect the ductility of the metal when cold, it acts like sulphur on its malleability.

The qualities of steel also undergo change when heated to a high temperature, or when subjected to a lower temperature for too long a time. The richer the steel is in carbon, the lower is the temperature at which the change takes place. Therefore, the harder the steel, the more carefully is it to be dealt with in the fire. Such over-heated steel becomes coarse-grained and brittle; that is, cold-short. If the temperature be increased, showers of sparks are thrown off, and the steel is said to be "burned." The alteration brought about in this way has generally been attributed to a diminution in the proportion of the carbon constituent, though this assumption is not warranted by the results of analysis. The presence of manganese and silicon is of more weighty consequence. When steel containing these is heated, it is not the carbon, but the manganese and the silicon that first became oxidized, and there results an important change in the properties of the steel. Later, the carbon is oxidized; and while the oxide of carbon escapes, those of the manganese and silicon remain behind, and the whole molecular structure of the metal is altered. If the heating be carried still farther, the iron will next be oxidized. A cast-iron furnace door, exposed for several years to the flame of a coal fire, was found to contain 27·8 per cent. of oxygen, in combination with iron, sulphur, nickel, copper, phosphorus, and arsenic. The cause of the sparks is not the combustion of the carbon, and the consequent generation of carbonic oxide gas, but the escape of gases imprisoned in the steel. Similar results may be brought about by exposing the steel to a lower temperature for a longer time; the oxidation of the constituents will, in this case, be effected in the order mentioned above, the only difference being in the slower action. Steel altered in this way is well described as "dead." A regeneration of the metal by mechanical treatment is hardly possible, since the original chemical composition cannot be restored by such means.—*Berg & Huttenmann's Year Book.*

THE PERSONAL APPEARANCE OF NOTED SCIENTISTS.

An association of scientific men was lately in session in Montreal, and many of the most noted demonstrators of the day were in attendance. A letter to the *Sun* describes the personal appearance of some, and we publish herewith a portion of the letter referred to.

"These learned men do not all look like the prodigies that many of them undoubtedly are. For instance, in the Mathematical and Physical department there were upon the platform at once Lord Rayleigh, the President of the Association; Sir William Thompson, the mere mention of whose name is calculated to make any student take off his hat; Prof. Dodge, who can talk about electro-motive forces at a rate that would make the head of the swiftest stenographer in New York swim, and four or five others who have world-wide reputations.

Sir Wm. Thompson is one of the leading mathematicians of the world, and knows, perhaps, as much as anybody about electricity and cognate subjects. He is noted for the original and sometimes startling views which he advances. He is the man who some years ago put forth the astonishing hypothesis that life might have been introduced upon the earth by means of germs brought to it from interstellar space by meteors. But much as he shakes up the savants sometimes, they have the highest regard for his authority. Yet he does not look at all like the scientific Nestor he is. He is a little, bent, lame old man, with a tuft of gray hairs on top of his head, which sway about as he bobs up and down, and long, straggling, uneven, gray whiskers hanging sparsely over his chest. He wears a rather ill-fitting suit of sober gray cloth, speaks in a piping tone, and when he is talking keeps his hands almost constantly in motion. He manages a big gold-rimmed eyeglass with dexterity, sticking it now over one eye and now over the other, and holding it safely between his eyebrow and his cheek bone, while his features are all astir with the earnestness of his talking. A brilliant diamond flashing on his little finger presents a strange contrast to the plain attire of this famous savant.

People who read scientific books and papers have heard much of Prof. Sylvanus P. Thompson. Prof. Thompson appeared on the platform in the form of a very young and handsome-looking man. He is rather slight in figure, and wears a little brown moustache. His eyes and complexion are dark, but there is a boyish rosiness in his round cheeks, and all the time that he is talking of "ohms" and "volts" and other electrical terms, the corners of his mouth are wreathed with smiles which follow the curved ends of his moustache and go rippling over his face. A delicate bit of pink necktie showed above his tightly-buttoned close-fitting brown bobtail coat.

A younger looking man than Prof. Thompson, a mere youth in appearance, is Prof. Hele Shaw, of England, who exhibited a machine which he claimed would perform mechanically and with perfect accuracy the operations of differentiation and integration. Sir William Thompson bent his nose close over this marvelous mathematical machine, but did not appear to be entirely satisfied that it could take the place of brains, while Lord Rayleigh added a little extra curve to his eyebrows and viewed the instrument from a distance.

In the section of chemistry Prof. Sir H. E. Roscoe is President. The famous chemist is fat and red faced, and speaks hesitatingly in a thin, small voice, instead of the orotund tone one might expect to hear from his expansive chest. He graciously nods assent whenever the speaker standing near him makes any striking assertion, nimbly jumps to his feet when a chemical formula is enunciated, and writes it quickly on the blackboard behind him in exquisitely clear characters, so that there shall be no mistake about it.

Everybody has heard of Lord Rosse's monster telescope. Every schoolboy has read about it and the wonders it has revealed in the heavens. This telescope was constructed by the father of the present Earl of Rosse, and just as Sir John Herschel was specially honored because he was the son of Sir William Herschel, so the Earl of Rosse is held in high esteem because his father constructed the largest telescope in the world. But the Earl of Rosse, like the younger Herschel, possesses a claim to much respect through his own devotion to science. He has efficiently continued the work that his father began. He is, however, perhaps the last person that one would pick out of a crowd for an earl. He is of medium height, lean and bony, and looks to be in the neighborhood of 50 years old. His thin cheeks are a little flushed, and like Lord Rayleigh he combs his hair crosswise over the top of his head without succeeding in covering the bald spot there. His head looks small, and reaches its greatest elevation about where phrenologists place the bumps of self-esteem and firmness. His large nose is a notable feature, worthy of the study of Lavater. He has long, ragged side whiskers, which meet under his chin, while his upper lip and the front of his chin are closely shaven. He wears a small seal ring, and a watch chain crosses the front of his waistcoat and enters the pockets on either side. On one end of the chain is his watch and on the other are a bunch of keys and a fountain ink pencil. He made an awkward appearance upon the platform with his big thick-soled shoes, his short sack coat, and his habit of swaying about like a schoolboy repeating an oration.

His reading was so utterly lacking in elocution that it was difficult to understand him. He described a process of polishing mirrors for telescopes, illustrating it by vigorously swinging his arms over a blackboard, and also told the astronomers what was the best plan to keep a telescope aimed steadily upon an object."

CORROSION OF MARINE BOILERS.

At a recent meeting of English Engineers the following facts were given by Mr. J. H. Hallett, of Cardiff:

The second and last paper read on Wednesday was one entitled "On the Causes and Remedies of Corrosion in Marine Boilers," by Mr. J. Harry Hallett, of Cardiff. This was a short but very suggestive and practical paper, which we intend to print *in extenso* as soon as we can prepare the necessary diagrams. Meanwhile we may give an abstract of its contents.

The principal causes of corrosion might be discussed under the two heads of defective design and defective management. The most frequent fault of design was the want of sufficient space to allow a thorough examination of the interior. The tubes were often placed too far out in the wings, and the manholes were too small. They should always be fitted in the wings, if the size of the boiler would allow, and one at the bottom of the back end was to be recommended. The steam space stays should always come over the tubes and not over the spaces between them, as if they did they interfered with the use of the scaling tool.

Double-ended boilers are especially liable to suffer from racking strains, due to the difference of temperature between the upper and lower parts. One method of reducing this difference was to lead the feed-pipe along the level of the upper tubes, so as to warm the water before it was discharged at the bottom of the boiler. The scum-pipe should be fitted with a pan shaped like an inverted saucer, and placed just above the level of the water for the scum to collect under. When the engines are standing, the water should be pumped to the top of the gauge-glass, and blown off down to the bottom two or three times. In a voyage of seventy-two days, with several stoppages, the author kept the boilers in excellent condition by the above plan. The mode of treatment adopted by the writer for new boilers is to have them washed out before filling, then to run them up with water to the normal height, and throw in a bucketful of common soda. Then steam is raised to 30 lb., and the scum-cock is opened for a little. The donkey-pump is washed out by being made to deliver overboard at first, and the feed-water overflowing from the hot well is allowed to run into the bilge for a time.

Corrosion in the upper parts of the boilers is principally caused by the introduction of grease from the engines, and good effects follow from discarding the use of lubricants in the cylinders. Various remedies have been tried for preventing corrosion, such as air extractors, circulating tubes and zinc. The writer had found Mr. Hannay's "electrogen" very effective, as far as he has experimented with it. It consists of a ball of zinc cast upon a copper bar, and then hammered to make it more impervious to the action of the water. On each end of the copper bar a wire is soldered, and the two wires are again soldered to the different parts of the boiler, so as to obtain metallic contact. Boilers which had shown a tendency to corrosion looked quite healthy in a very short time after these appliances had been fitted to them. Marine boilers do not often suffer from external corrosion, but the author had met with bad results from the bridge being built up to the backs of the combustion chambers. He considered that when a vessel was laid up it was a good plan to pump the boiler full to the very top of the dome, or to empty it thoroughly, put in it a stove of burning coke, and close it up.

Mr. Hallet's paper gave rise to an excellent discussion, the first speaker being J. R. Fothergill, who differed from many of the author's conclusions. Mr. Fothergill first referred to the erratic character of corrosion, and to the evidence collated by the Admiralty Committee on Boilers. Defective circulation, he remarked, was more a fault of old boilers than new ones, but in the latter corrosion was met with in places where the circulation was good. He considered that the best preventative was to keep a slight scale on the surface. From many experiments, also, he believed that the presence of air was an important factor in the case, and this had been shown by suspending strips of iron in an air-pump and feed-pump, when that in the air-pump (where the water was freed of air) was untouched, and that exposed in the feed-pump was seriously corroded. Air also increases the formation of a greasy mud which will not adhere to the plates, and prevents the formation of a protective scale. He believed that if the feed-water was thoroughly freed from air and oil there would be very little corrosion. Referring to some remarks in Mr. Hallett's paper, that in a boiler only partially emptied instead of being completely blown out, the bottom water became heavily charged with solids, he stated that these could only be solids in suspension, and he considered there could be no sensible difference in the quantity of solids in solution in different parts of a boiler. He was an advocate for admitting the feed near the water level, so that any air it contained might be at once liberated into the steam space and not have to work its way up through a large body of water. He had found that corroded places could be best treated by carefully washing them with soda and then coating them with a wash of Portland cement. This would generally prevent further mischief. Mr. Hallett had spoken in his paper of doing without lubricants; did he, he asked, also prevent oil working in through the stuffing-boxes? Instead of emptying boilers, as Mr. Hallett advised, he considered it better to let boilers stand full of water until cold, and then to run the water off. The reputation of many mineral oils was, he considered, exaggerated, particularly when used in connection with steam at high pressures.

The next speaker referred especially to the electrical aspect of the question, and advocated the use of amalgamated in place of plain zinc in boilers, so as to get practically the action of pure zinc, which was not commercially obtainable. It might be also desirable to connect the zinc by wires to various parts of the boiler, so as to obtain a better electrical connection than now always existed. A block of amalgamated zinc so connected would be considered to do all that the electrogen referred to by Mr. Hallett could do, and the more so if the zinc was used in connection with a copper plate forming a galvanic couple.

Mr. Jacobs mentioned the case of a vessel built about four years ago, which made at first a five months' trip, during which her boiler was not opened. On her return it was found that some stays had been reduced by corrosion from $1\frac{3}{8}$ in. to $\frac{5}{8}$ in. in diameter, and that there were also seriously corroded patches on the plates. It was at first feared that the boiler was ruined, but the stays were renewed, the corroded places washed with petroleum and coated with a wash of Portland cement, and the feed was altered so as to deliver near the water level. The result was to stop the mischief, and the boiler was now working.

Mr. F. C. Marshall described the case of a double-ended boiler in which about 100 tubes failed from pitting after being a very short time in use. In this case it had been the habit to only partially empty the boiler, and it was found that the pitting took place on the under side of the tubes at the ends which, owing to the trim of the vessel, were lowest. Tracing the matter out, it was found that the manner in which the boiler had been treated had led to moisture being left on the tubes, this moisture draining down and dripping off the tubes at the spots where the corrosion occurred. In another case, the sides of a furnace were extensively corroded just along the level of the fire-bars—neither above nor below—and it had occurred to him that the plates at this point might, owing to the presence of the fire-bars, be in a different electrical condition to what it was elsewhere. Both the boilers above referred to were of iron, and so far he had found less corrosion with steel than with iron. He considered that there could be no question as to the desirability of excluding air from boilers.

A member stated that the introduction of a small quantity of petroleum into the boiler had cured pruning in many cases where the boiler could not be used without it.—*Engineering.*

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A. F. Cushman, Hartford, Conn., one of the oldest and best known chuck makers in the country, has issued a new catalogue and price list of his goods, which all should send for.

SPOTS ON THE SUN.

At the recent meeting of English scientists in Montreal, the subject of our caption was discussed by persons entitled to express an opinion. The connection between sun spots and the weather, a subject which has become one of exceeding interest during the last few years, was opened by Prof. Schuster, of Owens College, and continued by Prof. Douglas Archibald, the meteorologist; the Rev. Father Perry, the distinguished director of the Stonyhurst Observatory; Sir William Thompson, and Mr. W. Lant Carpenter, the chosen colaborer of Prof. Balfour Stewart. While some differences of opinion in minor respects were developed among these savants, they were substantially in accord upon their principal conclusions.

These learned men presented the sun in a light that must seem startling to those who have not given particular study to the subject. Prof. Schuster declared that if the sun were a ball of solid steel, magnetized to the utmost possible degree of intensity, it could not produce upon the earth any magnetic influence comparable to that which actually is produced by or through sun spots. Yet astronomers do not know just how this effect is produced. They only know that when the sun is tormented by contending forces, when black spots appear upon its face, and vast masses of vaporized matter are spouted heavenward from its surface, while the whole region around the sun to a distance of hundreds of thousands of miles is aglow with the streamers of the corona, then the atmosphere of the earth is frequently illuminated with the aurora borealis. Telegraph wires and cables are gripped with a resistless power which suspends their action. The magnetic needle sways and trembles in an extraordinary fashion, and various effects are produced, which may be intimately connected with the influences which produce storms upon the earth.

Strange as it seems, the discussion made clear the fact that there is a probability that by studying the sun and its effects, savants may be able to predict the weather upon the earth. In fact, such prediction in a general way is already possible. It has been found by Prof. Stewart, Mr. Carpenter and others that magnetic changes, produced apparently by the sun, precede meteorological changes both traveling from west to east. The magnetic changes take less than two days to travel from Canada to England, while the weather changes which follow take seven or eight days to cross the Atlantic. But whether this rule holds for all parts of the world, is not known, because of the lack of observations in different countries.

The observation of sun spots also seems to furnish a means of foreseeing the general character of the seasons, for it has been found that exceptionally hot summers generally occur a year or two after sun spots have been most numerous, and exceptionally cold winters a year or two after the sun has been most free from spots. It has also been shown that the most destructive cyclones in both the East and West Indies occur when the sun spots are most numerous. The great difficulty is that the period during which the sun spots increase and then diminish in number is somewhat uncertain. It is generally about eleven years, but sometimes it is only eight years, and again it extends to sixteen years. The sun is just now passing through a period of spottedness. One singular fact that has recently been brought to light is that when great sun spots are numerous many small comets are seen in the neighborhood of the sun.

The red sunsets also received some attention. Prof. Archibald reporting that a committee of the Royal Meteorological Society had received information from all parts of the world going to show that the sunset glow was caused by dust thrown into the air by the tremendous volcanic eruption near Java a year ago. This dust seemed to have spread all over the earth, traveling at the rate of 2,000 miles a day. None of the savants who listened to this statement appeared to be staggered by it, but Prof. Archibald qualified it by saying that so far the evidence, though strong, was wholly of a negative kind.

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Tracing Cloth is the finest of linen. Wash the size out of old tracings and keep the linen; it is very useful to the housewife.

WROUGHT IRON CAR WHEELS.

At various times attention has been directed to this subject in this country. So long ago as 1853 an experiment on a large scale was tried at the Morgan Iron Works, in this city, the object being to make solid wrought iron wheels, similar in shape to the cast iron wheels now in use. The method adopted was to squeeze the wheels into form between large dies, and at one operation. This failed, as might have been predicted, the reason being that the metal would not flow at once into all the shapes demanded of it. The blanks cracked in all directions, regardless of the heat of them. Wrought iron wheels are extensively used abroad, however, though as a rule they are not solid webs. The process described herewith relates to solid wrought iron and steel wheels, and is that practiced abroad.

"The wheel-center is constructed in three operations—the formation of the rough piece, the rolling into shape and to diameter, and the finishing off. The processes are a little different for working in iron and in steel. The description applies to a wheel-center having an undulated web about 3 feet in diameter and weighing 495 pounds.

"A wrought iron pile is made up of six layers of bars, 8 inches by 4 inches wide, cut to a circle 20 inches in diameter, placed between two flat rings of iron, one above and one below the six layers, keeping them in form and binding them. Three rings of $1\frac{1}{2}$ inch square iron, 7 or 8 inches in diameter, are piled upon the layers as material for the nave. After the hammering for the first heat, the slab is inverted and three more rings are placed on the other side for the other portion of the nave, and for the second heat. With two more heats, making four heats in all, and five or six blows of the hammer in each heat, the forging is completed. The central opening is punched out in the operation of stamping.

"For steel wheels mild steel is used, having a tensile strength of from 25 tons to 30 tons per square inch. A special ingot weighs 530 pounds. The work is done in two heats. The rim and the web are rolled to form in one heat, by rollers similar to those employed for tires. In the same heat the center is finished under a 15-ton hammer. Steel centers are annealed by being raised to a cherry-red heat and cooled slowly, covered by iron plates. Centers of steel and of iron have been tested for strength by the falling of a weight of 7 tons upon the nave, the center being supported horizontally at the rim. The steel center resisted, without fracture, 210 blows of the hammer falling from 8 to 18 inches. The nave was depressed 4 inches. An iron wheel broke with 150 blows on a fall of from 8 to 12 inches."

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THE LIQUEFACTION OF GASES.

Mr. Cailletet recently exhibited, in the Paris Observatory, the apparatus that he used for demonstrating the fact that all gases (even oxygen, nitrogen and hydrogen, that were formerly regarded as permanent, obey the general law, and may exist in three states—solid, liquid and gaseous. It is at present in use in all laboratories.

With Mr. Cailletet's apparatus it is possible to obtain pressures of more than one thousand atmospheres, and to maintain these for weeks at a time. Herein is a new and fertile field of research which promises results of great interest to science.

Mr. Cailletet likewise exhibited the mercurial piston pump that he employed for liquefying large quantities of carbonic acid and protoxide of nitrogen for use in laboratories in the production of low temperatures, and for condensing in strong steel receivers the ethylene and formene that permitted him to lower the temperature of substances to much below the point that had ever before been reached. Ethylene, or bicarbonated hydrogen, requires for its liquefaction a much greater pressure than that which is necessary for the condensation of carbonic acid, but the operation is easily effected with Mr. Cailletet's pump.

As is well known, all solids or liquids, upon entering the gaseous state, absorb a large amount of heat. Alcohol, or, better still, ether, when poured into the hand, produces a sensation of cold, and, in surgical operations, this may be carried so far as to deaden all pain through the paralysis of the organs that are to be operated upon. The depression of temperature that ethylene effects upon evaporating is—104°; and when its ebullition is hastened by means of an air pump, we obtain—142°. Upon cooling a glass vessel containing ethylene boiling at the pressure of the atmosphere, Mr. Cailletet perceived, at the moment the pressure began to diminish, that the liquefied oxygen was assuming the gaseous state, and foaming just as champagne does upon coming from the bottle.

Under such effect of cold, nitrogen, oxygen, and atmospheric air resolve themselves into colorless, transparent liquids, of extreme mobility, which, upon passing over to the gaseous state, become the source of a cold that descends to —200°. Professor Olszewski, of Cracow, announced at the Academy of Sciences that hydrogen, the most intractable of gases, when submitted to this excessive degree of cold, condenses in the form of a transparent liquid, which, at the moment of expansion, flows over the sides of the glass vessel. Hydrogen is not, then, a solid metallic body, as has been believed, but seems to be, as far as its appearance is concerned, in all respects like liquefied oxygen and nitrogen.

The apparatus that have hitherto been employed for liquefying gases through compression have presented serious drawbacks—the dead space that always exists between the compressing cylinder and the bottom of the pump chamber limiting the pressure that is obtainable. Mr. Cailletet has completely surmounted this trouble by substituting a mercurial piston for the one generally employed. A cylindrical rod, covered with mercury, has an alternating motion in a cylinder, and the compressed gas raises an ebonite valve, and flows through a tube, into the steel receptacle that is to hold it.

The dead space is thus avoided, since the mercury, upon touching the valve, at every revolution of the pump, permits not a trace of gas to remain in the cylinder. Pieces of leather placed at the base of the cylinder prevent a re-entrance of the air during suction and an exit of the gas during compression.—*Nature.*

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CONCERNING SIDE-RODS OF LOCOMOTIVES.

When keying up parallel rods always have the engine on an even and straight track, for if it is standing on a curve, ever so slight, the inside wheels will have a tendency to close up, and the outside ones to spread, making the inside rod short, and the outside one long.

In putting or keying up parallel rods, always commence at the forward end, with the pins on the dead center, and work back. When you have keyed up both ends, take the rod in the middle, and if you can shake both ends you have it as it should be for that end; move the engine so as to bring the pins on the opposite center, and if it shows the same result you need not fear trouble from them.

I find a great many engineers are under the impression that the best place to key up parallel rods is on the eighth, which is a decided mistake. The center is the place to key them, for it is there the irregularities, if any, will be greatest; whether it be a sprung pin, or one out of line with the axle, or the wheels out of tram, there the irregularities will be greatest. They gradually diminish as the pin approaches the quarter, where it will be least, and will gradually increase as it approaches the other center. If the rod is free on both centers it will be free in any and every part of the circle. But not so if it is keyed on the eighth, as it is possible to be all right in that position and bind the centers so tight as to cause serious injury.

When driving the key down it should be tapped very lightly, and after the brasses have been keyed so as to touch each other, they should never be forced, as any attempt to drive the key further tends to ruin the brasses and distort the key and strap.

As in every improvement, there is the usual amount of prejudice against solid end rods on the part of some engineers. One of their objections, and, in fact, the only one they can present, is that they rattle after having run a short time. Admitting this to be a fact, is it not better to hear them rattle than it is to have cut pins, broken rods and cabs, and occasionally a ditched train, all from the parallel rods not having had proper care? The most artistic and strongest rod, for the amount of material used, is the double channel section, and with phosphor bronze bushings they would run a long time without giving any trouble. In a new engine recently turned out, they have made a departure from the old style of main and parallel rods. The strap is forged, fork shape, solid on the rod, with the back end open, and a block fitted to it which is held in place by two bolts passing through the block, making a very rigid back end. There is the usual key for taking up any lost motion that may occur. [This is not particularly new, but is unusual in locomotive practice.—Eds. M. E.]—*J. D. C., in Locomotive Engineers' Monthly.*

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SOME DEFECTS OF STEAM BOILERS.

Steam boilers are used as a medium to convey heat, or the accumulated force produced thereby, to an engine for the purpose of moving machinery to do certain work. The heat rises from the burning fuel within the boiler furnace, and penetrates the metal to heat the water in the boiler to 212° F. so as to form steam; but before its actual formation 966° F. has to be absorbed. Steam has no power to move a piston at such a low temperature, therefore more heat is required to produce the necessary force, and the higher the degree of heat contained in the water and steam, the more pressure will the steam exert on the piston when allowed to enter the cylinder. It is of the utmost importance to have perfect combustion, so that the whole of the heat may enter the water in the boiler. For this purpose various shapes and forms of boilers have been invented, but the Cornish and Lancashire types are found the most convenient for general purposes. Now 1 lb. of good coal is capable of evaporating 15 lbs. of water, but these boilers are only capable of evaporating one-third, or at the best one-half of the quantity of water they should do in proportion to the fuel consumed (which is far too small a proportion) owing to the flame and heat wave rushing through the flues too quickly for the heat to thoroughly penetrate the metal. Improvements have been introduced which have proved to be very advantageous in saving fuel, so long as they are kept clean. But even with these the average evaporation is not much more than half that which theory shows it should be, owing to incrustation. This evil of incrustation, together with unequal expansion and contraction, and the corrosion in boilers, are hindrances which ought to be removed.

Among the general evils to which boilers are subject, incrustation is one of the principal, because all waters contain certain impurities which settle in the boiler, as the heat cannot dissolve nor drive them off with the steam. These settlements remain generally where the steam is formed, and get baked into a hard scale on the plates, but mostly on the crown of the flues and conical tubes. As this scale is a non-conductor of heat, it requires 15 per cent. more coal when the scale is only one-sixteenth of an inch thick; and when it is a quarter of an inch thick, 60 per cent. more coal is required. It is not only the coal which is thereby wasted, but the water is kept away from the boiler-plates, which become overheated, and eventually have holes burnt in them.

Another trouble with boilers is the formation of smoke and the loss of unconsumed gases. When fresh coals are placed on the fire in an open fire grate smoke rises directly. The cause of this is not far to seek, as it will be easily understood that before the fresh coals were put upon the fire within the grate, the glowing coals radiated their heat and warmed the air above, and thereby enabled the rising gases at once to combine with the warmed air to produce combustion, but since the fresh coals are placed upon the fire these coals absorb the heat, and the air above remains cold. The fact is that these volatile rising gases cannot combine with the cold air for combustion, still a combination does take place in the following way: The cold air in the act of combination absorbs a part of the warmth of the rising gases which they cannot spare, and therefore they (the gases) must condense, so much so that small particles are formed, which aggregate, and are called smoke, and when collected form soot. So long as these particles, or gases, are floating they cannot burn or produce combustion. Of course the invisible hydrogen gas rising from the coals with the smoke would burn easily enough, but it must be first lit before it can burn.

The above sentences only refer to open fire grates; in furnaces smoke and waste of gases may be caused by too small a quantity of air, so that there is not enough oxygen to satisfy the rising gases, or there may be too much air, which, while passing through the furnace, absorbs heat and thereby impoverishes the combustion.

In the report of the Manchester Steam Users' Association, April 24, 1883, is the following: "The question of smoke prevention, and the relative merits of mechanical and hand firing, had been carefully considered by the association, and the conclusion arrived at was that, as regards economy, the two modes of firing gave practically the same result; as many as fifty five mechanical stokers had been removed from boilers under inspection. To prevent smoke by hand firing, nothing out of common was wanted, but only a reasonably fair draught, a reasonably fair boiler, regular firing, and the admission of a little air above the fire-bars to secure the combustion of the gases."

These statements support the author's opinion that smoke cannot be burned in the same furnace where it has been formed, and much less is any furnace door able to produce complete combustion of the fuel burning within the furnace. In fact, entire combustion is almost beyond the means of man, in an ordinary furnace. Still, improvements have been made by introducing warm air, to combine better with the rising gases of the burning fuel. But even this is no easy matter, considering that 150 cubic feet, or 22 lbs. of air are required for each pound of coal burnt; and it is a fact that the carbon requires great heat before it can be burnt, and further, that all solid fuel formed into gases and compressed gases while expanding absorb a large quantity of heat before they can burn.

On this subject, *Engineering*, of December 2, 1881, says: "Total combustion means, not merely the rendering the products of combustion invisible, it means the conversion of the carbonic oxide produced into carbonic acid."

Another author says: "The carbon burning in the flame has not completed its combustion, and it is only the high temperature of hydrogen burning which will enable the carbon to combine more readily with the oxygen in the air." It is only the clear white flame which will show that combustion is in its proper condition and everything is well heated. To prove that the carbon in the flame is only completing its combustion may be seen by the flame of a gas jet or of a candle, which gives a very white light, as for instance, the Siemens gas lamp. But if a little air be allowed to blow in from the bottom, then the white light will blaze out in a long dark red flame, and give little light, but plenty of smoke and soot. Again, if a plate be held over a gas or a candle flame, carbon, *i. e.*, soot, will settle on it, and the deposit is increased when the plate is held lower in the flame; in fact, the burning of carbon in a flame is only one of the stages of combustion, and when combustion is interrupted or incomplete, it produces smoke, which is increased, while the invisible steam formed by the hydrogen will condense and cling to the dust of the carbon. This can be proved by the flame in a furnace; the lowest part of the flame where the carbon has just combined with the oxygen is generally much darker, even when the top is quite white, and thereby gives the greatest heat of some 2,000° F., and when the flame is entering the tubes of a marine boiler, the bottom tubes are getting choked with soot, and the top flues, owing to the white flame, remain clean, and produce the heat required for forcing steam. The densest smoke is formed when stoking is commenced, or the partly burned coals in front are pushed backwards on the fire-bars. The coals now disturbed having been warmed and their pores opened, the previously confined gases rise in a mass, but meeting the cold air entering partly from the open fire-door and partly through the firebars, the gases condense and form smoke. To save this great loss of gases, and to prevent the formation of smoke, the damper ought to be nearly closed before the furnace doors are opened. If this plan is not adhered to, the owner of the boiler will not only lose all the gases, as stated, but in addition some 8 lbs. to 10 lbs. of coals, to make good the cold which has entered the furnace and flues by the door.—*Engert.*

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ITEMS FROM FOREIGN PAPERS.

Excellent Results Have Been Obtained from the triple expansion engines recently made by Messrs. Blair & Co., of Stockton, for the SS. *Burgos.* The initial pressure is no less than 160 lb. per square inch. It is not more than twenty-five years ago since 30 lb. was the highest in use at sea. The *Burgos* has made a voyage carrying a cargo weighing 2,450 tons. She averaged nearly 9 knots per hour on a consumption of 9 tons 6 cwt. coals per day. A sister ship, called the *Eros*, built in the same yard and upon the same model, was furnished with ordinary compound engines of the same power, by same parties. The initial pressure in this case was 80 lb. per square inch, and the speed obtained was 8½ knots per hour on a consumption of 13 tons per day. The saving effected will be found to be rather more than 28 per cent. If further experience should prove as favorable as this, it can scarcely be doubted that we are on the eve of another revolution in marine engineering as complete and universal as was the substitution of compound for simple engines. During the next few years we may expect to see triple engines put into new steamers, and substituted for existing compound ones in many now afloat. For it is evident that the one kind may be worked with a profit, when the other would be attended with none at all or with a loss.—*Engineering.*

The Condition Of The Steel Trade in Sheffield excites a good deal of anxiety. A Sheffield manufacturer, whose name is known the world over, attributes a good deal of our decadence in steel to the fact that while we have been standing still, competitors have been adopting the latest appliances in every branch. With few exceptions, for the highest classes of steel the process is practically the same to-day as it was 111 years ago; "just as if science and metallurgy had never made one single advance." "Fancy," he adds, "the steel melter going at six in the morning, putting his pots in the furnace, and getting 60 lb. out the first round by 10.30, the second round of 40 lb. four hours later, and the third round of 36 lb. later still; total, 136 lb. per pot per day, and using three tons of coke, costing over 40s., to get this result! How can this steel-maker compete with rivals who are making steel with coal at a cost of 5s. per ton, and get out twice the weight? The barbarous, old-fashioned process of making steel in crucibles, will," he thinks, "soon be extinct."—*Ibid.*

In regard to the expansion and contraction of steam boilers and the danger arising from it, a correspondent of the *Engineer* puts it in this way:

"Two summers ago I saw rails bent in a most extraordinary way by being pressed end to end by the heat of the sun, and I was curious enough to keep an eye on the same rails. When winter came I found the ends open so that I could nearly put the point of my umbrella between them. Now, if the upper side of a boiler is to represent the summer and the under side the winter, I don't see how we can escape having great strains on boilers, or that we need expect anything else than explosions where boilers are reported as being as good as the day they were made."

Here Is An Instance of the breaking of a side rod through the mere "whip" of it, up and down: The Bradway tunnel is one of the largest in England. Shortly after entering, the express reaches the summit, and is enabled to run down without steam to Sheffield at a rate of 40 to 50 miles an hour. A fast train from Derby to Leeds was doing this when the side rod of the engine snapped.

Important New Departures are taking place place just now in the production of manufactures of flint glass in England. Recently one firm manufactured a very handsome drawing-room suite in such glass, richly cut; the same firm are now constructing a massive and elaborate glass billiard table of the largest size and finest workmanship.

Chippings and Filings.

Twenty Thousand Dollars Per Month is the amount of the laundry bill for the Pullman sleepers.

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The Rhode Island Locomotive Works, Providence, have started up on full time, having taken a large order for engines.

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The Curtis Regulator Company, of Boston, have recently shipped a twelve-inch pressure regulator to be used in water works where the engines are run by boilers which carry steam at 65 lbs. This valve reduces the pressure to 25 lbs., so that two sets of engines are run at varying pressures from one battery of boilers.

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I. P. Witherow, New Castle, Pa. (late Witherow & Gordon), has a large contract on hand, well under way, for the Dayton Coal and Iron Company, of Dayton, Tenn. This contract consists of two blast furnaces complete, with all the iron work, roofs, etc., for them. There are to be five blowing engines, 36″ and 84″ × 60″, six hot blast stoves, twenty-four boilers, etc., etc.

◆

Japanese Magic Mirrors are in the market. These are made of fine burnished metal, and when lightly breathed upon disclose geometrical patterns, landscapes, or faces. Their manufacture is a secret, but is believed to consist in welding the pattern in one kind of steel or iron upon a plate of a different kind. One which reproduced faces sold at Philadelphia for $110.

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The Lubricator Suit in the United States Court for District of Mass., entitled "The Seibert Cylinder Oil Cup Co., *vs.* John J. Renchard, or American Lubricator Co.," involving the use of hydrostatic pressure and visible feed, has been decided in favor of John J. Renchard. This sustains the patents to John J. and J. Vin. Renchard, embracing the hydrostatic pressure and visible feed.

◆

Here Is The Last Remedy For Seasickness, taken from one of the French papers: "Take no food during at least four hours previous to embarking. An hour before stepping on board drink one or two cups of very strong coffee (without chicory).

Better thing than this is to get a spirit level and watch the bubble; so long as it is level you won't get seasick, when it is out of line away you go.

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The Tug Owners and schooner interests on Lake Michigan are consulting about the feasibility of combining against steam barges. The latter, as lumber-carriers, have recently monopolized a large share of the carrying trade, because they are both capacious and swift, and can go directly to yard docks without the aid of tugs. When their cargoes are discharged they can go to sea again, and no thanks to the tow-lines of the tugs. This has sadly impaired the income of the towing companies, and diminished the demand for sailing vessels. The two interests have devised a scheme for having the schooners towed from port to port, both ways. Thus the sailing vessels could make as good time as steam barges, and the tugs would not lose time waiting and rusting for tows.—*North Western Lumberman.*

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"No Carpenter In A City now thinks of lugging about a three hundred pound chest of tools, consisting only of moulding, sash, and match planes, as many in the country did in former years, in addition to the ordinary chest of tools which came into everyday use. Nowadays fine office and store fixtures, and much other work, comes from the mill in such shape that a couple of ordinarily clever workmen, with only a shoulder-box full of tools between them, will put it up more rapidly than the thoroughly trained carpenters of old times after making the fixtures by hand. The proportionate number of good carpenters is decreasing from this, and the fact that when a man finds himself good at any particular branch of the business, he follows it in preference to any other, and finds it more profitable to do so."—*Building Trades Journal.*

In A Paper issued by the Industrial Publication Company of this city a writer says:

"A great deal has been said about introducing mechanical education into our common schools. By mechanical education, however, is generally meant the art of designing—a subject which readily affects but a small portion of our industrial pursuits, and for which but a small number of persons are fitted. To mix such subjects with our common school studies would be to spoil both; but to engraft a provision for a good technical education upon our common school system would answer the purpose completely. This education should be given in separate schools, for the simple reason that all the pupils are not intended for mechanics, and many of them are not fitted to profit by the subjects which form a proper study for mechanics."

We do not take the same view of a mechanical education that the writer quoted does, but his ideas are sound.—Eds. M. E.

◆

Messrs. Clem & Morse, of Philadelphia, have recently perfected a new improved pneumatic safety-catch for elevators. The elevator platform proper is guided by ash strips three inches wide extending the full depth of the well. The safety-catch is attached to the bottom of the platform, and consists of a half-inch poplar board resting on springs; any pressure on this sub-platform causes two steel shafts, the full width of the platform, to revolve. The shafts are furnished at either end with toothed eccentrics, which, the moment the shafts revolve, clutch the guiding strips and motion is almost immediately arrested. The appliance works automatically by the resistance of the air beneath the elevator caused by the accelerated speed incidental to a breakage of the cable. The elevator was raised about ten feet at a recent trial exhibition, and the cable separated at that distance, when the car stopped in 1¾ inches without jar.

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Seasonable Item About Peaches from the Delaware *New Era.*

It has been estimated that 20,000 persons, men, women, and children, are at present at work in the orchards, engaged in handling the crop. Their wages average $1 per day, which gives $20,000 as the sum paid out daily. That is a pretty large sum to be distributed among the working classes at a season when the usual harvest work is about over. The number of peaches required to fill the peach basket at present in use varies, of course, with the size of the fruit. A fair average may, however, be struck at 200. This would give us about 66,000,000 peaches sent from the peninsula daily during the height of the peach season. The baskets are about 15 inches across the top; now, if all the fruit was shipped in these, and they were placed side by side, they would reach a continuous distance daily of over 77 miles. The peaches, allowing each one to be only an inch in diameter, if placed in one continuous row would reach more than 1,000 miles. The weight of an average basket is 30 pounds, which would give us 9,900,000 pounds, or 4,950 tons of fruit daily pulled from the peach orchards of little Delaware.

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Single Copies, 8 Cents
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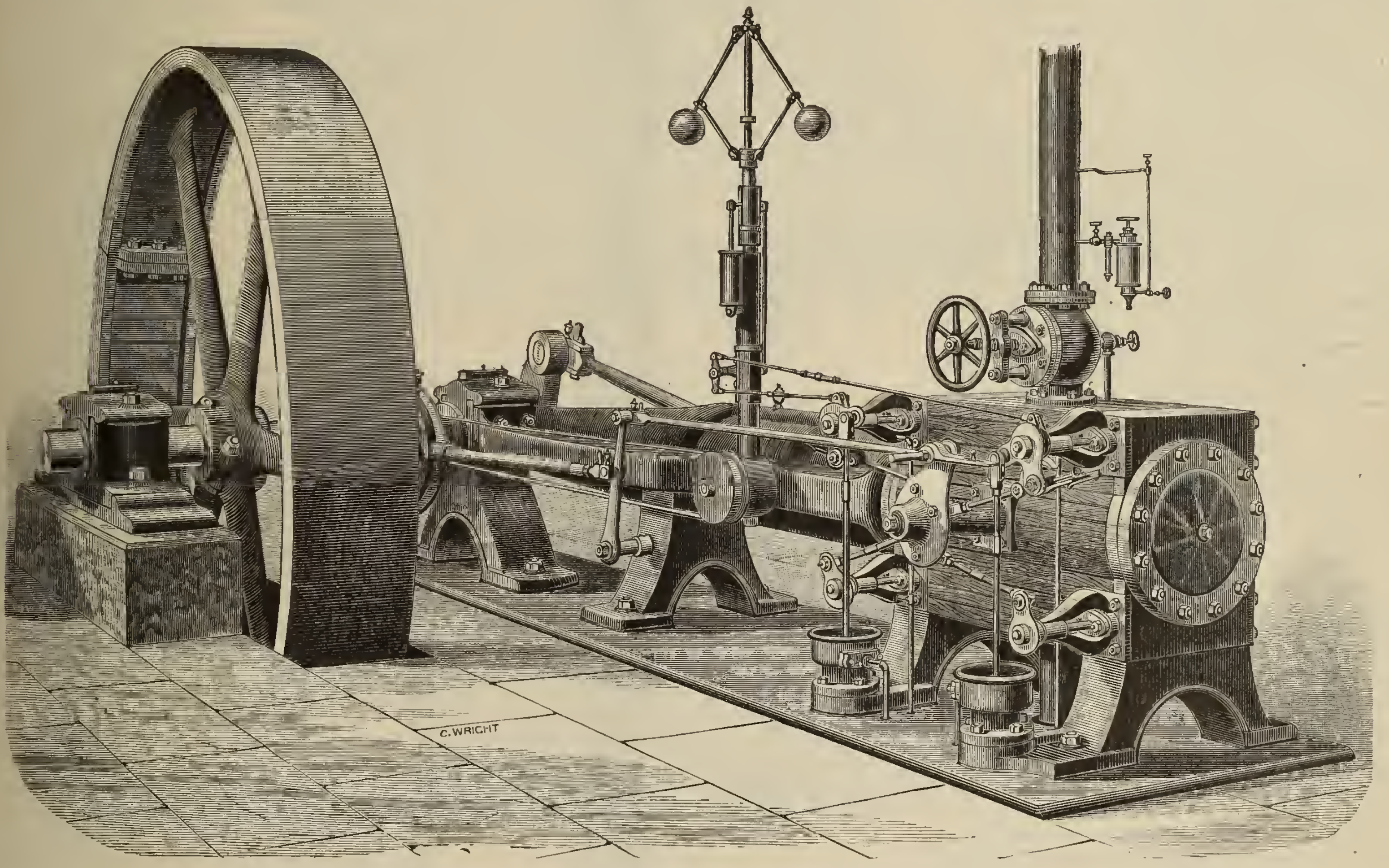
CORLISS ENGINE BY THE HEWES & PHILLIPS IRON WORKS, NEWARK, N. J.

Our engraving represents a horizontal engine of the well-known Corliss type, as made by the Hewes & Phillips Iron Works, of Newark, N. J. Careful inspection reveals many valuable improvements which, the builders claim, are original with them. Summarized, these appear to be a rigid and substantial support for the middle of the bed, at the end of the slides, placing the dash-pots above the floor of the engine room, so that they are easily accessible for examination, and making the crab-claw spring in two parts, bolted together, which very much lessens the liability of breakage. The valve-stem bearing on these engines is bushed with hard cast iron, so that the wear does not come upon the bearing itself. Manifestly this is an improvement, in that it confines renewals to the bush itself. The trips, or cut-off toes, are interchangeable, and can be reversed in four directions before requiring to be replaced. They are made of best cast crucible steel hardened. In other particulars these engines are equally honestly made, with a view to giving the purchaser the best value for his money. The greatest care is exercised in the selection of the material used. The iron for the cylinder is of the best charcoal brands, re-melted and again selected before finally casting, the result being a cylinder close and hard in its texture and of lasting durability. The forged parts of the engine are also of the best materials; the crank shaft and connecting rod being of the toughest and strongest charcoal iron, put together on the "built up" principle. The crank and crosshead pins and all the small pin connections, together with the governor spindle and eccentric rod, are made of the best crucible steel of special brand, worked with great care.

The interchangeable system is followed in the manufacture of these engines, and duplicates of any part can be had with the assurance that it will suit the place. Large numbers are running in every part of the country, and the manufacturers will be glad to send testimonials or places where they are located to intending purchasers.



Corliss Engine By The Hewes & Phillips Iron Works, Newark, N. J.

We Are Under Obligation to Prof. R. H. Thurston for report of trial of the engines of the steamer *Fall River*, by Messrs. Sague and Adger.

The *London Engineer* Says: Mr. Thomas Fletcher has made gas-tight elastic rubber tubing. The tubing is made of two layers of rubber with pure soft tin foil vulcanized between. It is said to be perfectly and permanently gas-tight and free from smell under all circumstances, whilst it retains sufficiently for all purposes the flexibility and elasticity of an ordinary rubber tube.

A New Crucible Furnace, known as Hodgkin's, has been patented in England. The object of the furnace is to make the crucibles—whether plumbago or clay—last longer, and it has the subsidiary advantages of effecting a saving in coke, shortening the length of the several heats, and somewhat improving the metal. Users have obtained as many as sixty-five heats out of a plumbago pot, and as many as twenty-five heats out of a common clay pot.

The *Times* Correspondent, speaking of the recent meeting of scientists at Montreal, says:

> "While speaking of the Americans who took part in the discussions, it is worth noting that, so far as appearances went, there was little except the cut of their clothes, to distinguish them from the Englishmen. There were not any marked differences of physique or facial appearance between the two sets of men. There were some Englishmen who were burly and some who were not, and the same is true of the American scientific gentlemen. What difference there was in the appearances of the faces lay mainly in the fact that the English countenances were in the main a trifle more rubicund, and with them was by far the greater majority of noses which bore token of being colored by tinctures taken inwardly and allowed to come to the surface in due course of time."

Colored like meerschaums, probably.

A Manager Of A Large Works, who was not a mechanic, wanted a heavy punch and shear. He invited a builder of such tools to tender for it. The builder came, the price was satisfactory, and the manager turned to a clerk and told him to make out an order, adding to the builder—"Send the machine to us next week." The builder said he didn't keep such large tools in stock, and couldn't send it under a month, at least.

"Why so?" said the manager.

"It will take at least three weeks to make the casting alone; it weighs 16 tons."

"Well, if you don't know how to make a casting of that size in less than three weeks you need not send the machine." And the manager thought he had said a sharp thing.

The United States Government keeps up a costly system of tracing out letters and valuable packages lost in transit through the mails. Unless others are luckier than we are, it might as well be dispensed with, for we never knew a lost article to be found. We admit our experience to be limited, for in four years we have not lost $20 in this way.

It Is Announced that Prof. Barker, of the University of Pennsylvania, is about to issue an invitation to leading manufacturers, engineers, and others interested in technical industries, to meet Sir Frederick Bramwell, and other members of the council of the Exhibition for Inventions, to be held in London during 1885. The object is to make known the scope of the intended exhibition and to induce American manufacturers and exhibitors to send goods to it.

The *Railway Review* Remarks:

> "So far as the printed bills of fare of some of the Western dining cars may be taken as a criterion of variety, the 'spread' is all that the daintiest epicure can reasonably desire, and if the good things are well served and not all cooked in one pot, these cars are in a fair way to fulfill their mission as a blessing to the traveling humanity."

That is just where the trouble is—that they do not pay. If dining cars are to be run for epicures, who cannot rest easy unless they have all the delicacies of the season, and many out of season, then the managers should not complain if the accounts do not figure on the right side. The mass, we believe, would be better satisfied with an honest beefsteak, or a properly hung piece of roast beef, than all the "pretty little tiny kickshaws," with wrongly spelled French names, that now adorn dining car bills of fare.

The Dutch Word for a station is *Standstilplatz*, which hits it just about right.

NOTES ON THE ELECTRICAL EXHIBITION.

The numerous companies which are insisting that their wires cannot be placed under ground excepting at great sacrifice, should send delegates to the Electrical Exhibition. They will find several very ingenious devices, which, the inventors affirm, are calculated to overcome every difficulty suggested. There is, for example, an underground tube or long flattened box made of iron, with different lateral compartments, which is intended for a subway. On either side are places for electric lighting wires. In the middle is a larger space for telephone and telegraph wires and generally for leads over which currents of low electro-motive force pass. The wires are all intended to be insulated and rest on metallic supports. The inventor claims that his arrangement of them is efficient and durable, and that, in the long run, the various companies will find it cheaper to use his device than to string their wires overhead. Another device consists simply of a long inclosed trough with compartments of rectangular sections. Each compartment is intended for a different class of wires. Another contrivance provides for surrounding the different wires with a braided wire coating outside of the insulation. This, it is claimed will prevent induction, which has so potent an effect in spoiling telephone service.

Some electric motors of small power are here. A dozen or more sewing machines are operated by them. Larger motors are not put to any use, but are permitted to expend their revolutions on the air. Of small contrivances for various useful and ingenious, though, in some instances, superfluous, purposes there seems to be no end. The basis of nine-tenths of them is the alternate attraction and repulsion of the armature of an electro-magnet which opens and closes an electrical circuit at stated intervals.

The electrical lighting devices thus far exhibited do not comprise all the adaptations, but only the best known ones which are in common use on this side of the Atlantic. In arc lights there are, notably, the Brush, the Ball, the Weston, and the Thompson-Houston. These, and in fact all others, differ little as to the lamps. The adjustments are pretty much the same, and in nearly all the current which feeds the lamps and gives them their light also regulates automatically the distance of the carbons apart. In some lamps, however, there is an alternating current. In others the current is constant. This means simply that in the latter case the positive carbon is always positive, and the negative always negative. In the other the carbons are each, alternately, positive and negative. The incandescent lamps all depend upon the same principle, namely, the heating, in vacuo, of a thin carbon filament of high resistance. In the Edison lamp there is a fiber of charred bamboo; the others use a carbonized thread or a piece of paper. In the Bernstein lamp, which is the most brilliant of the incandescent lamps, and occupies the ground midway between an incandescent and an arc light, a hollow thread, charred, is used. It resembles the coating of a bit of elastic after the rubber inside has been pulled out. For quantity of material it has more exposed surface than is to be obtained in any other way.

So far no examples have been shown of a kind of lamp that is a combination of the arc and incandescent, one form of which, the Swan lamp, is quite popular abroad. In this the carbon pencils —similar to those in use in arc lights—fit into little marble blocks, the ends of the pencils being separated a little by the marble in between. This portion between the ends of the pencils glows brilliantly and with about the color of a calcium light as soon as the current passes.

Lieut. Fiske, United States Navy, with his great reflected electric light, is waiting for the moon to grow less or for a cloudy night, in order to set his lamp at work and make visible objects two and a half miles distant.

A curious fact is that most of the exhibits are from New York or from the neighborhood of that city. This certainly suggests that the proper place for an adequate exhibition of the kind is the city of New York. Not only would that place supply of itself more exhibits than any other half dozen places in this country, but the fact of holding the show in that metropolis would bring more foreign exhibits than would be the case were it held elsewhere.

There has been much grumbling at the backwardness of the display. The large number of empty spaces and the unfinished condition of many of the exhibits are serious drawbacks. The lack, also, of a descriptive catalogue, making it necessary to do much asking of questions to find out what there is in the displays, is another preventive of comfort or satisfaction. When these troubles are adequately remedied the exhibition will be well worth a visit.—*N. Y. Times*

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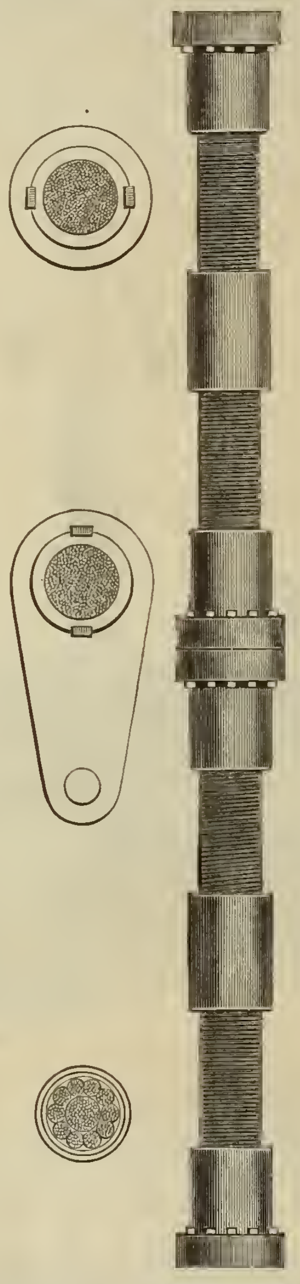
THE JEROME ELASTIC SHAFT FOR MARINE ENGINES.

We briefly noted the fact some months since, that an elastic shaft, made in a peculiar way, was proposed by an inventor in this city, and we now present an illustration of the device, showing its construction. The shaft, as may be seen, is made up of a number of steel wires laid parallel with each other, and rigidly bound together by external coils of wire wound both right and left. At required intervals collars are shrunk on to form bearings and crank-seats. It is claimed that this method of construction forms a much lighter and stronger shaft for a given quantity of material than a forged shaft; that it is absolutely sound throughout, and that, by its inherent elasticity, it will yield to sudden shocks without danger. The cost of the shaft is much less than solid shafts for the same duty.



This method of making shafts must not be confounded with those now in use, known as "spiral shafts," as it is entirely different from them.

The invention has been patented in this country and in England, and all interested can obtain further information by addressing the inventor, S. B. Jerome, 18 Park Place, N. Y.

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"Dynamic Electricity" is a most useful handbook for those connected with electric lighting. It contains, "*Some Points in Electric Lighting,*" "*On the Measurement of Electricity for Commercial Purposes,*" and "*Electric Light Arithmetic.*" We will send it free by mail for 50c.

THE THERMOGEN.

An improvement was lately introduced at the rolling mills of the Joliet Iron and Steel Company, which is said to be important. The invention consists of an apparatus for the manufacture of vapor fuel for heating purposes, and takes the place of the present expensive system of heating the furnaces by means of coal gas. It is called a "thermogen." Its cost is merely nominal, and it does away with a heating plant that cost $50,000, including the gas house, and the tremendous daily consumption of coal. It is a small cylindrical machine about four feet long and eighteen inches in diameter, with a shell four inches thick. This is placed on a furnace about seven feet long and four feet wide, and kept, when in use, at a cherry-red heat, and is connected with a crude petroleum oil tank by a small pipe, and also by a steam pipe from a twenty-five power boiler. Three furnaces are now heated by this vapor fuel, and the results are more satisfactory than those obtained by means of the coal gas system. It throws about fifty men out of employment, and saves a very cumbersome and disagreeable system of machinery. These thermogens will be introduced into all the departments of the plants where boilers are required, and are doubtless destined to revolutionize the present system of heating in factories and mills everywhere.—*Inter-Ocean.*

◆

HOW TO REMOVE FOREIGN BODIES FROM THE EYE.

Some machinists are very skillful in removing specks from the eyeball, using a fine-pointed penknife for the purpose. Dr. Agnew, a celebrated surgeon, says, in the *American Practitioner,* that a better instrument than a knife is thus made:

Take a splinter of soft wood, pine or cedar, and whittle it to a point. Then take a small, loose flock of cotton, and, laying it upon your forefinger, place the pointed end of the stick in the center of it. Then turn the flock of cotton over the end of the stick, winding it round and round, so as to make it adhere firmly. If you will look at the end of such a probe with a two-inch lens you will see that it is quite rough, the fibers of cotton making a file-like extremity. As the material is soft, it will do no harm to the cornea when brushed over its surface.

When ready to remove the foreign body, have the patient rest his head against your chest, draw the upper lid up with the forefinger of your left hand, and press the lower lid down with the middle finger, and then delicately sweep the surface in which the foreign body is imbedded, with the end of the cotton probe.

◆

This Man Has Trouble.

"Subscribers who neglect their subscription bills through carelessness or otherwise, and only pay the trifling amount after months of dunning, entail upon any newspaper office an amount of trouble and expense which forfeits their right to cash figures."

Tell you what to do—don't send the paper unless you get the money in advance, that lets every one out of dunning and being dunned, and makes all things lovely and of good report. The man who has not paid for his paper is not a subscriber. Come over and see us and we will show you a big book full of names, every one of which has been paid for in advance for—in a few cases—some years.

◆

In Regard To A Curious Phenomena, "*Hamlet*" writes to *The Scientific American* as follows:

"Two persons stand on each side of a fifth, who is seated in a chair. The four raise their hands (which are clasped with the forefingers extended), as high as possible over their heads, at the same time inhaling deeply. They then simultaneously bow as low as possible (always facing the sitter), bending the body from the hips, and swinging the extended arms from the shoulder till the hands touch the knees, at the same time exhaling as strongly as possible, these motions being repeated three times together. As they rise from the last position for the third time, the extended forefingers are placed under the knees and arms of the sitter, and he is lifted high in air as light as a feather. In this way I have seen four young school girls, under sixteen years, lift a man of 180 pounds with no more apparent exertion than would be required to lift a three-pound weight. To one who tries this experiment for the first time the result is very surprising."

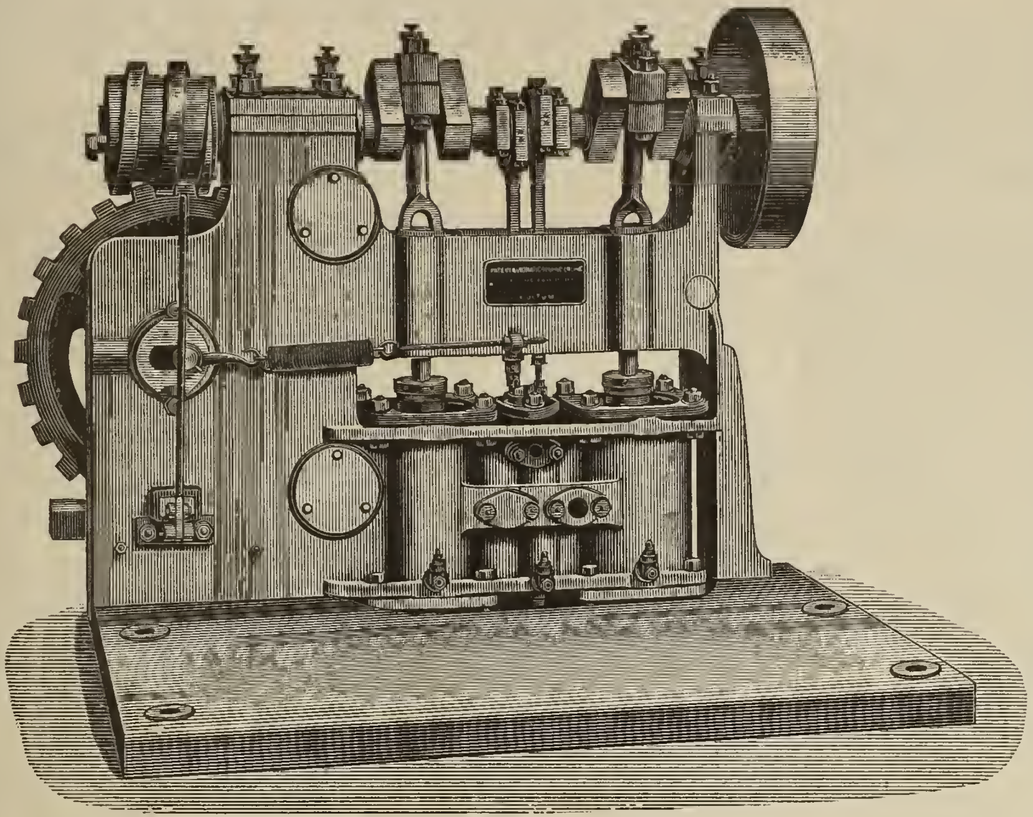
For ourselves, we can say that we have seen the experiment tried time and again, and it always failed of any result whatever.

◆

Punctuality is a great virtue in an engineer.

FOR TURNING ROLLING MILL ENGINES OFF THE CENTER.

Engines which act automatically are used for the above purpose in English rolling mills, and the present engraving is an example of a recent engine, made by Hargreaves & Co., of England, for either bringing the cranks into a favorable position for starting, or for effecting repairs to the engine or to the gearing. In cotton mills, particularly of the older type, the toothed gearing wheels are not bored out, but are fixed or "staked" on to the shafts by four keys, and hence, when a new wheel is introduced it often happens that the engine has to be barred round many times in order to get the wheel accurately adjusted. It consists of a pair of vertical engines, having cylinders 7½ inches in diameter, driving a crank-shaft upon which is mounted a worm. This worm gears into a wheel which acts both as a worm-wheel and a spur pinion, one side of each tooth being cut at an angle to suit the worm, and the other side being designed to gear with a ring of internal spur teeth cast on the inside of the fly-wheel of the main engine. The wheel is fixed upon a shaft carried in long slots, in which it can move from end to end. It is, however, normally kept at the inner end of these slots by a pair of springs. Underneath the wheel is a brake-block which can be applied by a lever to stop its rotation for a moment, when it is out of gear with the main engine. If the barring engine be running and the brake be applied, the result is that the wheel rolls forward on its bottom side until its teeth come into gear with those of the fly-wheel, when the brake may be released. The main engine then begins to turn, and should the regulator be open, so that the engine will get away under its own steam as soon as the crank passes the center, the pinion will remain in gear until this happens. The instant, however, that there is no longer any load on the pinion, the spring commences to draw it back, and should the fly-wheel overrun it, the influence of the spring is increased by a direct push which forces the two sets of teeth out of gear, and removes all danger of injury to either of them. The apparatus illustrated is suitable for application to engines up to about 400 or 500 indicated horse-power. A larger size with 9 in. cylinders will turn engines of 1,500 indicated horse-power. The makers have already built several of these engines, both for this country and abroad.—*Engineering.*



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SOUR GRAPES.

The *American Machinist* takes occasion, in its last issue, to haul American marine engine builders over the coals in its usual savage fashion. It says:

> "Marine engines must get but cursory notice here. This is the less to be apologized for, inasmuch as '*Maw's Recent Practice in Engineering*' is not entirely silent on the subject of recent American marine engines. If no more successful than the writer in obtaining information from American marine engine builders, the scant notice will match the scant courtesy. This experience with our marine engine builders is by no means novel. In all other departments of mechanical engineering, American manufacturers are noted for their liberality in furnishing information about their operations, but a small clique of marine engine builders seem to vie with each other in treating with discourtesy parties who try to learn something about the engines in course of construction. Those who have nothing to show, and whose methods of doing work are disgracefully crude, generally make the greatest mystery of their operations."

The publishers of The Mechanical Engineer have had dealings with American marine engine builders, as its pages show, and in no case have they been treated discourteously. On the contrary, full information has been given, and there is more to follow.

CARRIES ITS OWN COMMENT.

On the 15th inst. a new building which was used for compressing cotton, in Eufala, Ala., was destroyed by a boiler explosion, with the loss of several lives. The works had only been in operation one month, and had cost $30,000, but not a stone was left upon another. Only the bare facts, as stated above, are given in the press dispatches, but engineers know full well that to call such an occurrence a disaster is to misapply terms. So long as capitalists are permitted to erect steam boilers and employ persons who are unfit to be in charge of them, just so long will the community at large be in danger.

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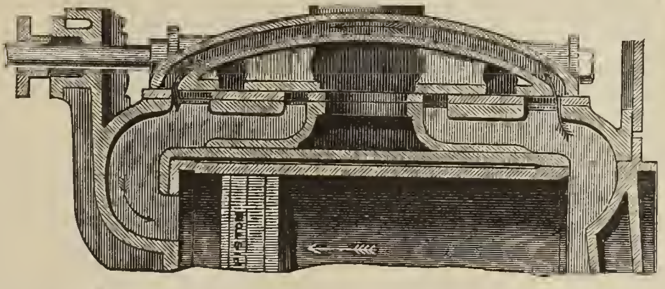
AN ENGLISH SLIDE VALVE.

Our engraving represents an English slide valve which is peculiar, in that it takes a portion of the steam at nearly terminal pressure, and allows it to pass over into the other end of the cylinder. In other words the spent steam exhausts, for a brief period, into the live steam side. This is said to be economical, in that it fills the ports and passages with spent steam instead of taking live steam for the purpose. An examination of an average indicator card shows that the same end is attained by compression with ordinary valves.



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When Cotton Cloth Is Bleached and dyed the constant pulling it is subjected to while wet causes an extension lengthwise at the expense of the width, and the result is that a piece originally 36 in. wide is reduced to 32 in. As the increase of length does not repay for the loss, it is necessary that the width should be recovered. For this purpose two pulleys, about 3 ft. in diameter, are set at an angle to each other, being (say) 28 in. apart at the nearest side and 34 in. at the furthest. A leather belt is taken half round each pulley, and is then led clear of it by means of guide rollers. Each edge of the narrow cloth is fed between the strap at the pulley at the narrow side, and the piece is drawn through until it emerges at the wide side. But before it reaches there it must either have expanded several inches or have slipped between the belt and the pulley, which is scarcely possible, and thus a 32-in. cloth comes out 36 in. wide.

TEST FOR ACID IN OIL.

On a sheet of bright copper, of course unlacquered, a number of shallow indentures are made with a round-faced hammer or punch. Samples of oil left for a few days in three open dishes, placed in a warm room, will show by the formation of verdigris where acid is present.

The existence of a blue tinge in a glass vial of oil is frequently assumed to indicate the presence of mineral oil. This, however, is illusory, as the same effect is frequently observed in the finest and best vegetable oils.

Of course many good oils are adulterated, and the entire oil trade has become odious for this reason. Professor Friese said that a large amount of what purported to be pure linseed oil placed on sale was examined by him and found to contain resin, sulphuretted oil and fish oil.

The use of refined paraffine oil for machinery is on the increase, and the growing demand for lubricants in which it is the chief ingredient is steady, and an immense trade is the result. However much it may be depreciated as inferior for certain purposes to whale oil, the advances in its treatment, and the increasing knowledge of its capacity to unite with other substances, have made it an indispensable article of general use. Its discovery came in good time, for, without it, the manufacturer would have been in as great need of a cheap and efficacious lubricant for his machinery as the world would have been in want of an inexpensive and satisfactory light without the accompanying kerosene.—*Oil, Paint and Drug Rep.*

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"HORSE SENSE."

La Bruyere, a French philosopher, said:

> "The generality of men expend the early part of their lives in contributing to render the latter part miserable."

He made a bull's-eye.

"Rare Ben Johnson" said:

> "A man should be careful never to tell tales of himself to his disadvantage; people may laugh and be amused at the time, but afterward it will be brought up and remembered to his disadvantage."

Bishop Colton said:

> "Nothing more completely baffles one who is full of trick and duplicity, than straightforward, simple integrity in another."

Socrates said:

> "Four things belong to a judge: To hear courteously, to answer wisely, to consider soberly, and to decide impartially."

And Cowper this, about knowing it all:

> "Knowledge and Wisdom, far from being one, have ofttimes no connection. Knowledge dwells in heads replete with thoughts of other men; Wisdom in minds attentive to their own. Knowledge, a rude and unprofitable mass, the mere materials with which Wisdom builds, till smooth and squared and fitted into place, does but encumber what it seems to enrich. Knowledge is proud that he has learned so much, Wisdom is humble that he has learned no more."

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A PASSING COMMENT.

"Look here!" said an official on the Philadelphia and Reading R. R. to us lately, "you stated in the last paper that a new locomotive of Strong's design had taken 14 cars up a grade of 50 feet, at the rate of 20 miles an hour!"

"Yes, we said that."

"Well, you want to understand that we have Baldwin engines on this road, 17″ × 22″, that I guarantee will take 18 cars up a 50 foot grade at thirty miles an hour. I don't consider that an engine 18″ × 24″ does any great things hauling 14 cars up a 50 foot grade at 20 miles an hour."

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A Voice From Kansas: "Of course I must have The Mechanical Engineer. I have been taking it over a year, have had better success with my work, and better satisfaction all round."

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed wilt be made with pleasure. It is specially requested that alt figures be made very plain and all proper names clearly written.

THE BOILERS OF THE LOUISIANA.

Editors Mechanical Engineer:

Referring to an article in your journal of September 6th, relating to the boilers in the steamship "*Louisiana*," of the Cromwell line, which states: "The shells are 8 ft. 6 ins. diam., the boilers are each 12 ft. 2 ins. long, from head to head, and ⅝ inches thickness," is there not some mistake? Those boilers are registered in the office of the U. S. Local Steamboat Inspectors as only $\frac{49}{100}$ of an inch in thickness from actual measurement. This thickness limits their pressure to 72 pounds of steam when new.

The great objection to this kind of boiler is evidently appreciated by Mr. Coryell when he says, "As they contain but a limited quantity of water relative to their evaporative power, everything depends upon the perfect filtering arrangement for the feed water in use in connection with them," evidently pointing to the difficulties experienced with most marine boilers carrying high steam from the constant lodgment of the residuum of the cylinder lubricant on the crown sheet of the furnaces, frequently causing them to bulge or come down. This difficulty would be likely to appear in the boilers of the "*Louisiana*" type, should they be used under any other conditions than those especially referred to by Mr. Coryell, viz.: a voyage seldom exceeding five days duration, with engines requiring the minimum amount of oil or tallow in the cylinders, and under a pressure not exceeding 72 pounds. The oil from the engines on entering this class of boiler tends to settle in the concave space of the crown sheets immediately over the greatest heat of the furnace, causing earlier and more serious results even than are likely to occur in boilers having internal furnaces, in which such deposits usually tend to the bottom of the shell away from the fire.

Contracting the draft area by "wing bridge walls" concentrates the heat on the rear seams of the tube sheet and shell, thus attacking the boiler in the most vulnerable point of its construction, where the iron is over an inch thick, necessitating repairs of the tube sheets as well as the shell, which repairs are both costly and difficult. The injurious effect of such high heat on the other thick seams of the boiler is also calculated to give trouble, but probably not so quickly as at the point previously referred to.

The steadiness of water level is certainly not to be wondered at, since the duty performed is very moderate. It is admitted that the evaporative work done by the eight boilers can be accomplished by six without difficulty, and whatever amount of water there may be entrained by the steam is easily and well taken care of in the immense superheater over the uptakes through which the steam has to pass on its way to the engine.

New York. Observer.

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MATHEMATICALLY BLIND.

Editors Mechanical Engineer:

Relying upon your good faith not to give any clue to the writer of this, I am one who finds that the mathematical faculty has been left out of his composition. I will be frank enough to say that this lack puzzled and pained me for a long time, and it was only after years of trial that I have come to the conclusion that there is something lacking in my mental constitution, which all the study in the world will not atone for. At the risk of being tiresome, I will explain how I am affected by figures, or any mathematical calculation whatever; even the simplest sum in addition bothers me, while decimal fractions are a perfect riddle. So soon as I undertake figures I am unable to concentrate my attention upon them. I wander off in my mind to everything else; something like this:

Two and two are four ("*I wonder how that rig willl work!*") three and three are six (*seems to me*) six (*that link is too short, and the angle it makes is too great at full stroke*), three and three are six, and two to carry make eight, how is that? let me see; then of course I go all over it again and probably make an entirely different result. This will suffice for an example.

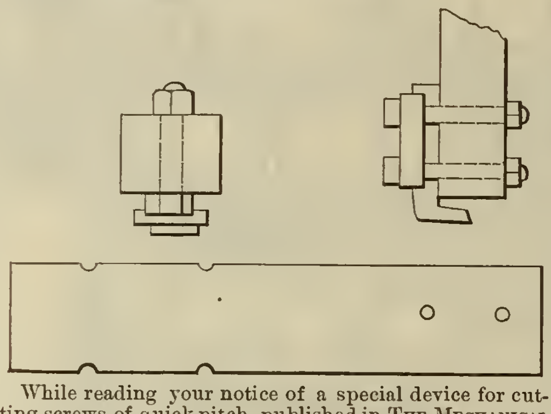
I have had opportunities to learn mathematics and have studied the subject under competent teachers. I went as far as quadratic equations, and while tutored did well enough, but at this day and time I could not tell the meaning of a single character. As to other faculties, I will only say that I am at the head of the management of a large concern where a very great number of men are employed, and I am led to believe that my services are not unsatisfactory, for the reason that, starting from nothing some years since, I have succeeded in building up the business, and own a good part of it myself. I have met with others similarly afflicted, and I use this word in its legitimate sense, for I consider it an affliction to be so constituted. I am keenly alive to the beauties and truths of mathematics, but it is to me a sealed subject. I cannot undertake it, for I never get the same result twice. I should be obliged if Mr. Bilgram, or any other person, would volunteer his advice on this matter. I do not see why a person may not be mathematically blind as well as color blind.

[In accordance with a wish of the writer of the above, we have re-written his letter in our own language, vouching only for the fact that the communication is true as to the statements, to the best of our knowledge.—Eds.]

TOOL-HOLDER. DEVICE FOR CUTTING WORMS.

Editors Mechanical Engineer:

We had some bed-plates to plane. The pillow-block was a foot higher than the face of the bed-plate, necessitating the use of a long tool to reach down to the bed-plate. While planing the first one I got tired of hearing the tool chatter, so I took a piece of 4″ square iron 32″ long, faced two sides of it, and cut four grooves in it near one end, so it would go between the studs in the tool-holder on the planer. Then I drilled 1$\frac{1}{16}$″ hole 2″ from the other end and another hole same size 4″ from that. I then took a piece of iron 4″ wide, ¼″ thick, 8″ long, and planed a groove in it lengthwise 3½″×¼″, and drilled holes to match those in the bar. Two 1″ bolts, with large flat heads, completed the job. We used two tools, 1″×1¾″ steel, and on the second bed-plate saved 25 feet in time over the first one. We also discovered that we had a tool-holder which allowed the tool to work up close to a wall, front or back, as per sketch.



While reading your notice of a special device for cutting screws of quick pitch, published in The Mechanical Engineer of Sept. 6th, I was reminded of a badly abused worm and wheel brought to the shop for repairs. There was no gearing on either of the lathes to cut the right pitch on the worm, and no way to make it at that time, except to make patterns and cast it. Time was too precious to do this. Fortunately, in this case the teeth of the worm-wheel did not go to the bottom of it by ⅜″ all around. A blank was bored and key-seated same as the old worm, then both blank and old worm were put on the same mandril 6″ apart. After being keyed fast on the mandril all were put in a lathe which had a stout oak block fastened to the rest; on the block were bolted fast four pieces of iron; one end of each had been fitted neatly to bottom of the thread or worm where it was not worn. When the lathe was started the old worm drew the rest along just as a lead-screw would. The pitch was right, and resulted in a good worm. A worm-wheel blank was turned up, and after being spaced with a pair of dividers it was bolted on a bevel washer on the tool-post of a lathe; the teeth were cut with a double-end cutter, in a bar nearly as long as the bottom of thread on worm. Repairs.

New Castle, Pa.

◆

GOVERNOR VIBRATIONS.

Editors Mechanical Engineer:

I have had charge of engines for several years, yet so small a thing as a half-inch screw puzzled me for two or three weeks. As I am always willing and ready to learn, I wrote to the builder of the engine and other parties. The builder's answer was, that the governor did not work free: it must be tight somewhere; but I was so sure that the governor was free in the joints that I could not see it that way. I thought it was owing to the fly-wheel being too light, and made preparations for a new one. As it happened, a belt broke in the mill, and while they were fixing it I got to fingering about the screws on the governor, and found one a little tight, and took it out and made it work free. From that time the trouble stopped, and the engine runs steady, smooth and noiseless.

"So small a thing as a half-inch screw
May worry a man most in two."

Abilene, Kan. A Reader.

◆

THAT NEW LOCOMOTIVE.

Editors Mechanical Engineer:

I see you have copied an article from the *Railroad Gazette*, and have thus given currency to a misstatement.

The Loco. designed by Mr. Geo. S. Strong, of Phila., Pa., is fitted with Joy's patent valve gear, and gridiron valves designed by Mr. Strong; these are placed on the ends of the cylinders, so as to secure short ports; no longer, in fact, than the metal of cylinder-heads.

The valve-stems are vertical, and connect by means of bell-cranks with the Joy motion, which actuates them.

The article in question did not originate with the *Railroad Gazette*, but was copied, with slight alterations, from the *National Car Builder*. Walter W. Scott.

New York.

◆

A QUERY.

Editors Mechanical Engineer:

We have two engines working on one shaft, making 65 revolutions per minute, with seventy pounds pressure, cutting off at quarter stroke. One engine has a condenser attached, and has the advantage of 26″ vacuum. Does one engine exert more power than the other? If so, why, and how much more power?

Fall River, Mass. A. B.

[The condensing engine exerts the most power by 15 to 25 per cent., through the aid afforded by the condenser. We cannot say exactly how much more, without cards from both engines, accompanied with dimensions. Full data should always be sent with inquiries.—Eds.]

◆

We Have Sold many volumes of "*Kinematics*," by Professor McCord, and all speak highly of the work. It is advertised in our book list.

Messrs. G. A. Grover and E. E. Worden, of Boston, Mass., have patented a simple device for locking elevators, so that they cannot be started without the consent of the operator, which is not the case at present. It also prevents accidents from imperfect slipping of belts on the driving gear or partly closed valves on hydraulic elevators.

Persons interested can obtain information by addressing G. A. Grover, 42 Bennington street, Boston, Mass.

◆

The *Gaulois* (French paper) pays compensation to any purchaser of a single copy, or his heirs, should he be injured or killed on the day on which the paper is bought.

Must be some "strike 'em dead" articles in it.

◆

A New Industry practiced in Washington, D. C., is that of stealing charts from the Navy Department and selling them as waste paper.

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A STEAM BELL.

The secondary railways in rural districts in Austria having no gates at the level crossings, or guards at such points, special precautions are required to avoid accidents, and the public has to be warned of the approach of the train from a sufficient distance. This is done by ringing bells preferably to sounding whistles, as these are more likely to startle horses. The steam bell shown has been adopted for this purpose, and is a simple contrivance. It consists of a chamber *a* with a seat for a flap valve *d* to which the hammer *e* is fixed. Steam is admitted through a small pipe *b* at the bottom, and after a certain interval attains sufficient pressure to lift the valve. The valve opening being large compared with the pipe *b*, steam escapes more rapidly than it arrives through the small pipe; the pressure falls and the valve drops, causing the hammer to strike the bell surrounding the cylinder. The valve is provided with an internal collar as shown, so that it has to rise the width of this before the steam is let out, and thus determines the swing of the clapper and the force of the blow. To intensify the latter and multiply the number of blows, the clapper spring is prolonged over the fulcrum and bent back so as to form a spring, which is tightened by the lifting of the flap, and sends the clapper down on the bell with increased force. The bell is fixed upon the roof of the cab by bolts. The diameter of the steam pipe is from ¼ to ½ inch, according to the size of the bell, and the distance of the clapper from the bell is a little less than the diameter of the corresponding cock. The steam pipe is made with a bend to allow for contraction and expansion. The number of blows given varies according to the steam pressure, and the opening of the steam cock.

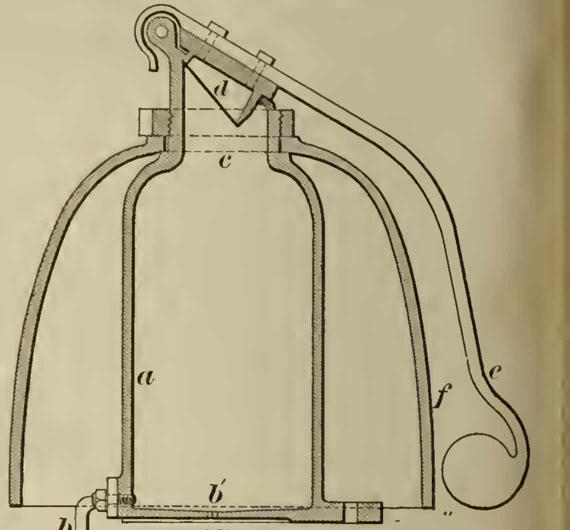

Fig. 1

With	90	lb.	pressure,	and cock	½	open,	170	blows per min.
	"	"	"	"	⅓	"	136	"
	105	"	"	"	½	"	240	"
	"	"	"	"	⅓	"	156	"
	"	"	"	"	⅕	"	136	"
	120	"	"	"	⅓	"	228	"
	135	"	"	"	⅕	"	200	"

To start the bell, the cock is opened full, and afterwards partly closed. The blows follow in such rapid succession that a kind of uniform sound with louder intervals is produced, but not of the same shrill character as by a steam whistle. —*Mechanical World.*

An English Contemporary refers to the following incidents as showing a demand for a better class of attendants on steam boilers:

"An attendant was laying off one of a range of boilers for cleaning, and after the boiler was emptied he went on the top of the boilers to take off the manhole cover, but mistaking the boiler, slackened the bolts of an adjacent boiler under steam. He was hurled with the manhole cover some 50 or 60 yards away, but miraculously escaped any serious injury. When our informant saw him with his head bandaged up a few days afterwards, his father, who was in charge of the boilers during his son's temporary absence, was advising him when he next had a boiler to lay off to make a chalk mark at the front end of the boiler, and when he went on the top to find this chalk mark before beginning to take off any manhole cover. Recklessness and ignorance on the part of attendants are together responsible for more serious accidents, probably, than any other cause."

It is impossible to conceive the stupidity of a man who could "mistake" a boiler under steam for one out of use.

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If You Make an appointment keep it to the minute. In this city dentists and professional men give appointments for certain hours, that time is sold, and the buyer has to pay for it whether he keeps the appointment or not.

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HOW ENGLISH YOUTHS BECOME MACHINISTS AND ENGINEERS.

As most of our readers are aware, the apprentice system, so called, in England, consists in paying to learn the trade, instead of being paid while learning it. The parents of the apprentice are obliged to pay proprietors of works a certain specified sum, after which the proceedings are as stated herein. The letter quoted is from a writer in the *London Engineer*.

"Let us suppose that the pupil is articled to Messrs. A. B. How and what is he to be taught?

Nearly all the work is piecework, and no one has time to take the pupil and teach him for teaching's sake. Suppose the work is erecting portable engines. The price paid for erecting an 8 horse-power engine is 25s. or 30s. It varies with locality, and from time to time. Two men are employed on the job, an upper hand who draws the pay (say $7.50) and pays an under hand, or second man, who gets from 7s. to 8s. for his share of the work. In very many instances he is only a superior sort of laborer. Now the practice is to hand the new pupil over to the erector, who pays him nothing at all. It is this man's interest to make the pupil useful as soon as possible, because the erector can get on fast, and earn more money.

After a time the pupil goes, we will say, to a planer or a lathe for instruction. Here he is almost certain to be wholly indebted to hints from a foreman and to keeping his own eyes open to the operations going on all round him. Finally, he pushes his way to the drawing-office. What is he supposed to learn here? Certainly not how to draw. The use of set square and bow pen ought to have been acquired long before. In the drawing-office he ought to learn how to design, and this he can do if he keeps his eyes open and considers what the use of everything he is put to draw is.

At the end of his pupilage he has learnt something more or less, but no one fancies that an engineer can be made out of a boy in three or four years. What is a youth of twenty-one or twenty-two but a boy? He cannot possibly have much experience or much skill. It is, I submit, of little use to teach boys how to estimate or get out prices. As a rule, boys have the most inadequate ideas connected with money. I may, however, push the argument further, and say that very few competent engineers are good commercial men as well. In almost all cases there is one partner, who is not an engineer, in every firm, and he does the estimating on a basis of figures supplied him by the engineer partners. It will be admitted that four years is short enough to supply a previously ignorant youth of seventeen with a fair smattering of practical engineering knowledge; but parents kick against a pupilage even as long as this, and insist that three years is enough. Now I defy any boy to learn how to estimate and buy and sell well in three years, if he did nothing else.

The fact is that there are at present a very large number of very young gentlemen walking about who call themselves engineers, because they have spent three years in a Works. My own experience of pupils is that they can learn all that they can take in, in the time, if they choose. Does anyone suppose for a moment that a tiptop latheman can be turned out in three years? Who ever heard of a smith being a finished artisan after three years' training? The proper time of apprenticeship is seven years, but the whole spirit of the age is against this."

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BOOK NOTICES.

Photography for Amateurs. A Non-technical Manual for the use of all. By T. C. Hepworth, Lecturer to the late Royal Polytechnic Institute. Cassel & Co., Limited, New York.

In his preface the author says that his object has been to provide a practical guide for the use of many amateur workers who, since the introduction of dry gelatine plates, have taken up the art as a pleasant occupation for their leisure; he goes on to state that the multitude believe photography to be an art which bristles with difficulty, and requires more or less knowledge of chemistry to be successful with it. Proceeding, the author dissipates these ideas, and shows—by the instructive pages of his work—that photography is quite within the reach of any intelligent person. Details are given in plain words, of every process, from the development of the latent image to varnishing the print.

This little volume will be of great service to manufacturers who take views of their machinery in place. When it is known how easily this can be done, and with scarcely more trouble and fuss than blue prints require, we fancy it will be more universally practiced. We look forward to the time when every machine shop which makes machines for market will have its photographic department as an important part of the establishment.

Modern Low Cost Houses. Published by the Co-operative Building Plan Association, 24 Beekman St., N. Y.

We are glad to receive a work of this character, for, so far as we are judges, it is a much needed one to our connection, and in fact to all persons who intend to build. The work in question is a compendious one, embracing all styles of dwellings at very moderate prices indeed; from a $400 cottage to a $6,000 Queen Anne villa. The designs are tasteful, even in the low-priced cottages. These are not mere boxes or barns, but comfortable dwelling houses, far more ornate in appearance than one would suppose, for the price; indeed, we are surprised to learn that any sort of a modern dwelling can be built and painted for so small a sum as $400. The rooms in such houses are small, it is true, but so is the price, and longer purses will find larger houses in the work under notice. Specifications and plans accompany the designs, as well as many useful hints to those intending to build. For the specifications various sums are required, from $12 upward, but these may or may not be needed. The price of this book is 50 cents, and it can be had by remitting to the above address.

We acknowledge the receipt of *The Health Miscellany*, from Fowler & Wells; *Report of the Board of Public Works*, Chicago, from Hon. D. C. Cregier; *Inaugural Address of the Director of the Chicago Manual Training School*, and *Properties of the Rotating Parts of Machinery*, from the Defiance (Ohio) Mach. Works.

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TO PREVENT PRIMING IN STEAM BOILERS.

An apparatus for injecting petroleum into steam boilers is thus described in a foreign paper:

The apparatus consists of a closed galvanized iron cylindrical tank, which varies in size according to the engine power. A tank containing about thirteen gallons is suitable for boilers of from 50 to 150 horse-power. It is placed in the engine room in any convenient position near the feed pump of the boiler. It is filled with petroleum by means of a pipe which leads to the bottom of the tank, and is closed by a screwed cap. A small hole is made through the cap and the pipe in order to allow the air to enter and to follow up the petroleum as it is used. There is also an air-hole on the tank, closed by a screwed cap, which is removed while the tank is being filled, the aperture allowing the escape of the air from the tank. The petroleum is supplied to the boiler through a pipe reaching nearly to the bottom of the tank, up which it flows to an outlet pipe, which is in connection with a regulator. This regulator is attached to the valve box of the feed pump, donkey pump, injector, or other appliance by means of which the boiler is supplied with water. The regulator is so fitted that the petroleum enters at a point between the suction and delivery valves of the feed pump.

On turning on the cock of the regulator, and starting the feed pump, the petroleum is drawn from the tank, and mingles with the feed water and is forced into the boiler. The regulator is fitted with a ball valve, which closes the passage to the tank, against pressure from the feed pump when the regulator is opened and the pump started, which valve lifts at each stroke of the feed pump, and allows the petroleum to flow to it. The petroleum thus applied so acts on the water and steam as to entirely prevent priming, to prevent incrustation in new boilers, and to remove it in old ones. Moreover, as petroleum lubricates the steam, the interior parts of the engine are kept clean and lubricated. The quantity of petroleum required to be applied varies considerably. As an example, it may be stated that the consumption in one steamer, on board of which the apparatus was fitted, is at the rate of one pint per run of twelve hours, administered in two doses six hours apart. The boiler in this case is of about 50 horse-power nominal; for larger boilers a larger quantity of petroleum is required.

For curing incrustation in stationary boilers, the quantity used at first is about one pint for every 100 cubic feet of water evaporated. This quantity is afterwards reduced according to circumstances.

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AN ACHIEVEMENT IN TRADE CATALOGUES WORTH SPECIAL MENTION.

Messrs. Manning, Maxwell & Moore, of 111–113 Liberty street, have sent us their new catalogue. It is about the size of an old-fashioned family bible, and contains in its pages nearly every tool known to modern machinists. It embraces engines and other machines as well, and is, in short, a complete exposition of the mechanic arts as regards facilities and appliances. There are, also, several pages devoted to useful information of a technical nature. The work is folio size, 660 pages, and is printed on paper made especially for the purpose, handsomely and substantially bound in roan cloth. It has been in preparation for some years, and the labor has been well bestowed.

A work of this size requires to be carefully compiled, otherwise it would be impossible to find anything in it. Accordingly, the contents have been thoroughly indexed, and any class of goods, of any special make, can be referred to on sight. All tools of a class are in one place; planer, for example, or chucks, and these are paged in the order of their sizes, from the smallest down. The prices are affixed; any change in them is printed on a separate sheet, which is forwarded promptly to holders of the catalogue for insertion. As each book is numbered, and the name of party to whom it is sent is recorded, they are readily traced. The catalogues are sent to Master Mechanics, Railway Superintendents, Purchasing Agents and Machine Shops all over the United States, also in Europe and in civilized countries generally. All charges are prepaid and the work itself is gratuitous, from which facts it is easy to see that the cost has been very many thousands of dollars; a small fortune in fact. All of this has been borne by the firm solely, no person outside of it having been permitted to share the expense.

The first week Messrs. Manning, Maxwell & Moore shipped over seven tons of their work, and will keep up the delivery until their labors are completed.

The catalogue is one of the handsomest we have ever seen, and, aside from the commercial aspect, has value as a work of reference. Persons of an inventive turn of mind will be surprised to see how many of their conceptions are already on sale.

THE
Mechanical Engineer,
FORTNIGHTLY.
EGBERT P. WATSON & SON,
Editors and Proprietors.
150 Nassau Street, New York.

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Friends are requested to note that some of the above News Companies keep THE MECHANICAL ENGINEER only for regular customers, and that it is difficult, therefore, to procure transient copies. All persons will confer a favor, by endeavoring to induce Newsdealers and Periodical sellers everywhere, to add THE MECHANICAL ENGINEER to their regular Lists. Unsold copies are always returnable if in good order.

☞The circulation of THE MECHANICAL ENGINEER is absolutely and wholly a paid one.

No credits are given, and no gratuitous copies are sent out except as samples, and a few, complimentary, to personal friends.

☞Papers will be discontinued at the expiration of the time contracted for, with due notice of same by postal card.

Entered at the New York Post Office as Second-Class Matter.

We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

EXAMINING ENGINEERS AS TO THEIR ABILITY.

From time to time, we receive inquiries from our friends as to where certain set rules and formulæ for the examination of engineers can be had. Persons who wish to obtain certificates suppose that a rigid cross-examination into their abilities will be instituted, and naturally they wish to be prepared for the worst. This matter of examination is very much exaggerated, as to its main features. In itself it is not to be feared, for the questions asked are only such as any well-informed man should be capable of answering without difficulty. What is to be feared, however, is that personal considerations, or prejudice, may have some influence in preventing really capable men from obtaining positions. Inspectors, as a rule, are too lenient, rather than too exacting, and in some instances not so discriminating as they should be.

While we hold that all men should be examined as to their fitness to be in charge of steam machinery, we do not think that questions should be asked which are manifestly above the level of the situation. Engineers are not learned men, and are not expected to be. As a rule they have raised themselves from the ranks, and their opportunities for obtaining an education of a high class have been limited. Obviously there is no reason, or sense, in framing beforehand a series of test questions which, if a candidate could answer, would entitle him to enter a technical school as a pupil. Neither should questions be purposely confusing, or involved, as to their construction. Many men who know their duties well enough, would be put out of countenance by a long-winded question which seemed formidable, but was, after all, a very simple matter.

What sort of an examination should an engineer pass? Our idea of it is something like this: First of all, the candidate should be questioned as to his sense of responsibility; as to his consciousness of the power he holds in check and of which he is the sole controller. If he does realize this it is a great point in his favor. An engineer is in charge of steam boilers daily; he sees the exhaust passing quietly away, and comes to feel that steam is a harmless kind of an agent, after all; not reflecting, possibly, that right by the side of him there are, literally, thousands of tons of latent force pent up in an iron vessel which is none too strong for its duty. We therefore say again, that it is of the utmost importance that an engineer should be morally conscious of the power in his charge.

For the rest, the matter is simple enough. A candidate should certainly know the first four rules of arithmetic, and as much more as he chooses to acquire. He cannot get along with less than the rudiments. The areas of safety valves, and how to load them for a given pressure, should also be one of the questions asked, for this bears directly upon fitness for the place. Questions as to practice enter into the examination. Ask the candidate how he would set a common slide valve, how he would take up lost motion, what he would do in case an engine pounded badly, what care bearings need, and what he would do if they heated badly. Let him tell what modern methods of construction are, how pistons are made generally, what the advantages and disadvantages of lead are, what troubles governors are liable to, and what he would do in certain specified cases. Questions as to injectors and feed pumps are also in order, how they are constructed and operated, and how many different kinds he has seen. A candidate ought to know the strength of his boiler, and how to arrive at it, as regards the shell at least; he should also be examined as to his knowledge of bracing and what its object is. He should be questioned as to what the tensile strength of good merchant iron is, per square inch, and he should tell how he would fire a steam boiler, and explain the difference between a good and bad fire, and poor coal or good coal. Different forms of boilers should be discussed, and the virtues of them explained; scale and its attendant evils should be considered, as also the best means of getting rid of it, and the nature and office of the vacuum in non-condensing engines.

Now this seems a long and formidable catechism to put a candidate through, but if read without reference to length it will be seen that there is not one question which should not be within the reach, or the comprehension, of any man of ordinary ability and experience. They relate directly and positively to his fitness for his place. Some of them are not essential where a man is only in a subordinate position, but whatever the place there are no questions in the list which would injure a man to acquire.

As to what an engineer should not be asked, a word is not amiss. Catch questions, or those which are trivial, and merely intended to confuse and embarrass, are certainly out of place. As tests of ability they are useless; as mechanical or professional jokes they are out of place. Asking a man already embarrassed by the consciousness that he is under fire—what he would do in case the man-hole plate fell in with 60 lbs. steam on the boiler, may be funny to the examiner, but it is not so to the candidate. Elaborate questions on indicator cards, as to isothermal curves, adiabatic curves, units of heat lost, etc., etc., are wholly out of place. A candidate should be capable of reading an indicator card on sight, and some containing palpable defects should be handed him for explanation, but the average man should not be questioned upon subjects which, perhaps, the inspector himself knows only by name, and of which the mass of men know nothing whatever.

Another word, as to the manner of the examination. A candidate who presents himself has a right to civil and courteous treatment. Inspectors owe it to themselves and their position to treat every one as they would like to be treated themselves in a similar position. A candidate is not on trial for any offense; even if he were he should not be bullied, and he is ill at ease, or nervous from a consciousness that he may make a mistake which will be charged against him. The candidate should be encouraged, and an effort should be made to set him wholly at ease, so he can show himself at his best. Under encouragement he probably will.

A BUSINESS NOTICE.

Subscribers through newsdealers, who may have had trouble in getting all our issues, are requested to make known their wants to us. We can supply back numbers, excepting No. 2, Vol. 7.

Many persons have written that they would be glad to take THE MECHANICAL ENGINEER if they could find it on news-stands all over the country, but that local newsdealers assert they cannot get it from their supply agents. This is not true. THE MECHANICAL ENGINEER can be had at every local agency of the American News Company; any statements to the contrary on the part of local newsdealers are incorrect. The American News Company has persistently, and with great patience, investigated every complaint we have forwarded them. Recently a friend in North Amherst, Ohio, stated that his news agent had tried to obtain THE MECHANICAL ENGINEER in Cleveland, but reported it as not to be had in that city. This letter was sent to the American News Company, with the following result:

> NEW YORK, Sept. 18, 1884.
>
> MESSRS. EGBERT P. WATSON & SON.
>
> GENTLEMEN: Yours of the 17th, with enclosure, came duly to hand. We will send some additional copies of the next issue to our Cleveland branch, and request the manager to notify the trade that they can procure as many copies as they desire. It will be well, I think, to send some show-cards for distribution in that city.
>
> Respectfully yours,
> PATRICK FARRELLY, *Manager.*

Many newsdealers do not care to bother themselves to obtain one copy of a paper, and where they have only a single application they simply misstate facts to save themselves trouble. At all the agencies named in the list on the editorial page THE MECHANICAL ENGINEER should be on sale, regularly, for the list was furnished us by the American News Company itself. Where a local news agent will not procure a single copy we can send the paper for three months at a cost of 50c. in advance, each quarter, to those who wish to make such an arrangement.

Our friends can very greatly aid us in extending our circulation, if they will insist upon the local news agent procuring THE MECHANICAL ENGINEER for them.

Some have written us, saying that their papers did not come regularly. As to this we can only say that we have never missed one publication day. This occurs on alternate Saturdays, and we have yet to lose the mail. THE MECHANICAL ENGINEER is in transit to all by 12 M., fortnightly; further than this we are powerless.

We are always glad to replace any missing numbers, and to receive advices of irregularity, which we will endeavor to correct as far as possible. We recognize the serious importance to our interests of having every single issue go straight, and will spare no pains to that end.

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GOOD TIME TO PUSH TRADE.

Nothing is better settled than the fact that publicity is the life of business. A man may be as energetic as he will in his immediate orbit, but his doings and his gains will be confined to small things. These will grow smaller still, unless he reaches out to other sources for business. As a rule, men recognize these facts, but some feel that in dull times, like the present, for instance, that they must retire for a season until a general demand arises for merchandise. To our mind this is a mistake. Abandoning the field leaves more room for others, who do not fail to see their advantage, and who are also the first to reap the reward when business revives.

Realizing this as a cardinal point in trade, we have, during this dullest of dull summers, spent more money and pushed our trade more persistently than ever before, and the results have been quite what we anticipated. The Mechanical Engineer bears witness that it is rapidly appreciating in value, and we think this due to the sound business principles upon which it is conducted. We are manufacturers of a newspaper. We buy and sell in open market, just as a steam engine builder or a ship builder does, and—always referring to our own experience—we find that enterprise and publicity pays. Without publicity any business suffers, no matter what its nature, for the simple reason that the multitude refer to what is before their eyes, and, as a rule, have short memories. Of all other times, a dull period in trade is the one in which to catch the attention of the people at large.

◆

INDICATORS FOR STEAM USERS.

If steam users in general were aware how easily the indicator could be read by them, as regards its revelations, we think a great many such instruments would be sold directly.

The indicator is practically a check on the coal pile, and, when properly used, is a reliable one. An idea of those who have ever heard of an indicator, and know something about its uses, is that it is a deeply mysterious and highly scientific instrument, only to be used by professors; but there never was a greater mistake. After a little information, which any business man can readily acquire from works on the subject, the steam user can tell just what is being done in his engine room, and as readily as he can tell time by his watch. When he once learns the characteristics of a correct card, and that every engine, of whatever description, should make such and such lines, he can save money by the purchase of an indicator, provided his engineer has not one already.

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READ IT.

We hope those who feel that the end of all things is at hand will read the article elsewhere, entitled "*The Country's Prosperity*," by Rufus Hatch, a well-known broker of this city. The article is a succinct and clear exhibit of the status as regards business interests everywhere. Being a record of facts, and not personal opinion, it should give weak brethren heart of grace to wait a little longer, before donning sackcloth and ashes.

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ENGINES OF THE ALBANY, SS.

At an early date we shall publish engravings of the engines of the new lake steamer *Albany*. This vessel is the latest built of steel, and has many features wich will interest our readers. Indicator diagrams will accompany the engravings. We are indebted to Mr. Frank E. Kirby, the designer of the vessel and engines, for the opportunity.

◆

Among The Twelve Hundred Laws regulating the press and printing offices which have been issued in France since Francis I.'s time, there is one threatening the proof-reader with the penalty of death if he leave but *one* blunder!

It is lucky that law does not apply in this country—for some papers.

OVERHAULING AN ENGINE.

Number 4.

In our last conversation upon this subject you spoke briefly upon lining up the parts so that they all would be true, relative to one another. Tell us in detail how you would square the crank with the guides.

I would begin by putting a brace in the back end of the cylinder. I would have only a single brace, not a cross, so that I could get my hand in each side to center the line easily. I would bore a hole ¼th of an inch diameter in the brace and run the line through it. This hole, so much larger than the line, would give me a chance to accurately center the line, and would avoid any possibility of the line binding in the hole, as it might if the hole was not exactly straight through. I would center the line by the bore of the cylinder, not by the counterbore, and carry the line clear to the end of the bedplate. I would keep the line as short as I could. Suppose, now, that I have previously lined up the main bearings and had the shaft in place, I would turn the crank on both centers alternately, bringing it up to the line, and adjust it so that the center of the crank-pin journal came on the line. I would then drop a plumb line so as to just touch the cylinder line, take up the latter and try the crank up and down on the half centers.

Suppose you had to raise or lower the outboard end to bring the crank-pin square with the line, would that not throw the shaft out fore and aft?

No, sir, it wouldn't if I carried the shaft bodily up or down. Your question is only a catch. I know the shaft-blocks are right horizontally, for I leveled them by the line before the shaft was put in. Now, if I raise or lower them to bring the pin right, I throw the bearings out horizontally. That won't do. The shaft will bear then only on the corners or outsides of the boxes, and the fly-wheel will be turned into a bevel wheel, or, rather, it will stand at a greater or less angle.

What is to be done if the pin does not stand square with the vertical line?

If it is out one way or the other that shows that the crank or the pin, possibly both, does not stand square with the shaft, and it is not a nice thing to encounter. Unless the error was great, say one-sixteenth of an inch in the length of the pin, I would not attempt to alter it. If I had to do it I should drive the old pin out and turn a new one with the shank eccentric to the crank-pin journal; that is the only way I know of to remedy it. These things occur but seldom in well-constructed engines. I would not alter a crank-pin that was only one thirty-second of an inch out of truth in 6 inches.

What other detail would you examine?

I would give the governor close inspection. If the engine is otherwise in good order I would charge it with any unsteady motion in the engine. According to my notion, this is the part that is seldom made as it should be. The joints are either too tight or too slack. Every part should work easily, yet without any slack motion. I have always had in mind an ideal governor, the pins of which worked on centers like those in a lathe. As governors are now made, in many cases the very motion tends to bind them. The jointed arms have long bearings, and the pins fit tight in them. When such an apparatus is revolved at a high speed the side strain tends to throw the faces of the joints hard against each other, and thus make the whole thing work stiffly; although when the governor is not at work the parts move easily enough. There is such a thing as having too good a fit at times. I had a governor once which bothered me in just the way I have mentioned. After I had taken it down and rounded the faces of the joints so that they merely bore but did not bind, the engine ran perfectly. Sometimes the joints of a governor work properly when the pins are in one certain position. In running, these pins gradually revolve or work round and stick. That is because the pins are not true. All joints under motion, where pins go through them, need careful attention.

How about the pump?

If you mean the old-fashioned plunger pump, I don't know where there are any in use; at present injectors, or independent pumps are used almost wholly. These latter have rubber valves mostly, and require no attention, except to see that they are not worn out or stuck fast by the springs. These latter get cocked sometimes, and hold the valve askew. Injectors cease to work from a variety of causes, the chief one being dirty passages or limed-up nozzles. I would take particular pains to have all joints, whether steam or water, tight; all the stuffing-boxes the same; and, with an engine properly adjusted as I have described, I should be very much surprised if any sound came from it.

You would probably set the valves before you started the engine?

Yes, and I would rectify them by the indicator. That would tell me at once whether I had done my work properly or not.

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SOMETHING ABOUT METALLURGY.—Number IV.

By Norman W. Wheeler.

The now obsolete "stuckofen" was an enlargement of the bloomery fire, and the modern blast furnace was developed from it.

The "stuckofen" was usually built of stone with firestone lining, and had the internal form of two truncated cones joined together at their bases, the small end of one cone terminating upon a flat hearth, and the small end of the other forming the top, or throat, through which the fuel and ore, in alternate charges, were introduced, and where the gas escaped.

At one side, a few inches above the hearth, there was a tuyere connected with a blowing-machine, often consisting of leather bellows, worked by water in some cases, but as often by animal power, and sometimes even by men and women. Opposite the tuyere a portion of the wall was omitted, and the opening closed by a temporary wall, which had to be taken down for the removal of the iron lump when formed. The fuel was always charcoal, and the ores needed to be as free from earthy impurities as possible.

It is plain that when this furnace was "blown in" the same conditions for ore reduction were present as in the bloomery fire, but the height of the column of burning fuel mixed with ore was much greater, a common height being 15 ft. But there was no means of manipulating the product while it was forming, because the lower part of the furnace was closed up, and the fire was too deep to allow reaching the lump from above. The fuel and ore were put in at the top, in alternate charges, and as the fuel burned away the column sank down; and because the top of the fuel was, for the most part, below the top of the furnace, air could not mix with the escaping gases directly upon the surface, so that the preheating of the ore when first charged could not be had in this furnace, as in the bloomery fire, but, generally, the same action of the reducing gases upon the ore occurred in the "stuckofen" as in the bloomery fire. This for the reason that the column of materials was higher and the ore exposed to contact with reducing gases for longer times, the ore did not need to be broken so small. When the reduced iron came down so far as the tuyere, it was exposed to oxidation, by reason of the great heat in that zone of CO_2 combustion, and the excess of free O, while that part below the tuyere was exposed to carburization by reason of the great heat and the presence of CO gas. The carburization of iron changes it to steel, or cast iron, and is brought about by exposing iron sponge or bars at a red or a yellow heat to CO gas. In fact, the position of the tuyere was frequently changed during the growth of a lump upon the hearth, and the blast directed so far above the lump as to make the oxidizing and carburizing zones neutralize the action of each other, and the slag was drawn off from time to time.

When the lump was thought large enough, iron bars were thrust through from wall to wall, above the lump, to hold up the materials, the temporary breast wall knocked away, and the lump dragged out.

This lump was less homogeneous than one from the bloomery fire, and really consisted of a mixture of iron, steel and cast iron, in veins, sometimes so well defined that lumps of steel were cut from the lump before it went to the hammer.

Such furnaces, whether large or small, were very wasteful in the matter of fuel, inasmuch as nearly the whole of the C escaped as CO, and burned to CO_2 in the open air, where it could do no good; and as the earthy materials were fluxed by iron, they were wasteful of ore.

THE PROFESSOR IN THE MACHINE SHOP.

Number 65.

Miles came into the office last week, just as Jacob and I were going home, and said: "Gentlemen, I wish to inform you that my time is out."

"Is that so?" we both exclaimed, and both with one accord reaching out a hand, "is that so, Miles?" "Well, I congratulate you," said Jacob. "And so do I," said the writer, and we shook the now thoroughly embarrassed Miles so heartily by the hand that he looked as though he had a "chill."

"Miles, you have done well," said I. "You have attended to your business, and I hope you will succeed in whatever you undertake. If good wishes are of any avail, I am sure you have ours. What are you going to do, now that you are your own master?"

Miles hesitated; he never was a very fluent speaker, and he thought a moment before he spoke, and then said:

"I think I will go and see how work is done in other places."

"Well said for you," Jacob replied. "If you stick here in this country place you will never be a first-class man. You want to get outside in the great world, and learn how to shift for yourself. You want to be out of a job, and out of money, too, and be a long way from home in dull times. That will learn you something. It will tell you what stuff you are made of—whether you are a man, or only a raw recruit in the ignoble army of tramps."

All this time Miles stood, first on one foot and then the other. The shadow of the counting-room was over him, and he was ill at ease. I couldn't make out what he wanted at first, but in a moment it flashed across me that he came for a settlement. He wanted the wages due him, so that he could shake off the dust of the shop from his feet, and feel himself his own boss. I said as much as this to him and found that I was right, and turning to the books I ran over his accounts. Every pay day he had left a portion of his wages in our charge against this time, and as he had only himself to keep, his personal wants were small. I found on balancing the account that Miles had to his credit the snug little sum of $350, his own savings, which he had accumulated, penny on penny, and when I told him the amount he was surprised. "I had no idea it was as much as that," said he. I thought for a moment and then said to Jacob, "Let's make him a present of $50, so that he will have an even $400 to start out with. "Yes," said Jacob; "with all my heart."

"Miles," said Jacob, "Mr. Moulton and myself recognize your faithful service and attention to our interests, and we present you with $50, over and above your balance, so that you may be encouraged to do the best you can, always—no matter whom you work for."

Miles said never a word. He could not, but I saw by his face that he felt strongly enough and had sense to keep his mouth shut, lest his tongue run away with him. He finally mustered speech enough to say: "Gentlemen, I don't deserve it."

"Sit down a moment," said Jacob, "while Mr. Moulton makes out your account, and I will tell you something. You are your own master now, and I hope you will make a good boss for yourself. If you only continue as you have started, you will go straight enough. Remember this, though, that what you have done here, and learned here, is only a small part of the business, and no part whatever of other people's methods. When you get outside, as I call the great world, it will throw you off your feet if you are not careful. You will go to New York, or Philadelphia, perhaps, and you are so honest and sincere yourself, that you can't understand that others are not the same. You get on the train with a pocketful of money, and make friends with strangers, and when you get off, you know more than you did and have less money. Take my advice and keep yourself to yourself. Make no acquaintances or friends, so called, on the road. Admit no man to your confidence until he has proved himself worthy of it. When you go into a strange town to hunt up a job, the first thing you do should be this: If it is a place of any size, get a directory and take down all the names of machine shops; find out where they are and visit them in turn. When you go to ask for a job don't walk slap into the counting-room and run against some whipper-snapper of a clerk; in nine cases out of ten he will tell you they don't want any help, just to show his authority. Wait until you can get a chance to go into the shop. In many large shops you cannot get this opportunity, but in most places there is a way to get in, if you know how to find it. I never saw the shop yet I couldn't get into. Go around on a side street and you will generally find an entrance. If you do get in, don't go right up to the foreman and ask for work as though he was bound to give it to you. Many a man loses his chance by his manner. Find out what kind of a man the foreman is, and go to him at the right time, when he is not busy or bothered about something. Watch him and see if he is in a 'fease' over any matter, and if he is, keep out of his way. Ask some of the boys if the concern are hiring men, and find out what your chances are first. You can generally tell pretty well whether any help is needed or not, by the looks of things. If you see half the tools idle, and the vises empty, if you see the proprietors standing around the shop and looking solemn, you may skip right out without asking any questions. You are not wanted. A machine shop without work is a very dismal place; don't stay long in it. Remember this also—'put money in thy purse.' Oftentimes a man's pocketbook is his only friend; it is one he can rely on every time. Whatever you earn, little or much, spend less than it. Travel by water always, when you can; it costs less than by rail, and money is more of an object to you than time.

"Another word, Miles—as from a sincere friend—don't marry and settle down until you are reasonably sure you have found the place you mean to stay in for some time to come. Look around first, and then you won't be dissatisfied when you make a home for yourself, thinking that some other town is better than the one you are in. You are just of age, and there is plenty of time to settle after you are settled yourself. Five or six years' travel will do you more good than I can possibly describe."

"Yes," said I, handing Miles his check, "Jacob's advice is good, and worth quite the amount you hold in your hand, though you needn't give him the check for it. Keep a stiff upper lip, Miles, and when the road is the hardest pull the hardest; down grade the train will run itself. Good by, boy, and good luck go with you."

Miles gripped us both by the hand like a vise, pulled his hat over his eyes, and went out without a word. He turned back after a step or two, waved his hand horizontally, in the modern style, and disappeared. That was his way of expressing his thanks.

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THE COUNTRY'S PROSPERITY—ITS EXTRAORDINARY GROWTH IN THE LAST DECADE.

In the ominous predictions that are being made about the evil effects of the recent panic and the constant allusions to the panic of 1873, with its years of subsequent depression, no attempt is made to compare the general condition of the country at each of these two periods. The last decade has added an enormous amount of wealth, population, and development to this country, as a glance at a few statistics will show. A few facts relating to the chief points that show the growth and prosperity of the country between 1873 and 1884 will suffice. The population has increased from 38,500,000 in 1870 to 50,155,000 in 1880, by last official census, and is now probably not less than 56,000,000. The wheat crop of 1873, which was the largest ever raised up to that time, was 281,000,000 bushels. This year the wheat crop will probably reach 550,000,000 bushels. The corn crop of 1873 was 932,000,000 bushels. This year we may expect from 1,800,000,000 to 2,000,000,000 bushels. The oat crop of 1873 was 280,000,000 bushels. In 1883 it was 571,000,000 bushels, and in 1884 will probably be over 600,000,000 bushels. The newspapers have been crying out that England would not take our wheat at the high prices at which it was held, but in the past nine weeks we have exported 18,000,000 bushels, against the same period last year, when we exported 11,000,000 bushels. This, in connection with other facts, leads to the conclusion that we shall soon be in receipt of a very large importation of gold.

The earnings of the Western roads have more than doubled in the last ten years. Chicago, Burlington and Quincy showed earnings as follows: 1873, $11,400,000; 1883, $26,100,000. Chicago, Milwaukee and St. Paul—1873, $9,000,000; 1883, $23,600,000, Chicago and Northwestern—1873, $12,700,000; 1883, $24,000,000; Union Pacific—1873, $10 000,000; 1883, $21,000,000; Rock Island—1873, $6,419,000; 1883, $12,189,000. Of course these roads have increased their mileage and their capital stock.

The total mileage in the United States was, in 1873, 70,650 miles; in 1883, 121,480 miles. With the increase of railroad mileage comes the extension of the telegraph.

The growth of the Western Union Telegraph Company in the past ten years, as shown by their published reports, is an evidence of the rapid increase of business during that period. This company had in 1873, 154,000 miles of wire; 1883, 432,000 miles of wire, showing an average annual increase of 27,000 miles of wire. Their earnings were in 1873, $9,300,000; in 1883, $19,400.000, an increase of over 100 per cent. The number of messages sent were in 1873, 14,400,000; in 1883, 41,000,000. The number of employes was in 1878, 10,800; in 1883, 21,000. The increase in earnings has been in the face of a reduction of rates from 64 cents in 1873 to 38 cents in 1883. The consolidated opposition telegraph companies claim to have 65,000 miles of wire and 600 offices, while Western Union claims to have 36,000 offices. Twenty-five years ago a day message from New York to Chicago of ten words, on the produce market, cost $2.50; to-day a single message of twenty words can be sent over the same distance for twenty-five cents.

The Pacific Mail Steamship Company in 1873 did not absolutely own one iron steamer. Out of their earnings in the past ten years they have paid for nineteen iron steamships, have a million dollars in their treasury, and are now paying a quarterly dividend at the rate of 5 per cent. per annum.

The anthracite coal trade was, in 1873, 21,220,000 tons; in 1883, 31,790,000 tons, an increase of over 10,000,000 tons. The production of petroleum was, in 1873, 187,815,000 gallons; in 1883, 505,931,000 gallons.

A few facts relating to the largest cities East and West will serve as an indication of the growth and progress of the whole country. In New York the perfect system of elevated railroads has grown from a "one-legged" road on Ninth avenue and Greenwich street to four double track fully equipped lines running the entire length of Manhattan Island. The number of passengers carried was, in 1873, 644,000; in 1883, 92,000,000. The earnings have increased as follows: In 1873, $64,000; in 1883, $6,000,000.

Numbers of very costly buildings have been added to the city, notably the New York Produce Exchange, costing over $3,200,000; the Mills Building, costing $2,500,000; the Mutual Life Insurance Building, costing about $2,000,000; the Washington Building, costing about $1,600,000, etc.

The Brooklyn Bridge has been built at a cost of $14,500,000, and has proved as useful in the transfer of passengers and merchandise between the two cities as have the elevated roads in city travel, yet the ferry boats are more crowded than before the bridge was built—just as the surface roads of New York city carry as many passengers as before the elevated lines were erected.

The population of Chicago has increased from 364,000 in 1873 to 650,000 in 1884. It has become the grain center of the world, and the cattle and hog market of the country. In 1873 the number of cattle received was 671,000; in 1883 it reports a receipt of 1,800,000 head. The number of hogs taken into Chicago in 1874 was 1,800,000; in 1883, 4,000,000.

Improved railway road beds, steel rails, and equipment of every kind have made it possible to bring produce from the far West to the seaboard as cheaply as it could be carried a few hundred miles twenty years ago, and the same fact applies to freight carried West.

Kansas City in the Southwest and St. Paul and Minneapolis in the Northwest are second Chicagos in their development, and with much greater proportionate increase.

With this great increase in those things which go so far toward making a nation prosperous, we have to record the decrease in the public debt of the United States from $2,162,000,000 in 1874, to $1,498,000,000 in 1883. What does all this prove but that the country is prosperous beyond peradventure. Overproduction, whether of steel rails, iron, cotton cloth, or manufactures, must be more readily absorbed to-day than ten years ago. A shrinkage in Wall street, or a panic cannot affect the country as disastrously in its present strength and magnitude as it could when the business of the country depended more particularly on New York financial quotations.

Wall street has had its shrinkage, and it is time to stop predicting ruin and hard times with the panic of 1873 as a text. Real estate may decline in value, and in all probability it will, for with the increase of wealth will come the desire to invest money where it will net 4 per cent. per annum.

With Government bonds netting less than 3 per cent. it is natural to suppose that the time must soon come when real estate will no longer net 6 per cent. and over.

In 1873 the Government of the United States had on hand, of gold, silver, and greenbacks, $77,000,000 legal tender. In 1877 they had $133,000,000. In January, 1884, they had $440,000,000. Each year they had obligations out, of interest accrued and certificates representing a portion of the money held by the Government relatively.

Another point to be taken into account. In 1873 probably one-half the public debt was held abroad. To-day nine-tenths of it is held here.

The above facts will enable the public to draw its own conclusions as to whether the future promises disaster or prosperity.

Rufus Hatch.

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AN ENGLISH MACHINIST IN AMERICA.

An English machinist now in this country was recently questioned by a reporter of the *Memphis Avalanche*, in regard to the social condition of the trade in his country. This is what he said:

"What wages do machinists receive in England?"

"Journeymen receive from $5 to $10 per week. Occasionally $11 or $12 is paid, but very rarely. Twelve dollars is the highest sum paid to a journeyman machinist, and where one gets that much there are hundreds who do not make more than $8 to $10."

"Take a single man, for instance, what would you rate his living at?"

"A single man can get board for $3 a week, and with exercise of care and economy can dress himself on $3 more. This can only be done by driving a close bargain. Clothing is cheaper there than in America, but meats and breadstuffs are higher. Flour is worth from $8 to $10 a barrel; beef is sold from 15 to 30 cents a pound; pork is 13 to 16 cents a pound, ham about 20 cents. Boots and shoes range about the same, possibly a shade less than in this country."

"How do men with families live on such wages?"

"It is pretty hard, that's a fact. The average of wages is about $8. A man with a wife and one or two children to provide for cannot buy food and shelter for these for less than $6 a week. This leaves him but a scanty allowance for clothing. The average English mechanic is a total stranger to anything like luxury. Indeed, I am sorry to say, the condition of our mechanics is far from being good. The extent to which they are dependent upon the charity and generosity of the wealthier classes is surprising. Donations are constantly being made. The clergymen are good friends to the workingmen. They carry around subscription lists and solicit donations of food, clothing and money. They superintend the distribution of the same. In many districts organized charitable societies look after the wants of the people. But for this many hungry mouths would be still hungrier."

"How do apprentices manage to make both ends meet?"

"They come in for their share of privations; they receive from $1 to $2 per week, and generally serve from five to seven years at their apprenticeship."

"Has the free-trade system of England nothing to do with the depressed condition of trade?"

"No, that has nothing to do with it."

"What do you, as a representative English mechanic, think of our protective tariff here in America?"

"Every one of us would like to see America opened up to free trade," was the candid reply. Since I've been in this country I've met many mechanics from the old country, and they all say that if America would open up free trade they would return to England, and be enabled to get as good wages as they receive here. They might go back, but they would not stay, for I've seen many of my acquaintances who have visited America and returned to England again, but they were not contented, and sooner or later would pack up and strike out for the States again."

"You seem to like this country. Possibly you might be induced to stay here. In the event of your doing so would you still be in favor of free trade?"

"Well, you see, I don't just know; but then, I guess—yes, in fact, if I were going to live here I wouldn't want to see free trade established."

Mr Wm. Bentley, the speaker quoted, is an intelligent English mechanic, who fully understands which side of his bread would receive butter to the best advantage. In answer to a concluding question, he said: "I receive when at my regular work just $12 per week. Of course this is special work I'm at now, and consequently get special wages. Our foreman, the man directly over me, gets $15 per week, and that is more than the average foreman gets. I am free to confess I can't save any money to amount to anything, but we have to accept the situation and be thankful for what we have."

Here an apprentice is paid from $4 to $7 per week; journeymen average $2.50 a day, the sums ranging from $2 to $3.50 per diem, while foremen receive anywhere from $1,200 to $2,000 a year. A man holding a position in this country similar to the one occupied by Mr. Bentley would be paid from $1,000 to $1,500 per year, while the living line here is as cheap, if not cheaper, than in England, especially in the matter of food, which is cheaper and of vastly greater variety than can be found on any English table.

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A WORD ABOUT DISINFECTANTS.

The use of disinfectants has of late years greatly extended; few private houses are without them. None should be. By the free and proper use of disinfectants cholera has been reduced from the very terrible position it had attained in the eyes of our forefathers, to a much lower level.

There are many kinds of disinfectants known, and sold at varying prices, some entirely worthless as disinfectants. Every one is familiar with bleaching-powder (chloride of lime), which is so much used. It is very effectual, owing to the chlorine gas which it freely gives off when exposed to the atmosphere, or moistened with dilute acids, such as vinegar. Charcoal, too, is well known as a disinfectant, and as a powerful deodorant. We may here remark that a deodorant simply disguises the bad smell without destroying the poison which it may contain, and in this respect differs from a true disinfectant.

Of all known disinfectants, carbolic acid is now generally admitted to be the most efficacious, and it is the basis of most of the disinfecting agents now sold. The acid is too powerful to be used alone, and is therefore generally mixed with eighty or ninety per cent. of some other substance not possessed of disinfecting properties. Sometimes the bisulphites of lime and magnesia are added, and these substances are themselves possessed of disinfecting properties; but more generally chalk or sand is used; or the acid is simply diluted with water. A small portion of the mixture sprinkled in water-closets and other places where decomposing matter is allowed to remain will diminish, if not entirely remove the chances of contagion, and sweeten and purify the atmosphere.

Although carbolic acid is so efficacious, there are some who object to its use. It smells strongly, and many persons are thereby prevented from using it. It is a pity on this account to be robbed of its advantages; and such persons would do well to try and educate themselves to the smell. Moreover, it is better to breathe an unpleasant and pure atmosphere than a dangerous one. The smell of pure carbolic is much more easily borne than that of crude carbolic; and we would recommend the use of the purest carbolic procurable, diluted with eighty or ninety per cent. of water, or mixed with the same percentage of precipitated chalk. It is difficult for the chemist, trained and accustomed to the offensive and unwholesome smells in the laboratory, to understand how any person can retain a strong dislike to the comparatively sweet smell of carbolic acid.

There are some reasonable objections to the use of carbolic acid as a disinfectant in a concentrated form. In the first place, it is a powerful poison, and if taken internally, is certainly fatal. The liquid carbolic acid varies in color, as the crudeness of the product increases, from pale straw to dark brown, approaching almost black in the very impure kinds. This darkening is due to the presence of tarry substances, which add considerably to the offensiveness of the smell. This changing color renders it liable to be mistaken for other liquids. On more than one occasion it has been mistaken for the black draught usually sold by chemists as a common purgative.

The smell of carbolic acid is very characteristic, and can readily be distinguished. When it has been accidentally taken internally, castor oil and sweet oil should be freely administered, and a doctor obtained without delay. It is very painful when externally applied, as it rapidly cauterizes the fleshy tissues. In the concentrated form it should be very cautiously handled. Oil or carbonate of soda rubbed on the parts are the best remedies for external injury and pain. Water may be applied externally, but should not be taken internally.

Another objection to the use of carbolic acid in the concentrated form is that it is apt to be wasted, for many persons are ignorant of or incredulous as to its powerfully destructive effects on animal life, and are sometimes so forgetful of principles of economy in this matter as to use carbolic acid in an undiluted form, and in quantities far in excess of what is required.

To prevent waste, the acid is used to form the basis of what are known as "carbolic disinfecting powders," which consist simply of chalk, or some other cheap substance, in a finely divided state, to which from ten to twenty per cent. of carbolic acid has been added, and sometimes from five to twenty per cent. of the bisulphites of lime and magnesia, together with some coloring matter, to give a pleasing effect to the eye.

Powders are an expensive form of disinfecting by carbolic acid; and a considerable saving might be effected by persons who use it largely if the mixing were done by themselves instead of by the manufacturers, and the same tins used over again, while the article so made would have many advantages. It could, in the first place, be made as strong as the necessities of any particular occasion might require, and in the next place, the pure acid may be used for house disinfection, and so lessen the disagreeableness of the smell, while the commoner kinds may be employed for yards, stables, fowl-houses, etc. The method of making powders is very simple. About four ounces of the acid, by weight or measure, should be added to one pound of precipitated chalk, or fine sand, or mould, or any other harmless substance in a finely subdivided state, and thoroughly mixed in a large bowl. This powder will be suitable for all ordinary purposes, and will be far superior to many of the disinfecting powders sold at twice the cost.

Why, it may be asked, cannot our chemists discover some pleasant and non-poisonous disinfectant? Why are we under the necessity of substituting an intolerable smell for a bad one? The answer is that nothing but poisonous substances can be good general disinfectants, as the dangerous matter which it is the aim of disinfectants to destroy is chiefly organic, of which too, though of course in a far higher degree, the vital parts of the human being consist. Of disinfectants, charcoal is perhaps the least objectionable; it is neither dangerous nor mal-odorous; but though extremely valuable as a deodorant, its usefulness as a disinfectant is very limited. A disinfectant must be capable of destroying the lower forms of organic life, some of which constitute disease; and the province of the chemist is to find out that substance which is most destructive to these lower organisms, and least dangerous and objectionable to man. Carbolic acid best answers these requirements, and on this account has recently come into extensive use.—*Cassell's Magazine.*

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BALANCING MACHINE PARTS.

We have received an interesting pamphlet on this subject from the Defiance Machine Works, Defiance, Ohio, and extract a portion which treats of the subject in general, but contains many useful hints. We presume the pamphlet will be sent entire to those who apply for it.

"The vibrations, or jarring, caused by the unbalanced rotating parts of machinery are owing, not to the centrifugal force of excessively heavy portions, but to a striving, as of all rotating bodies, to assume rotations upon their centers of gravity. If it be desired that a rotating body run smoothly, without jarring its adjuncts, its qualities must be the same as those of a body rotating in space, having a mechanical center upon which it is desired it shall rotate, and a mechanical plane in which it is desired it shall continue.

If a rotating body be so suspended as to be free to obey all impulses excepting that of gravity, and its plane of rotation be normal to the line of gravity, the point of greatest prominence will be somewhat in advance—in the line of direction of rotation—of the point of greatest deficiency of weight. The amount of advance will vary with variations of speed. An effort to constrain the body to rotate upon its mechanical center will very much increase such advance. Therefore, in any method of balancing the rotating parts of machinery, there should be, as nearly as possible, an absence of restraint.

The rotating parts of machinery whose journals are confined by rigid boxes, furnish very conflicting indications of the whereabouts of the cause of unbalanced conditions. If boxes are constructed so as to be free to move in some directions and not in all directions, as they have been by some experimenters, the indications will be still more conflicting. The amount of "throw" caused by an unbalanced part of machinery is generally very small, notwithstanding the violence of its energy. There are stationary parts in the construction of nearly every machine, which are capable of vibrating in unison with the times of rotation of some running, unbalanced part, and which are also capable of serving as accumulators of vibrations. Accumulations thus arising may be, mathematically, multiples of the times of the vibrations of other and heavier parts; and it is obvious that a violent shaking may ensue, even when the initial vibration is so small as to be almost inappreciable. The aggregation thus subjected to vibration will have a natural isochronal movement, the periods of which will depend on its inertia, distance from its natural center of motion, and tendency to oscillate upon such center. When the periods of semi-rotation and the periods of natural vibration coincide, a continuous, but not always uniform, oscillation will be established. Upon the establishment of such oscillation, the time of rotation will have become slower and the time of oscillation faster. That portion of the rotating body which possesses the excess of weight will, during its semi-rotation, strive to move in directions opposite to those of the vibrating mass, and, if it were not for the time which necessarily elapses in the transmission of force from the rotating body to the vibrating mass, the movements would be diametrically opposite. The conditions depending on dimensions, weights, times and structure, are so varied and complex that the relative times of the movements can only be determined by experiment in each individual case.

These "relative times of movements" often perplex the locomotive engineer, and lead him to think that the counterbalances in the driving wheels of his engine should be augmented in weight, when they are already too heavy. Such counterbalances are more frequently too heavy than too light. Often by watching intently the conduct of the driving wheels of his engine, he discovers that the light portion of the wheel strikes the rail violently, thereby transmitting a jar to the engine. Keen perceptions by sight, feeling and hearing, are necessary to the conclusion that the times of the contact of the light portion of the wheel with the rail and the times of the jar are simultaneous, or nearly so. He accomplishes the first offices of a good observer, and elate with that success, and having in mind the one property of the counterbalance, that of its centrifugal force, he fancies that an increase of its weight would hold the wheel to its proper place.

The above observations apply only to those bodies which, by reason of high velocities, predominate sufficiently over restraint to enable them to rotate upon their centers of gravity. The balancing of rotating bodies can be attained only by running up to such velocities.

The degree of velocity at which a striving to rotate upon its center of gravity begins, in a rotating body, cannot be determined by the progress at present attained. The constraints and impulses, by which "centrifugal whirling" of axes is rendered possible, bring into existence forces which at present defy computation."

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ELECTRICAL FALLACIES.

It is strange that intelligent people should be misled by wild statements regarding results attained by inventors of novel electrical apparatus. There is no law of nature more firmly established than that of the conservation of energy, which teaches that in the transmission of power, or the translation of energy from one form to another, the net result *must* exhibit a certain loss, due to friction, absorption, radiation and other causes. Notwithstanding this easily understood fact, fabulous stories are circulated from time to time. These are admitted into the columns of alleged scientific papers, where they acquire additional prominence from the endorsement of supposed experts. Since the introduction of the electric light, the generation of electricity by steam power has become a familiar process to the public, as well as to scientists and electricians. The inventor or promoter of nearly every new lamp or dynamo machine which is brought out, invariably asserts that less power is required to produce a given result than was the case with previous inventions.

The evolution of the storage battery is making similar progress, and in this the margin between the electricity which goes in and that which is subsequently taken out is the real test of efficiency; hence, whatever merit there may be in a new form of secondary battery, will generally be found to be based upon its greater percentage of efficiency.

Generators which produce electricity in effective quantities at a merely nominal cost may generally be looked upon with suspicion, and should their results be out of all proportion to well established scientific formulæ, it is safe to assume that the true inwardness of the experimental exhibition has been carefully concealed.

The use of galvanic batteries for the production of light, and for the generation of motive power, has a peculiar fascination for many investigators, even at the present day, when the use of steam and water power has been conclusively proven to be the most economical method of evolving electricity. As a matter of convenience such a process may be advantageous, but generally speaking it cannot be otherwise than wasteful, cumbrous, and inconvenient.

Various schemes are set on foot from time to time which have no other object than the fleecing of those who are induced to invest money in them. Scientists and experts are ridiculed for their skepticism, the growth of which has been fostered by the bursting of hundreds of bubbles, practically as visionary as perpetual motion. We regret to say that electricity has been the foundation of many questionable enterprises, owing to the fact that, to some, it appears to be an unfathomable mystery, which may be infinitely developed by ingenious inventors. Upon this basis of popular ignorance, manufacturers and venders of magnetic ointments, electric plasters and galvanic belts, have laid the foundations of vast fortunes. A wide field has been opened for cultivation by adventurers of this class, and the efforts of the press should be directed toward their suppression, rather than encouragement.—*The Electrical Engineer.*

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THIS WOULD BE NICE TO WRITE WITH: Andes, of Vienna, gives the following receipt.

For copying ink: 3 parts shellac; 1 part wax; 7 parts fat; 4 parts mastic; 3 parts soap; 1 part soot.

Water, it seems, is not needed.

DIMENSIONS OF MODERN ENGLISH LOCOMOTIVES.

Commencing with passenger engines for fast traffic, and taking the Great Western Railway, we find that it holds a unique position, as its fast broad gauge trains are worked by the same type of engine as that designed in 1848, although, of course, the bulk of the stock has been rebuilt, almost on the same lines, and rendered substantially new engines. They are single engines of 7ft. gauge with inside cylinders 18in. diameter, and 24in. stroke; the driving-wheels are 8ft. in diameter, and there are two pair of leading wheels, and one of trailing, all of 4ft. 6in. diameter. The total wheel base is 18ft. 6in., the boiler is 4ft. 6in. diameter, and 11ft. 3 in. long. The grate area is 21 square feet, and the heating surface is, in the fire-box, 153 square feet; tubes, 1800 square feet; total, 1953 square feet. The weight in full working order is, on the four leading wheels, 15 ton 18 cwt.; driving wheels, 16 tons; trailing wheels, 9 tons 10 cwt.; total, 41 tons 8 cwt. The tender weighs 15 tons 10 cwt., and will hold 2700 gallons of water.

The boiler pressure is 140 lb. on the square inch, and the tractive power per pound of steam pressure in the cylinders is 81 lb. These engines take the fast trains to the West of England—the Flying Dutchman averages 170 tons gross load, and runs at a mean time table speed of 53 miles per hour, which, allowing for starting, stopping, and slowing down to 25 miles per hour through Didcot, gives a speed of nearly 60 miles an hour.

The average consumption of coal per mile, of thirteen of these engines, with the express trains between London and Bristol, during the half-year averaged 24·67 lb. per mile, the lowest being 23·22 lb., and the highest 26·17 lb., the average load being about eight coaches, or 243 tons. We have already seen that in 1849 the Great Western express ran at a higher rate than at present, being an exception to the general rule; and the fastest journey on record was performed at this time by one of these engines, when on May 14th, 1848, the Great Britain took this Bristol express, consisting of four coaches and a van, to Didcot, fifty-three miles, in forty-seven minutes, or at the average speed of sixty-eight miles an hour. The maximum running speed was seventy-five miles an hour, and the indicated horse-power 1000. A class of engines corresponding to this type in their general dimensions, but with 7ft. coupled wheels, was introduced on the line, but it was not found successful. Through the courtesy of Mr. Dean, I am enabled to give a table showing the running speeds and loads of the principal express trains, broad and narrow gauge, to the West and North of England, run on the Great Western Railway.

Great Western Railway.—Average Speed and Weight of Express Trains.

Train.	Speed to first stopping station.			Weight of train.		
	Station.	Distance.	Average speed—miles per hour.	Engine and tender.	Carriages and vans, empty.	Total.
BROAD GAUGE	TO WEST	miles. OF ENG-	LAND:	tons.	tons.	tons.
9.0 Paddington to Plymouth........	Reading	36	47	67	149	216
11.45 do.	Swindon	77¼	53	67	104	171
NARROW GAUGE	TO THE	NORTH:				
10.0 Paddington to Birkenhead.......	Reading	36	39·2	60	190	250
4.45 do.	Oxford	63½	48·8	60	129	189

The narrow gauge trains are worked by two classes of engines. The first is a single engine with inside cylinders 18in. diameter, 24in. stroke. The driving wheels are 7ft. diameter, and the leading and trailing wheels 4ft. The wheel base is, leading to driving wheels, 8ft. 6in.; driving to trailing wheels, 9 ft.; total, 17ft. 6in. The boiler is of Lowmoor iron, 10ft. 6in. long and 4ft. 2 in. outside diameter. The grate area is 17 square feet, and the heating surface is, tubes, 1145½ square feet; fire-box, 133 square feet; total, 1278½ square feet. The boiler pressure is 140 lb. on the square inch, and the tractive power per lb. of mean pressure in cylinders, 92 lb. The weight in full working order is, engine, leading wheels, 10 tons; ditto driving wheels, 14 tons; ditto trailing wheels, 9 tons 10 cwt.; tender, with

40 cwt. coal and 2600 gals. water, 26 tons 10 cwt.; total, 60 tons. These engines are extremely simple, but well proportioned, and are a very handsome type, and their average consumption of coal, working trains averaging ten coaches, is about 24·87 lb. per mile. The standard couple passenger express engine on the narrow gauge has inside cylinders 17in. diameter and 24in. stroke; the coupled wheels are 6ft. 6in. diameter, and the leading wheels 4ft.; the wheel base is 16ft. 9in. The boiler is 21ft. long by 4ft. 2in. diameter; the grate area is 16·25 square feet; and the heating surface is, tubes, 1216·5 square feet; fire-box, 97·0 square feet; total, 1313·5 square feet. The boiler pressure is 140 lb., and the tractive power per lb. of steam pressure in the cylinders, 88 lb. The weight in full working order is on the leading wheels, 10 tons, 5 cwt.; driving wheels, 11 tons; trailing wheels, 9 tons 15 cwt.; total, 31 tons.

Turning now to the London and North-Western Railway, we find that about 1872, the weight of the heavier express trains had so increased, that a new standard type for this service was designed, and is now the standard passenger engine; it has inside cylinders 17in. diameter and 24in. stroke; the driving and trailing wheels are coupled, and are 6ft. 6in. diameter, and the leading wheels 3ft. 6in. The fire-box is of copper, fitted with a firebrick arch for coal burning, and the grate area is 15 square feet. The heating surface is, in the tubes, 1013 square feet; fire-box, 89 square feet; total, 1102 square feet. The wheel base is 15ft. 8in., and the tractive power 88 lb. for each lb. of steam pressure in the cylinders. These engines, working the fast passenger trains at a speed of about 45 miles per hour, burn about 35 lb. of coal per mile, when taking trains weighing about 230 tons gross. A variation from this type has been adopted on the Northern and Welsh sections, known as the "Precursor" class. These engines have 5ft. 6in. coupled wheels, and weigh 31 tons 8 cwt. in working order, but in other respects are very similar to the standard engines just described; with the Scotch express, averaging in total weight 187 tons, between Crewe and Carlisle, over heavy gradients they burn 33 lb. of coal per mile.—*London Engineer.*

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THE AMENDED CONSTITUTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

We publish herewith the amendments made to the Constitution of Stationary Engineers at Baltimore, in September last.

Article VI.

Sec. 1. The Association may grant charters upon the written application of ten engineers and the payment of $20, who have not been rejected or expelled by any subordinate branch of this organization; and no subsequent charter will be granted in any city or town without the consent of subordinate Associations previously chartered. In States having an organization, charters shall issue only under the rules of such State body.

Article VIII.—Deputies.

Sec. 1. Each delegate to the National Convention shall be a Deputy for the district he represents. He shall have supervision of the work and propagation of this Order; and from such charter fee of $20 that he may collect, from any new Association, he may retain $10 for expenses. All Deputies shall be commissioned by the National President.

Sec. 2. It shall be the duty of a Deputy to supervise the work and propagate this Order; he shall have charge of the secret work and insure its uniformity in his district; he shall see that the quarterly reports are regularly and promptly made and sent with the *per capita tax* to the national headquarters; he shall install all officers in his district, and be present at the organization of all new branches of this Order that may be made in his district, and shall at all times requisite observe the working of the Order, and endeavor by all suitable means to increase the influence, standing and efficiency of this Order among the citizens of his district; he shall hear all cases of controversy among members and endeavor to arrange or settle the same; failing this, he shall cause a full report of the same to be prepared for the Arbitrators.

Sec. 3. In organizing new branches the Deputies may retain from the charter fee ten dollars to pay his expenses, and shall send ten dollars in all cases to the National Secretary, to pay for the outfit furnished with such charter.

Sec. 4. In the event of the death, removal or resignation of a Deputy, the branch from which such Deputy was elected shall at once proceed to select a suitable person to fill the position, and forward his name to the National President for appointment.

Sec. 5. Each subordinate Association shall have one vote in the National Convention. When an Association has over fifty members, it shall have one vote for each fifty or any fraction of fifty; but no one Association shall have more than five votes.

Sec. 6. No proxy shall be admitted to a seat in the National Convention, nor shall any delegate represent any subordinate Association outside of his own State; and no delegate shall represent more than two Associations.

Sec. 7. Delegates to the National Convention shall come provided with credentials, properly attested, to entitle them to seats in the Convention.

Sec. 8. When it is deemed necessary for the safe working of any subordinate Association it shall be lawful for the three principal officers to issue a local password.

Sec. 9. The President of the National Association shall issue semi-annually a traveling password to be transmitted to the Secretary of each subordinate Association, to be given to members receiving a visiting card.

Article X.

Sec. 2. All books, papers and regalia used by the Association shall only issue from the National body, and shall be uniform.

Sec. 5. Roberts' Manual of Parliamentary Rules shall be the guide of this body on all questions not heretofore specified.

Sec. 6. The initiation fee to be paid by candidates joining subordinate Associations shall not be less than three dollars.

Article XI.

Sec. 1. All delegates to the National Association may become life members of the same by paying into the National treasury, annually, the sum of $1.00. Such life member shall have all the privileges of this body except voting.

Article XII.

Sec. 1. This Association will not authorize the issue of any certificate, badge or other evidence of membership except a pass or traveling card, which shall never be issued for more than three months, and no such card shall be issued if the applicant shall be in arrears for dues. In cases where necessary, by a majority vote of his Association the time may be extended not to exceed twelve months, applicant in all cases prepaying his dues for the time said card is in force.

Article XIII.

Each subordinate Association may provide for honorary or contributing members to be elected from citizens who desire to aid us in our objects, and may allow them all the privileges of full members except voting and representatives.

Article XIV.

All persons desiring to join this Association must go before a board, composed of members of this Order, and be examined as to their qualifications as an Engineer before they can be admitted to membership.

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The American Electrical Exhibition will be held in Boston, from Nov. 5th, to Jan. 3d, 1885. The several sections are the production of electricity, electric conductors, measurement, application of electricity (high power), application of electricity (low power), terrestrial physics, historical apparatus, special novelties and electrical literature.

This exhibition is in the interest of science and education in electrical and mechanical art; also to show the rapid advancement made in electricity, its methods and appliances, and its possibilities and probabilities. It is intended to make the exhibition complete and comprehensive in every particular, and to exceed in novelty any that has ever been held in New England.

All communications should be addressed to American Electrical Exhibition, P. O. Box 1130, Boston, Mass.

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Edison, it is stated, has purchased 235 steam engines in the past two years.

DETERMINING THE DISTANCE OF OBJECTS AT SEA.

The rules for determining the distances of objects at sea, says Prof. R. A. Proctor, when the height of the observer's eye and the height of the concealed part of the object above the sea level are known, are exceedingly simple. Geometrically, the dip of the sea surface is eight inches for a mile, four times this for two miles, nine times this for three miles, and so forth; the amount being obtained by squaring the number of miles and taking so many times eight inches. But in reality we are concerned only with the optical depression, which is somewhat less, because the line of sight to the horizon is slightly curved (the concavity of the curve being turned downward). Instead of eight inches for a mile, the optical depression is about six inches at sea, where the real horizon can be observed. But, substituting six inches for eight, the rule is as above given.

Six inches being half a foot, we obtain the number of six inch lengths in the height of an observer's eye by doubling the number of feet in that height; the square root of this number of six inch lengths gives the number of miles in the distance of the sea horizon. Thus, suppose the eye of the observer 18 feet above the sea level; then we double 18, getting 36, the square root of which is 6; hence the horizon lies at a distance of six miles, as seen from an elevation of 18 feet. For a height of 30 feet, which is about that of the eye of an observer on the deck of the City of Rome, we double 30, getting 60, the square root of which is 7·7; hence, as seen from that deck the horizon lies at a distance of $7\frac{7}{10}$ miles. If the depth of the part of a distant ship's hull below the horizon is known, the distance of that ship *beyond the horizon* is obtained in the same way. Thus, suppose the depth of the part concealed to be 12 feet, then we take the square root of twice 12, or 24, giving 4·9, showing that that ship's distance beyond the horizon is $4\frac{9}{10}$ miles. Hence, if a ship is seen so far hull down, from the hull of the City of Rome, we infer that its distance is $4\frac{9}{10}$ miles beyond the distance of the horizon, which we have seen to be 7^{7} miles—giving for that ship's distance $12\frac{3}{5}$ miles.

◆

CAUSES OF BREAK-DOWN.

An English boiler insurance company takes risks upon engines and steam machinery in general, and the company's report, lately published, gives some interesting details of their experience. These are not particularly valuable to our readers, but they serve to indicate sources of trouble which are more or less common wherever steam engines are used. During the years 1882, '83, '84, in which risks have been taken, the break-downs have been diminishing materially. The special causes are given as follows:

Causes purely accidental or unascertained.	42	per cent.
Negligence of owners or attendants.......	14	"
Orginal defects and ordinary wear........	14	"
Weakness and bad design................	30	"

The specific parts which gave out are thus detailed:

	Number.
Spur gearing...........................	30
Valve gear.............................	21
Air pump motions.......................	19
Bolts, gibs, cotters and straps........	18
Main shafts	8
Columns, entablatures, pedestals and bed-plates.	8
Air pump buckets and valves	7
Fly wheels.............................	7
Parallel motions and links.............	6
Air pumps and condensers...............	6
Cylinders and valve chests	3
Piston rod crossheads..................	3
Piston rods............................	3
Cranks.................................	2
Pistons................................	2
Beams and side levers	2
Governor gear..........................	1
	146

From this summary by far the greatest number of accidents occurred from spur gears used as drivers. Very nearly 20 per cent. of all the disasters are charged to these details, from which fact we deduce that they are extra hazardous appliances. More than one instance is on record in this country where the failure of a tooth caused a serious breakage of other important and expensive parts. Next to spur wheels come valve-gear, air pump motion, bolts, gibs and keys and straps. These are unquestionably in need of careful attention in all machines.

Main shafts, it appears, break but seldom, while all the other parts are practically exempt from special dangers. Careful supervision is always in order; before the accident takes place is the best time to examine.

◆

EXTRAVAGANT STATEMENTS.

It is to be regretted that those who are interested in manual training schools should not be more moderate in their statements of the advantages to be derived from such schools. Unquestionably they are of value, but such assertions as that appended are liable to make trouble in the future for youths who credit them. We quote from the *Industrial World.*

> "Mr. Thomas Foley, for many years an instructor of machine-tool work in the Boston Mechanic Art School, before becoming an instructor had served an apprenticeship of seven years and had worked at his trade for several years. Mr. Foley has seen and tried both methods, knows whereof he speaks, and testifies to the superiority of the manual-training-school method over the apprentice system. He says: It appears like throwing away two or three years of one's life to spend them in attaining a knowledge of a business that can be acquired by a proper course of instruction in twelve weeks, two hours each day, five days each week, in all 120 hours. The dexterity that comes from practice can be reached as quickly after the 120 hours instruction as after two or more years spent as an apprentice, under the adverse circumstances of ordinary apprenticeship.
>
> "What Mr. Foley says stands to reason. The apprentice in a shop is a hewer of wood and a drawer of water, the last and least important individual in the shop. In the manual-training school, on the contrary, the boy is the most important individual. He is the object for which the school exists. He is the material that is to be finished. Instead of being left to himself, to pick up what he can, competent and intelligent instructors devote themselves to his training. As an apprentice the boy exists for the benefit of the shop. As a scholar in a manual-training school the shop exists for the benefit of the boy.

From a somewhat extended experience in the machine business, we are unable to indorse the statements of Mr. Foley. We are asked to believe that a youth can become a workman before he has acquired manual dexterity! That is, he can learn to swim in the parlor, and try it in the water afterward.

If Mr. Foley is a mechanic, he must know that the years of a young man's apprenticeship are devoted to becoming skillful with tools, as much as anything else, and that the time is by no means thrown away. The idea that a young man can learn to chip and file in 120 hours, to say nothing of any other branch of the trade, is preposterous, unless by learning Mr. Foley means giving verbal instructions! If he does mean that, then the whole art and mystery of the machine trade can be told in an hour—in even less time, and Mr. Foley's 120 hours are thrown away. But giving verbal instruction to a youth is very different from learning a trade.

◆

THE WOOD-LATHE.

When a man or boy first tries to run a wood-lathe there is generally fun. He will put in a piece of wood, and screw up the tail-spindle until the wood smokes, and is then ready for business. He takes a big gouge and tries to scrape off some wood. The first thing he knows, the gouge catches and breaks, or the work comes out of the lathe, or the gouge is torn out of his hands and makes a bee line for the nearest window. A flying chisel will always make for glass unless the typical small boy is around. If he is, he is sure to get the full benefit of all such missiles.

After catching two or three "crabs" our man will find that by running the chisel or gouge over the work so as to let it bear on the bevel formed by grinding, he can regulate the depth of cut at his convenience. Herein lies the whole art of turning; hold the chisel in such a manner that it will cut off a shaving like an apple peeling, and you may be sure you are cutting the wood easily and cleanly. Don't scrape the work by holding the chisel perpendicular to it, but see that the cutting edge and the grinding bevel are tangential to the work. A good turner will make a cut so smooth that it will discount sandpaper in a hurry. Where the end of a grain is exposed burnish slightly, by holding the middle of the tool upon it. A very high polish can be imparted to nearly all kinds of wood by this method alone, and it forms a very desirable finish.—*Cabinet Maker.*

◆

NUMBER 2, VOLUME VII., is out of print; persons who wish to part with that issue can obtain 25c. for it at this office.

Chippings and Filings.

EXPERIMENTS WITH THROWING DYNAMITE by compressed air still continue at Fort Hamilton, in this harbor. The original gun was only 4″ caliber, in which air at 500 pounds per square inch was used, but another gun, 8″ diameter, with 2,000 pounds air pressure, is under way.

◆

A PATENT HAS ACTUALLY BEEN GOT OUT in Europe for what may be called a self-moving steam engine. Electricity does it all. The man provides a boiler and makes steam in it by a coil inside, traversed by electricity. He gets the electricity from the engine itself, which is to be moved by the steam made by the electricity the engine made!!!

◆

THERE ARE SOME WISE MEN in private life whose names are lost to posterity. Here is one:

A wealthy London merchant said: "I always feel happy when I am advertising, for then I know that, waking or sleeping, I have a strong, silent orator working for me who never tires, never makes mistakes, and is certain to reach the sources from which my trade must come."

◆

A CONTEMPORARY teaches its grandmother to suck eggs after this fashion:

> "Carpenters know how soon the butt-ends of chisel-handles split, when daily exposed to the blow of a mallet. A remedy, suggested by a Brooklyn man, consists of simply cutting off the end of the handle and attaching two disks of sole-leather. The leather prevents further splitting."

Man, man, this was done years and years ago, "or ever the earth was made, or the foundations laid thereof."

◆

THEY CHANGED HIS JOB.—The London *Engineer* says:

"A case came under our knowledge years ago, in which a pupil who had paid a fee of several hundreds of pounds to a first-class firm of mechanical engineers, spent his first three months working a machine screwing bolts, and when he remonstrated, was put for another three months to screw nuts."

◆

MICHAEL McDONALD, engineer at Milford, Mass., caught his sleeve in the screw of a shaft, and was whirled around at the rate of 400 revolutions per minute. His clothing was all torn off, but when he fell to the floor he was absolutely uninjured.

There are a lot more set screws, lying in ambush for the first one that comes along, but all will not be so fortunate as Michael.

◆

FOR AN EXCESSIVELY CAUTIOUS PERSON, commend us to this one. He writes to a foreign contemporary as follows:

"I have a crank-shaft which shows cracks parallel to the axis. The cracks extend throughout the whole length of the bearing. I wish to know whether it is prudent to work the shaft in its present state, or whether it would be better to obtain another shaft. I am afraid if I get another shaft it may prove as bad."

◆

MR. LOUIS W. DAY, of Beverly, Mass., who has written a great many very sensible articles for THE MECHANICAL ENGINEER on practical subjects, under the pen-name of "*Smoke Arch,*" has started in business on his own account at the above place, in a general line of engineers' supplies, wrought iron pipe, etc. Those in his vicinity who favor him with trade may be sure of an intelligent knowledge of their wants from an engineer's standpoint.

◆

THE INTELLIGENCE OF PRINTERS and their constant improvement should be credited with contributing much to the success of engraving, for the excellence of it would not be known had not ways been invented for taking perfect impressions. The impression is greatly improved by raising those parts of the tympan against which the heavy parts of the engraving are pressed, using thin pieces of paper for the purpose, otherwise the heavy places would be too light and the light places too dark.—*Paper World.*

◆

IN 1851 TWO MEN began a search for hidden gold in Dungeon Rock, Lynn, Mass. They worked for 29 years and then died. All there is to show for their labor is a hole in the rock 8″ diameter and 175 feet deep. The men were father and son.

The father, in 1851, was worth a comfortable amount of property, but spent it all in the twenty-nine years that they worked, and left the property itself mortgaged for more than it was worth. Those who best knew the men say that they were both unusually smart and intelligent, except in this one particular, and what possessed them in this is beyond human understanding.

◆

A WRITER IN *Engineering* claims that Oregon was obtained by the United States under the following circumstances:

"A British ship of war sent to protect British interests on the Pacific, with a nobleman for commander, who, fond of salmon fishing, tried to tempt the mighty salmon in the waters of the Columbia, but the fish would not bite, and in disgust he wrote to his brother, a prominent statesman, that the whole country was worthless." Yet this is the river that furnishes two-thirds of the salmon in the world. It was the old story, a pine forest, a useless wilderness, to barter for some more valuable consideration, and a country the size and value and climate of France was hastily signed away."

◆

NOT MUCH OF A RIDDLE.—There are 1,800 prisoners in the jails of the State, at an expense of $3.31 per week each for sustenance alone. Says Mr. Round: "This sum of $309,816 is respectively submitted to the attention of those 'labor reformers' who say that for the men to work in the State prisons for 50 cents a day is taking the bread out of the mouth of honest labor. Let them furnish a solution to the following simple problem: If 3,000 men in the State prisons earning their living at 50 cents a day rob the honest laborer of his bread, how shall it affect him if 1,800 men in the county jails are living in idleness at an expense to the working public of 50 cents a day for each man?"

It affects him very slightly indeed, for the sum named, divided among the people of the State of New York, amounts to nothing to speak of. The working man is very willing to pay his share, which wouldn't be 50 cents.

◆

THE TUPELO GUM AND THE WILLOW OAK are timbers that are destined to a commercial value never, until recently, dreamed of. A gentleman residing in Mississippi who has tested them thoroughly says the first variety is almost as soft and light as the cork of commerce, and is the whitest timber in the valley. It is extremely light and cannot be split, and at the same time it is very tough and tenacious and will bear a very heavy strain. It will, some day, be used principally for buckets, bowls, pitchers, and trays; also for ox yokes, and for almost all kinds of water vessels. This wood grows among the cypress trees, and is far more abundant, and floats like cork. The water or willow oak is second only to the live oak, and is almost an evergreen; it takes the coldest weather to make it shed its leaves, and it is almost as hard when seasoned as the live oak, and for the rim and spokes of wheels it has no superior. For ship building it will almost equal live oak.—*Memphis Appeal.*

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Twenty-five cents a line for each insertion under this head.

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THE MECHANICAL ENGINEER.

New Series. Vol. VIII.—No. 8.
Enlarged 1883.

New York, October 18, 1884.

Single Copies, 8 Cents
$2.00 per Annum.

HARLOW'S VALVE GEAR FOR DIRECT ACTING STEAM PUMPS.

This valve gear consists, practically, of two moving parts, viz., the auxiliary valve *P* attached to and forming a continuation of the piston-rod, and the main valve *V* moved by the plunger *F*. *S* represents the steam supply-pipe, *Ex* the exhaust, *L* the main steam port to the lower end of the cylinder, and *U* that to the upper end.

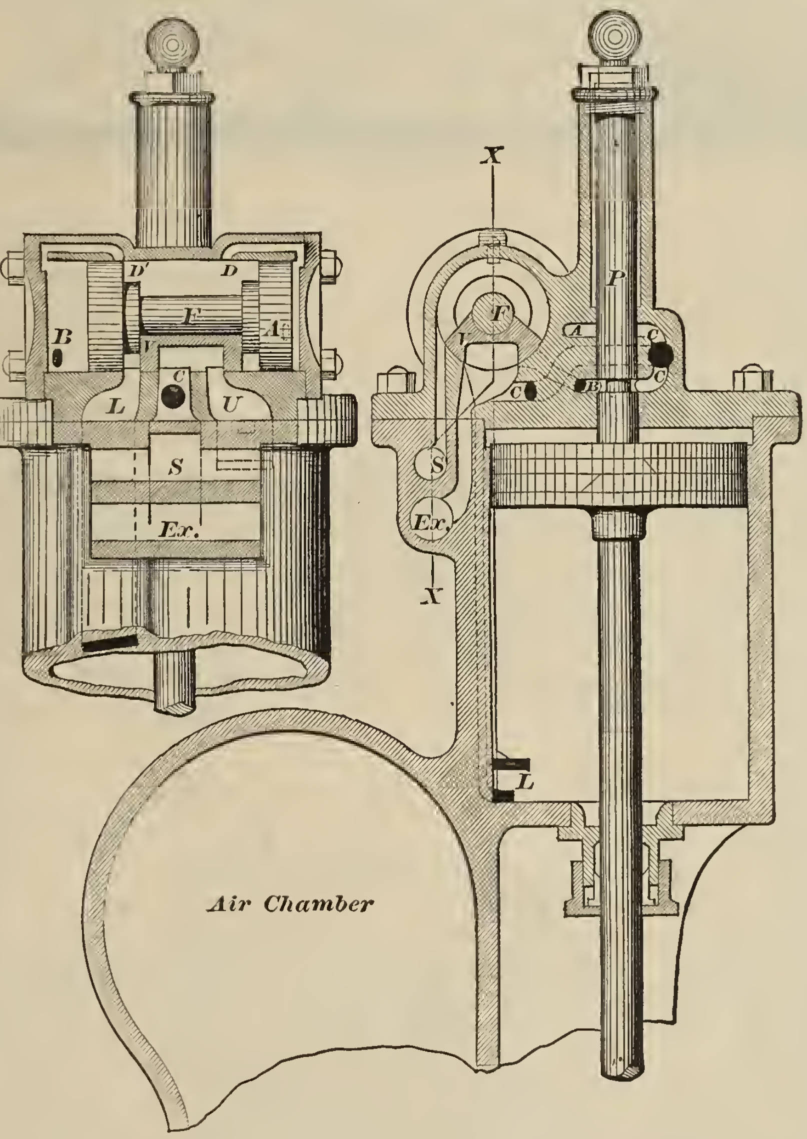
The operation of the valve is as follows: As shown in the cut, the main piston has reached the upper end of its stroke, the auxiliary valve *P* has connected ports *B* and *C*, exhausting the steam from that end of the auxiliary cylinder.

Steam now enters the other end through port *D*, and thus reverses the main valve.

When the main piston has reached the lower end of its stroke, the ports *A* and *C* communicate over the end of the auxiliary valve *P*. Steam now enters the port *D'*, reversing the main valve for the up stroke, thus obtaining a positive motion of the main valve without the use of tappets, springs, combined levers, cams, or other similar parts. By the arrangement of the ports in the auxiliary cylinder the plunger is prevented from striking the heads by means of steam cushions.

Another valuable feature is, that if the main valve be moved too far by its momentum, the cushions will return it to a fixed point at either end of the stroke, leaving the main steam ports fully open. The main steam ports are divided when they enter the cylinder, so that when the piston nears the end of its stroke a part of the steam is cut off and the speed of the piston is reduced. Also, when the stroke is reversed, only a portion of the steam enters the cylinder at first, thus giving a motion approximating that obtained by a crank and fly-wheel. This allows the pump valves time to seat without shock, prevents the piston from striking the heads, and, in connection with the steam-valve gear, makes a steam pump that is claimed to be practically noiseless at any speed.

This pump was designed by M. S. Harlow, 372 Washington St., Hoboken, N. J.



Harlow's Valve Gear For Direct Acting Steam Pumps.

◆

A NEW STEEL PROMISED.

Press dispatches say that a syndicate has been formed for the purpose of experimenting and controlling a new process of manufacturing steel which is to compete with the Bessemer, and the expectation is that it will take the place of iron in the manufacture of different articles. The syndicate is composed of Mr. Francklyn, of New York, owner of the Garfield cottage at Long Branch; James Henderson, of Bellefonte, Penn., the patentee; Marshall Brothers and Hughes Patterson, Philadelphia; the Montour Iron Works of Danville; the Reading Iron Works, William McIlvain & Sons, Reading; E. & G. Brooke, Birdsborough; Charles L. Bailey, Harrisburg; all prominent iron manufacturers, each one of whom has paid in $10,000 to form a pool of over $100,000 to use in perfecting the invention. The patentee claims that he can manufacture steel much cheaper than it is done at present. Steel ingots were sent to the different members of the syndicate and tested with satisfactory result. At the McIlvain mill specimens of this new steel were rolled, bent, twisted and punched the same as iron.

It is said that in rolling from the ingots no blisters form. The "Henderson" is an open hearth steel, while the Bessemer is not. Mr. Henderson has been experimenting at Bellefonte during the past year.

◆

The Man who thinks clearly writes clearly.

ISAAC NEWTON.

Members of the profession who were acquainted with the late Isaac Newton, a well-known engineer of this city, will be pained to learn of his death by his own hand on the 25th Sept. Mr. Newton was a great sufferer from dyspepsia and rheumatism, and it is thought that these ailments unsettled his mind. Although a young man, comparatively—his age was 47—Mr. Newton had occupied many responsible positions, and at the time of his death was engaged in several important enterprises.

◆

A Small Propeller on Lake Superior, called the *Waubun*—80 ft. long by 14 ft. wide—cost $26,000. This is explained by what follows: At one time all her cabin metal work was solid silver, and some idea of the expensive fittings may be gathered by a glance at the cabin. It is furnished throughout in paneled black walnut, has a sideboard that cost $1,500 and is fitted with velvet and plush cushions. All the lockers are lined with velvet, nickel plate abounds, and stained and ground glass are in the windows. The parties who bought her sold $2,000 worth of solid silver off her and there is some left. The boat has two 10 × 12 engines, a five foot wheel, and has a record of eighteen miles an hour. She is employed in regular service.

◆

Reports Concerning Experiments made at Cherbourg with a newly invented explosive (a mixture of carbon disulphide and hyponitric acid) show it to be a formidable rival of nitro-glycerine. The mixture burns, when not confined, with a brilliant white light, and can be used for illumination. This fearfully powerful substance is intended for filling shells and torpedoes.

◆

Several Persons have written in regard to the indicator advertised for sale in this paper, and some of them have requested the owner of it to "hold it" for a brief period, in order that they may meet the payment. The advertiser says that he is willing to oblige, but cannot defer any longer, and will sell to the first cash customer.

◆

The Fossil Meal Company, of 48 Cedar St., are meeting with great success in the sale of their boiler covering. The large number of testimonials from prominent manufacturers in their possession are evidence that it is of practical value. Fossil meal is an earthy substance, very light in nature, and easily applied by any one; it can be used over and over again. We advise all who want a good lagging to try it.

◆

Engravers Of The United States have made remarkable strides in wood engraving, and it is generally admitted that they excel the engravers of Europe. The reason is to be found, largely, in the competition that has existed for ten or twelve years between *Harper's* and the *Century* magazines. They have made strenuous endeavors to get the best talent, and have urged engravers to more perfect work, until, at the present time, but little wood engraving is done so well as that published in those magazines.

◆

Recently We Found a flat bristle brush, two inches wide, in the cellar of a house we had rented. It had been used in white lead and left in wretched condition. By cutting off a layer of bristles on the outside, and soaking it two or three days in kerosene oil, the bristles became pliable, and were easily cleaned by a free use of the oil and by working the brush on a piece of board. It was used about the house, then cleaned out in the oil and set in a clean dry can, where it will remain soft as silk.

Brushes kept about the house for any purpose may thus be kept in prime condition, whereas when set away in water they are forgotten; the water evaporates and leaves them well nigh worthless.—*Cor. Coach Painter.*

◆

Mr. John Haug, of Philadelphia, surveyor to the British Lloyds, says:

"A steel ship costs from 8 to 10 per cent. more than an iron ship of the same size, but its greater carrying capacity will enable it to pay off this increased cost in two or three years. A steel vessel built for the Spanish ore trade, carrying 1,300 tons, cost (in 1877) £18,350; an iron vessel of the same size would have cost £17,000, but would only carry 1,220 tons of ore. The extra net earnings of the steel vessel due to the 80 tons extra carrying capacity were £560 per annum. As steel is gradually approaching iron in price, the difference in cost of iron and steel ships will grow less, and, as the latter material is growing more uniform and reliable, perhaps a greater reduction of thickness than 20 per cent. will be admissible.

"The first sea-going vessel built of steel in the United States is Mr. William Astor's steam yacht *Nourmahal;* she has been constructed in accordance with Lloyds' rules, under special survey, to class 100 A1, and the numerous samples selected from her materials for tests, required by Lloyds' rules, have mostly exceeded the tenacity and ductility required by the rules."

◆

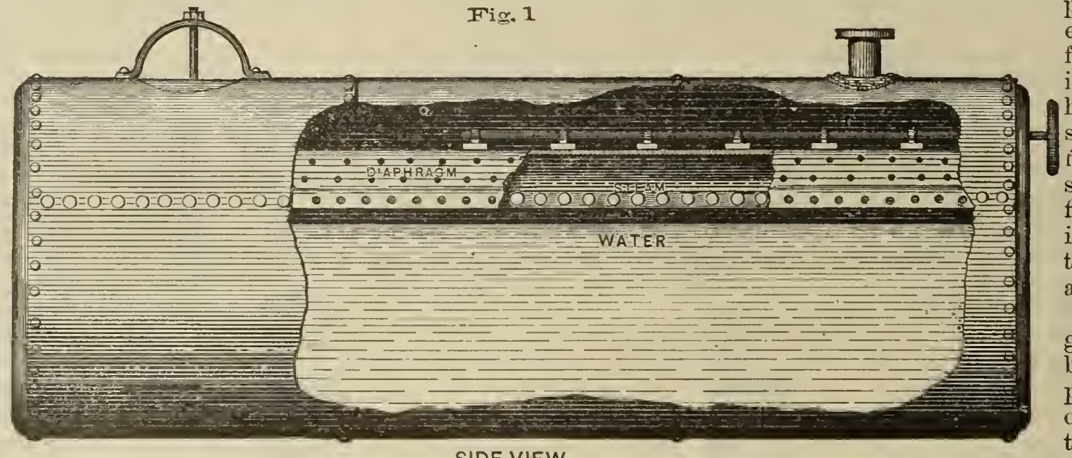
What Nonsense this premium business for subscribers is! Here is a lumber paper out West that offers to give a pocket-knife—among other things—to each subscriber who pays $1.00, the regular subscription. The knife is listed at 60c., so that the paper is worth only 40c.! Why not give the knife and the paper both, to all who will send their address on a postal card?

THE LAWSON NON-EXPLOSIVE PATENT STEAM BOILER.

The illustrations represent the Lawson boiler, which, it is claimed by the inventor, is entirely safe from explosions. The explanation appended is a portion of a paper by Thos. Kays, Pres. of the Lawson Non-Explosive Boiler Co. The entire paper can be had from the Company, 155 B'way, N. Y.

The Lawson theory is this: The only explosive material about a steam boiler is water; and water, when superheated, which can be done only under pressure, will explode upon a sudden removal of that pressure, with a force quite equal to that of dynamite. The boiling-point of water varies with pressure. In a vacuum water boils at 70° sensible heat. Under atmospheric pressure it boils at 212°, and cannot be made hotter unless confined under additional pressure, because the escaping steam carries off the heat as fast as fire can impart it. In a steam-boiler under 10 lbs. pressure it boils at 241°; 50 lbs., 300°; 100 lbs., 340°; 200 lbs., 389°.

Fig. 1



SIDE VIEW

Water when heated to the boiling point requires 966° additional heat to change it from the state of water to the state of steam. This change is substantially instantaneous at all pressures. As each molecule of water absorbs the last of the 966° it instantly explodes into steam. As the last degree is absorbed cohesion is overcome and repulsion becomes the predominant power.

The true source of the development of the great destructive power in a steam boiler is the sudden *concentration* of the sensible heat in the water above 212° (or above 70° in case of a vacuum caused by the condensation of steam) into a part of the molecules of water, passing into them the 966° necessary to change them from the state of water to the state of steam.

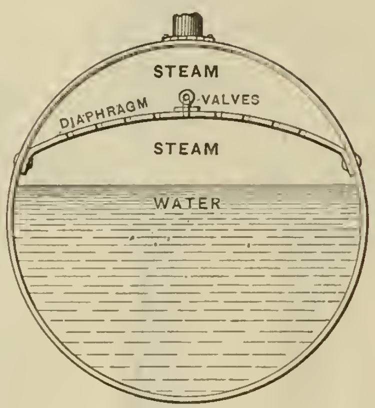
That the stored heat in a boiler concentrates to form steam is shown by familiar experiments.

As, for instance, causing water at less than 212° to boil by placing it in a vacuum; or by merely condensing the steam over heated water in a bottle.

Again, take a steam boiler under a pressure of 100 pounds and a corresponding temperature of 340°. Remove the fire, and the formation of steam will cease. After a short time raise the safety-valve, and the water will begin to boil, and generate and give off steam continuously as the pressure is reduced, until a temperature of 212° is reached, and enough steam will be generated and blown off to fill the boiler many times.

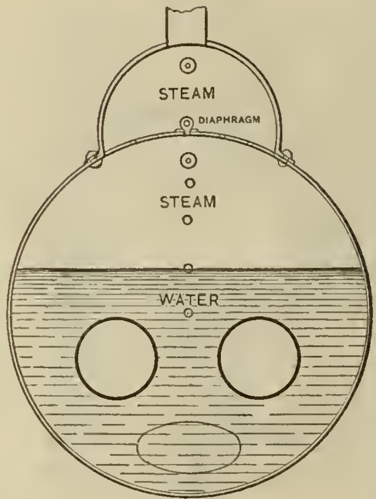
These tests show that the boiling-point of water is lowered by simply diminishing the pressure. They show this, and also show the true theory of boiler explosions. They prove in the most conclusive manner that the sensible heat above 70° stored in the water concentrates in a part of the molecules of water, giving to them the 966° necessary to change them into steam. The water ceases to boil, no heat is applied, and by merely reducing the pressure the water again boils. The 966° above the boiling-point necessary to cause ebullition are not absorbed from the fire at the instant the water begins to boil the second time. They are already stored up in the water.

Fig. 2



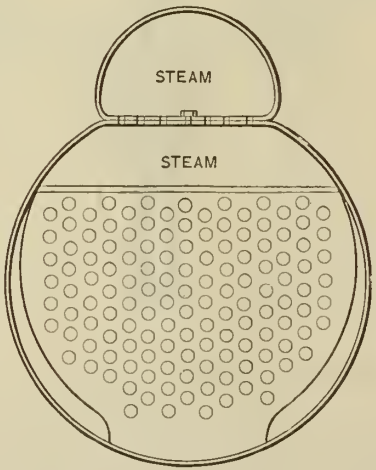
END VIEW

Fig. 5



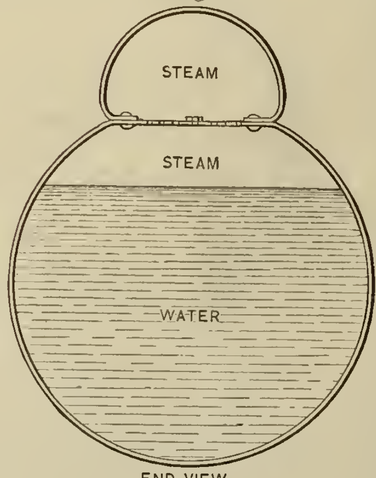
END VIEW

Fig. 6



END VIEW

Fig. 7



END VIEW

The distinction between *rupturing* and *exploding* is generally overlooked. When a boiler gives way at a weak point, resulting in damage, it is often called an explosion. When ruptured by mere pressure, the force exerted upon the shell being gradual and uniform, the weak point yields while the balance remains intact. Serious damage may result, but a uniform and unobstructed flow of steam never produces the phenomenon properly called an "explosion." With an explosion the actual destructive force exerted is not measured by the tensile strength of the boiler nor by the regular pressure of the steam. The force is far in excess of either—five, ten, and often twenty times as great: an immense aggregate concussive and destructive force, that tears asunder the weak and the strong parts at the same instant and demolishes everything within a large radius.

The rational solution of a steam boiler explosion is this: The water in the boiler, under pressure, is superheated and possesses a highly expansive power. Upon a sudden removal of the pressure, without a corresponding reduction of the temperature, it starts into violent evaporation. This mass of nascent steam is checked by coming in contact with the solid and unyielding shell of the boiler. The result is that the aggregate force of this nascent steam strikes every square inch of the shell of the boiler at the same instant and with the same force, and with a power far in excess of the tensile strength of the boiler; and, moreover, this force is augmented at the instant the shell gives way by an immense reserve power caused by the further evaporation of the water in the boiler.

Mr. Lawson, having discovered the cause, naturally turned toward the remedy, which is a simple one, and consists in the construction of a boiler with a partition-plate or diaphragm dividing it into two compartments, the lower containing the water, and the upper containing steam only. The steam pssses from the lower to the upper compartment through numerous small perforations and a number of small valves in the diaphragm. The aggregate openings of the valves and perforations should be less than the valve through which the engine is supplied. By this means the pressure upon the superheated water is kept approximately uniform, and all sudden explosions of any dangerous quantity of water into steam and consequent striking blows are avoided.

The diaphragm extends the length and width of the boiler, and is firmly riveted to the sides and ends thereof, as shown by Figs. 1 and 2. It may be circular or flat and so located as to cut off about two-thirds of the usual steam space.

The perforations and valves vary with boilers of different size. The aggregate area of all the perforations and valve orifices should be about ten per cent. less than the area of the steam-port. In ordinary size boilers there should be one perforation of one-quarter of an inch in diameter to each horse-power, rating ten square feet of heating surface to the horse-power, and such number of valve orifices of about two inches in diameter as to make up the balance of the aggregate area.

This lessening of the aggregate area ten per cent. below that of the steam-port will give a very slight diminution of pressure in the engine with steam working at full stroke, but will give practically full pressure at every other point of cut-off.

There must be two steam-gauges used, one connected with the water space below, and one with the steam-space above the diaphragm.

When the boiler is set and ready for use such small valves should be closed. As the steam is generated and the engine put in operation at its full capacity, any additional steam required is obtained by gradually and partially opening such valves until the required amount is liberated and ascertained, when such valves are set, and need but little further attention. In thus arranging such valves particular attention should be paid to the steam-gauges. The valves should be opened only to that extent at which the pressure upon the superheated water in the lower compartment, as shown by the gauges, remains approximately uniform with that in the upper, with the engine in full operation. Thus arranged, any unusual and sudden withdrawal of steam from the upper chamber is attended with no possible danger.

Boilers thus constructed and arranged are protected against explosions, whether the water wholly or partially fills the water compartment. If wholly filled a sudden reduction of pressure in the steam compartment can instantly affect only the surface of the water to the extent of the aggregate area of the perforations and valve orifices, and no dangerous quantity of water can be thus exploded. As the pressure upon the water below the diaphragm is thus slightly reduced, small portions of the water pass into steam and maintain uniformity of pressure.

If the water should get low, thus accumulating an unusual quantity of steam below the diaphragm, there can be no danger of an explosion. The discharge of steam from the ordinary boiler into the empty pipes and cylinder upon the sudden opening of the valves, is at a velocity of over 100,000 feet per minute, and for an instant there is a great reduction of pressure upon the surface of the superheated water. This cannot occur with the Lawson diaphragm in a boiler. With it the passage of steam from the water compartment below the diaphragm to the steam space above it is limited to that quantity used by the engine with the piston moving at the rate of say 600 feet per minute, and cannot exceed this precise amount to any great extent, although the steam may, from some unusual cause, be temporarily rushing from the steam space above the diaphragm fifty times as fast. The diaphragm limits the quantity of steam discharged from the water compartment to the exact amount necessary to drive the engine in full operation, and the liberation of this amount at such uniform rate can be attended with no possible danger.

The Lawson diaphragm is to the steam boiler what the air-chamber is to the hydraulic ram. It performs a similar but much more important function. The elasticity of the air moderates the otherwise solid blows of water upon the pipes; the diaphragm preserves uniformity of pressure upon the water, and thus prevents its explosion and the consequent violent and irresistible concussive blows upon the shell of the boiler.

There is still another operation constantly going on in this chamber, which greatly aids in thus depositing the sediment. It is this: The steam is drawn from this chamber for use. At each cut-off of the supply of steam to the engine there is a slight intermittent motion to the steam in this chamber. At each cut-off there is a decrease in the specific gravity of the steam resulting from the change of pressure, and this decrease of gravity and intermittent motion all tend to deposit the sediment. This boiler, therefore, with no other contrivance, thus forces the solid foreign substances in the water into the upper chamber before they have any chance to fasten themselves to the shell of the boiler. Thus, the mystery of boiler explosions having been solved, and a perfect preventive devised, accompanied by the attainment of dry steam, absence of incrustation, and safety with high pressure, are we not upon the threshold of a new era in the use of steam?

Explosions are thus prevented, not by extra strong boilers, but by preventing the occurrence of the cause. Boilers thus constructed can be safely operated at a pressure closely approaching their actual tensile strength.

The invention is applicable to every style of boiler, and can be readily applied, internally or externally, to new or old boilers.

Figs. 1 to 7 fully illustrate the invention. Figs. 1 and 2 show an internal and Figs. 3 to 7 an external application. Figs. 1, 2 and 5, high pressure, and Figs. 6 and 7, very high pressure.

This discovery and invention remove all obstacles to the use of high pressure. With immunity against explosion higher pressure is safely secured, and with it greater power and economy attained. It produces dry steam, and prevents "foaming," "priming" or "entrainment."

With the diaphragm, the steam passes from the lower compartment to the upper, not at one point, but in small quantities at many points; and the steam used being taken from the upper compartment, all the concussive force and intermittent pressure and motion are arrested and confined to the upper compartment, and the result is that the pressure upon the surface of the water is *uniform;* there is no rising and falling, no irregular pressure, no irregular and violent ebullition.

With boilers thus constructed, incrustation is wholly prevented. All foreign solid substances held in suspension or solution are separated from the water and deposited upon the diaphragm, where they do not interfere with the generation of steam, and whence they can be readily removed.

◆

THIS IS WHAT A FRIEND WRITES from Nova Scotia:

"Although I have seen but one copy of your paper, and perhaps that is not enough to form an opinion on, and assuming that one copy is a fair sample, I consider it a better paper than the —— or the —— for engineers and machinists, as it contains more *applicable* knowledge for the craft. If it continues in this line I predict a large sale for it in the Dominion. Find enclosed $2, etc., etc."

We found it.

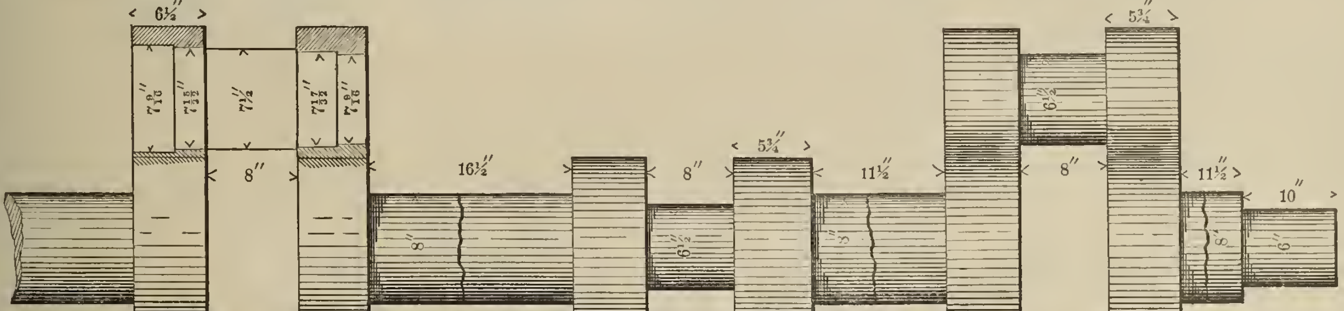
A MARINE CRANK SHAFT OF THIRTEEN PIECES.

By E. S. Chapelle.

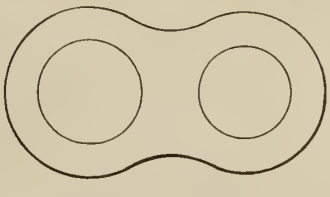
Those of your readers who were interested in the description of a crank shaft made without special tools, in a late number of your lively paper, will doubtless be interested in another which has been built in the same shop, with equally god results.

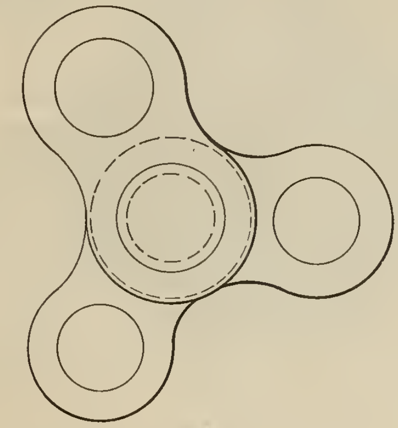
Fig. 1 of the accompanying drawings represents the after-web of the crank shaft, showing the form of all the webs, which are of wrought iron. Fig. 2 shows the arrangement of the several cranks 120° apart. Fig. 4 shows thickness of webs, size of holes, length of bearings, etc.

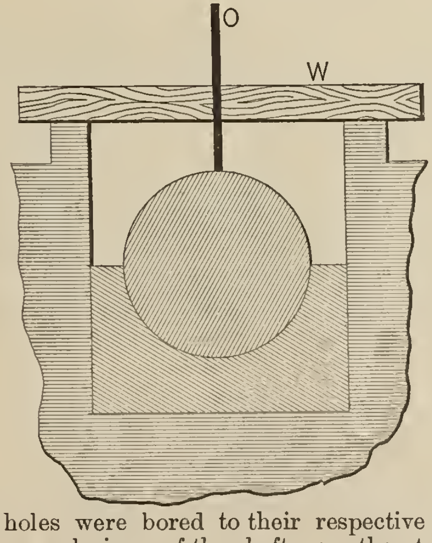
The webs were rough finished when received, and were first planed and the shaft holes then bored, on a Pond Machine Co.'s boring-mill, to a uniform size of $8\frac{1}{16}$ inches. Then the crank-pin holes were bored to their respective sizes. The several pieces of the shaft were then turned, and the bearings finished, allowance being made for shrink-fits for the webs; after locating and finishing the key-ways the webs were heated and shrunk on to their respective places and keyed in the usual way. Key-ways were also made in one of each pair of webs at the crank-pin end. The crank-pins, of steel, were then turned for press fits, and a key-way made in one end to correspond with that made in the web.



The reader is requested to ignore the sizes marked on the crank-pin section. The author should not be held responsible for them; his drawing is mislaid, so that we cannot verify them.







The several pieces of the shaft were then placed in their boxes in the engine bed, which had been bored to receive them, and the crank-pins forced in with two heavy screws, aided by blows from a 200 lb. battering-ram. It will be seen by referring to fig. 4 that the crank-pins were entered through one web and that there are two sizes in each web. This allows the parts to be exactly in line at first entering, and avoids cramping in any way. The united force of three men with an eight foot wrench was required to turn the nuts on the bolts used in drawing in the crank-pins, while two men plied the battering-ram. Distance pieces were fitted between the webs of each crank which kept them the right distance apart, while the crank-pins were being drawn in, and a "glut" was fitted in the key-way to insure that being in line. Then keys were fitted in the key-ways of one end of each crank-pin, and in the other end a hole was drilled, half in the crank-pin and half in the web, and reamed with a taper reamer, and a round pin fitted and driven in, instead of a key; it being impracticable to make the key-ways in the usual manner.

Fig. 3 is a sectional view of the shaft in its box in the engine bed, with a piece of wood, *O*, lying across the jaws; a wire, *W*, passes through the wood, and just touches the shaft. A wire was adjusted over each of the four bearings in this manner, and the contact of the wire with the bearing tested with a piece of newspaper. Then the shaft was turned one-quarter of a revolution, and again tested with paper; then another quarter of a revolution and again tested, and so on until each bearing was tested in four places, making sixteen in all. In no place did the variation from the first position exceed the thickness of the paper used.

As the bearings were all as true as good machine tools could make them, and the joints all satisfactory, it is conceded by good judges that we have a better crank shaft than could be possibly made if finished after being put together.

This crank shaft will be worked by steam pistons of 15, $23\frac{3}{4}$, and $37\frac{1}{2}$ inches diameter, with steam at 150 lbs. pressure on initial piston, expanding on the other two before condensing. Good work is expected of it, as one man can easily turn it in its bearings with the upper boxes and binders on.

◆

"MR. WALTER W. SCOTT writes to THE MECHANICAL ENGINEER (No. 9, current vol.) concerning an article copied by it from the *Railroad Gazette*, describing the locomotive designed by Mr. George S. Strong, of Philadelphia, saying that it gives currency to a misstatement.

We may observe that the article in question was *not* copied from the *National Car-Builder*, but originated with this paper, and that the engine in question is *not* fitted with Joy's valve gear, but with a motion invented by Mr. George S. Strong, which, in the opinion of many well qualified to judge, is a distinct improvement upon Joy's gear. A perusal of United States patents Nos. 304,970 and 304,972 will enable those interested to form some idea of the essential features of this valve motion."—*Railroad Gazette.*

◆

THE NOVEMBER NUMBER of *The Magazine of Art* will contain articles on "The American Salon," by W. C. Brownell, illustrated with engravings after F. A. Bridgman, Wyatt, Eaton, Stewart, Boggs, Grayson, and W. T. Dannat; a second chapter of "Head Gear in the Fifteenth Century," by Richard Heath; "Out of Town," by J. Penderell-Brodhurst, with illustrations by Allan Barraud; "Betwixt Tavern and Tavern," by Percy Fitzgerald, with illustrations drawn by E. J. Lambert; "Old English Painters," by Edmund Ollier, with engravings after Riley, Walker, Nathaniel Bacon, and Peter and Isaac Oliver; and "French Furniture," by Eustace Balfour. Cassell & Co. (Limited), New York.

◆

JOHN H. FLYNN, master mechanic of the Western and Atlantic Railroad, and President of the American Association of Master Mechanics, died at his home in Atlanta, Ga., on the first instant.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

"OBSERVER" ANSWERED.

Editors Mechanical Engineer:

The thickness of the plates in the boilers of the *Louisiana*, I think, will have to be ⅜ inch and no "mistake." A new sheet has been put in each boiler, and *now*, should 90 lbs. working pressure be needed, there no longer exists a legal reason why it can be refused when applied for. It seems probable, therefore, that a 72 lbs. certificate will be held for several years to come, unless a "great objection" bulges the shells over the furnaces!

According to "*Observer*," this may occur at any time, under his 5 days' rule, as, unless the river water at New Orleans is reasonably pure, it is our custom *not* to change the water in the boilers; very often it is unchanged for the round trip, or about 11 days.

The fact is "*Observer*" goes very far into probabilities to prove something *he wants to*, but the really objectionable paragraph to him in my first communication is:

> "And have developed a most efficient boiler; safe, simple, and cheaply constructed."

This is abominable, and I am sorry, because I, too, am in favor of the sectional water tubular type, and suppose this fact, concerning the "*Louisiana's*" boilers, ought not to have been circulated, as it tends to spoil business.

If the wing-walls do concentrate the heat, I can assure "*Observer*" that in no wise does it distress the boilers. The truth is that the "vulnerable point" is *no point at all*, and only exists in "*Observer's*" imagination; the same of "necessitating repairs," etc.

It is also gratifying to know that "the injurious effects of such high heat on the other thick seams of the boiler" does *not* give trouble in practice.

Now it is true (and to this is due the economy and efficiency of these boilers) that the furnace heat is very considerably higher than that which *can* be had in water walled furnaces. In the former more perfect combustion is obtained, yet the hard work wears but lightly upon the iron of the boilers, whether the thickness be ⅜ or 1¼ inches at the seams. The "*Louisiana's*" boilers have required no repairs, not even caulking, since the entire removal of the superfluous heating surface, a period of five round trips.

The last paragraph (in "*Observer's*" communication) is simply an attempt to belittle a success in boiler designing, practically demonstrated. I ask, can he do as well?

The article commented upon by "*Observer*" was given to The Mechanical Engineer as a statement of a peculiar and somewhat remarkable experience in boiler engineering, which can be verified upon inspection. What is "likely to appear," and the prophecies of failure which have been so frequently expressed, I take no *stock* in, neither do I in a *probabilities man* on the boiler question.

The boilers of the "*Louisiana*" are working admirably, notwithstanding the adverse criticisms; their practical success is commented upon favorably by *practical engineers*. I have had several communications to this effect, in which I am congratulated, etc.

New York. M. C.

◆

THE RECORD OF AN OLD ENGINEER.

Editors Mechanical Engineer:

I have been getting your interesting and valuable journal from a newsdealer here for some time. I intended sending direct for it, but having been busy repairing and getting the mill started up after harvest, I have neglected it. Enclosed please find two dollars.

I may be termed an old engineer, but am not too old to learn! I have a good many mechanical books and have taken several mechanical journals and always find something interesting and instructive in them all. I was born in Pennsylvania in 1830, and built many a flutter wheel, and run it by the spring branches, with tilt hammer attached, making music (?) for the neighborhood by beating on a tin pan, etc. I learned the blacksmith's trade in Pittsburgh, started on the steamer *Ben West* in the spring of 1850, to learn engineering. I went on the steamer *John Simonds*, December 1852, running from St. Louis to New Orleans (one of the largest boats of her day); I was on her five years; on steamer *Belfast*, running between Memphis and New Orleans, two years; then quit steamboating and started blacksmith and jobbing shop in Memphis, Tenn.; ran it until 1863, when I closed, as everything was military there then. I went on the river again and was chief engineer on steamer *Imperial*, the first boat that went through to New Orleans after the surrender of Vicksburg. Was engineer on steamers *T. L. McGill* and *Kate Kinney* several years, and afterwards took charge of the machinery of an iron furnace in 1869 at Carondelet, Mo., and was there until the crisis of 1873. I steamboated nearly two years longer, and now have been engineering a flour mill here for nine years.

I have been a member of quite a number of engineers' societies, and advocated the law requiring the licensing of stationary engineers in St. Louis, and the inspection of stationary boilers, etc., in 1866. Also, was one of a committee of three appointed by the Marine Engineers Association, of St. Louis, Mo., to examine into the cause of a destructive explosion on Franklin avenue in said city on October 17, 1866. My information has been obtained by hard knocks and close study. I number among my friends some of the best engineers of St. Louis and New Orleans.

I have kept a diary of important matters (to me) ever since I commenced steamboating.

Now I do not write this through vanity, but to let you know what kind of engineers appreciate your valuable paper, and also to encourage you to go on in the good work. J. W. B.

Chester, Ills.

[We thank our correspondent for his favor; his has indeed been a wide experience. No doubt many of his old friends and comrades will see this and recall days that are past. It is worthy of note that our friend says: he "is not too old to learn." That is a wise man's sentiment.—Eds.]

◆

A MACHINIST'S VIEWS ON MATHEMATICS.

Editors Mechanical Engineer:

Mr. Bilgram's letter in The Mechanical Engineer for September 20th brings up a point on which you will probably say I am "cranky." There is no doubt but that any one who understands 2 × 2 can as easily understand $x \times y$; but please take notice that I say *understands* 2×2.

Let Mr. Bilgram question a dozen high school graduates in some shop about the 2×2 and see how many of them really understand it. The trouble is, nowadays, that scholars are taught to say 2×2=4, and that ends the matter. Once in a great while some boy will not be satisfied that 2×2 really does equal 4 until he has counted his fingers or marbles and proved it to his own satisfaction. Such a boy develops into a good mathematician; others generally do not. To carry the point a little further: take 3×2 instead of 2×2. The scholars will say: 3×2=6. Ask them how many 2×3 are and they will probably say: "Why, 6, of course." Now I venture the assertion that not more than one out of the dozen can show why 2×3=3×2, and I claim that those who cannot do not understand the matter, and cannot be expected to understand the $x \times y$. Why this is so (if it is so), is not for me to say, but I cannot resist the temptation to remark that Philadelphia, where Mr. Bilgram's letter is dated, pays her school teachers at least as low salaries as any city in America.

Mr. Editor, you have, yourself, before now in your paper, covered all I could say about the "mathematical faculty," and I know from sad experience that you are correct. I claim to be a fairly intelligent person, but what little I know about mathematics has come from the hardest work I ever did, or ever expect to do, so that I never expect to be able to understand an article by Mr. Bilgram, which I lately saw, on the "*Center of Gyration*."

To go back to the high schol graduates, how many of them could do a problem in square root if they had forgotten the rule, were out on the prairies, and had lost their text books? Machinist.

Boston, Mass.

◆

GOOD ADVICE FROM A BOILER MAKER.

Editors Mechanical Engineer:

I would like to give a few hints to your readers about boilers. I have done a good many repairing jobs in my time, and always tried to find out the cause of the trouble.

I suppose many of your readers have been troubled with "pockets" or bulges in boilers over the fire. I have cut a good many of them out, and found bolt-heads, rivets, and even washers on the sheet that bagged. Other cases of bagging have been caused by leaky seams. Mud will always gather around a leak, especially if on the bottom or on crown sheet. Engineers should have such leaks caulked immediately. If a boiler-maker is not to be had readily get a small fuller made; any cold chisel will do by grinding the edge off rounding; caulk *lightly* all leaky seams with this.

There are often cracks from the edge of the sheet to rivet-holes; these can be closed with the fuller by working the crack together from each side without danger of their opening again, if caulked solid. These are called "fire cracks," but they should be called cold air cracks, for they are chronic on boilers that have the furnace doors open long and often. If the bulged plate has to come out let the boiler-maker take it out well up on each side, so that the seams will be as far away from the fire as possible. By putting a small patch on, a sort of enclosure is formed by the rivet-heads, all ready for the mud to collect in, and it is ten chances to one that all the bad iron is not cut out. If the piece to be removed is on the seam, let the boiler-maker cut out each side of the seam, for the holes in the inside sheet will be elongated and the neck of the rivet won't fill it; the rivets will be leaking before the boiler-maker gets back to the shop, if he has any distance to go! J. C.

Penn.

◆

PETROLEUM AS A PREVENTIVE OF PRIMING.

Editors Mechanical Engineer:

In your last number you quoted an article on "*Petroleum as a Preventive of Priming*." Is it a safe remedy, and, if so, what grade of oil would you recommend?

Also, will thirty (30) sq. ft. brass condensing surface run a 4×6 boat engine cut off at half stroke? G. D S.

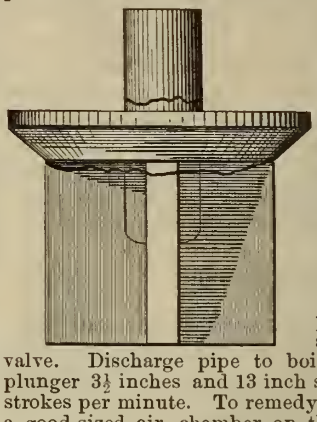
Boston.

[We have never had any experience with petroleum as a preventive of priming, and cannot advise on that point. A mechanical device is preferable. Of such the dry pipe is the most simple and satisfactory. If the boiler primes through being overdriven or defective construction, the dry pipe will stop it. It is simply continuing the steam pipe inside the boiler, horizontally over and partially around the water, as far from it as possible. The upper part of the pipe is drilled with very small holes equal in number to 1½ times the area of steam pipe. If properly arranged the trouble will be entirely obviated. The holes should not exceed $\frac{1}{16}$th of an inch in diameter. We may add that many boilers prime simply because the water is carried too high in them; 1½ gauges is perfectly safe. The condensing surface named is ample for the duty required, if kept completely immersed.—Eds.]

TROUBLE WITH FEED PUMP VALVES.

Editors Mechanical Engineer:

In reference to an article in number 3 of The Mechanical Engineer, by John W. Nystrom, on hydrostatic boiler tests, a case mentioned is very similar to some that I have had, and I send you a broken suction valve for a boiler feed pump, the appearance of which will give you some idea of its action. It is a very good sample to some that were broken in the same pump. This one ran three days; others would run from one to four weeks. In some the tops would break off, in others the wings, and still others would break both top and wings, as per diagram. I will give you the size of pump and valves. Two sea-cocks are attached to pump on a 2-inch and 2½ pipe about 6 feet long, with an air-cock close to the pump, the water standing about four feet above the valve. Discharge pipe to boiler is 2″; diameter of plunger 3½ inches and 13 inch stroke, making about 90 strokes per minute. To remedy the trouble I had I put a good-sized air chamber on the suction side of the pump, and one of the *old valves*, and it has been *there doing good work* for about seven months and is all right yet, making as many as 125 strokes per minute. I rather think that the *force* of impact is weakened some. I would be pleased to hear from others who may have had similar trouble. Vacuum.



Milwaukee, Wis.

◆

TO MEMBERS OF THE NATIONAL ASSOCIATION STATIONARY ENGINEERS.

Editors Mechanical Engineer:

I wish, through your columns, to thank the secretaries and members of the different subordinate associations of stationary engineers for their courteous and considerate assistance during my term as Secretary of the National Association.

I am heart and hand in the work and shall do all I can to assist my successor in his arduous duties, but, according to an article adopted at our last meeting, I am, in a measure, confined to the State of Michigan, and would be pleased to correspond with the engineers of that State relative to organizing associations. I will also be pleased to attend to communications from whatever source. If all the delegates who were at Baltimore, and were constituted deputies there, would spend a little time corresponding with and working up new associations, there is no reason why next September there should not be one hundred and fifty associations represented. Now let all go to work and see who will be the means of organizing the greatest number of good, live associations in the eleven months that intervene.

175 Elmwood avenue, Detroit. A. M. Davy.

◆

VARIOUS QUESTIONS.

Editors Mechanical Engineer:

I would like to ask a few questions through your valuable paper, from which I have learned very much. I have charge of a boiler and have to blow off every week regularly. Would it injure to blow off two and a half or three hours after fire has been drawn, then wash out and fill it? Is there a boiler compound that will clean and keep boilers clean without injuring the iron? If so, please name it, and where to be had. Please explain what pulsating is in boilers. E. J. H.

San Francisco, Cal.

[Three hours is scarcely time enough for brick work to cool down; six is better. There are boiler compounds which are useful when properly employed; consult our advertising columns. Pulsation in boilers is a throbbing action of the shell, the same as in the human pulse.—Eds.]

◆

INTERMITTENT WATER SUPPLY.

Editors Mechanical Engineer:

In your issue of September 6th, under the heading of "*Questions*" you say:

"Do you sometimes run your boiler full and then shut the feed off entirely?"

I pump the boiler up to near the top of the gauge-glass before quitting for the night, and leave it that way till morning; this gives the mud a chance to settle and we have plenty of water on hand to give the boiler a thorough blowing out. I do the same at noon. Can't see anything objectionable in the practice. If any, what is it? Eccentric.

[There is no objection to our correspondent's practice; in fact, it is commendable. Our question had reference to an intermittent feed water supply.—Eds.]

◆

ATTENTION, ASSOCIATIONS OF STATIONARY ENGINEERS!

Editors Mechanical Engineer:

I would like to have the associations who were not represented at the convention by their own members, and associations who were not represented at the convention, elect one of their members to serve as deputy for the year, and send name and address to me, so that I can make out commissions for all deputies.

Chicago, Ills. J. G. Beckerleg,
Pres. N. A. of S. E.

◆

A Man who wanted trains on an Illinois railroad to stop near his farm, put up a sign "run slow" on a culvert. This worked very well for four years, until some one got tired of running slow and discovered the fraud.

QUICK WORK IN ENGINE BUILDING.

The large pumping engines built by E. P. Allis & Co., of Milwaukee, for Allegheny City, Pa., were formally tested and accepted on the 1st inst. The result of the official test made by D. M. Green, of the Rensselaer Institute, Troy, N. Y., demonstrated a duty of over 106,000,000 foot-pounds per 1,000 pounds of water evaporated, and this after making deduction for the amount of power required to feed the boilers and giving no allowance for the water entrained in the steam. The result was largely in excess of the duty required by the contract (95,000,000 foot-pounds), and could not be otherwise than gratifying to both the city authorities and the builders. The immediate and perfect success of the engines, their original design and the rapidity with which they were constructed are unexampled in the history of American pumping engines. We doubt if, in the history of mechanical engineering in this country, another instance can be found where machinery of such magnitude has been contracted for, drawings and patterns of every piece made, machines finished, erected, tested and paid for in so short a time. The contract was dated Aug. 7, 1883, the first engine was started May 31st, 1884, and a week later made a 24-hour run, pumping seven and one-half million gallons into the reservoir, an excess of one and one-half million gallons over contract requirements. Between Aug. 7, 1883, and Sept. 8, 1884, new drawings and patterns were made for every piece, and the two engines fitted and erected ready for duty, tested, accepted and paid for. If anyone has done better than this we shall be pleased to hear from them.—*Millwright and Engineer.*

◆

PLEA FOR MANUAL TRAINING SCHOOLS.

A writer in the *Popular Science Monthly* says: Parents often complain that their sons who have been to school all their lives, have no choice of occupation, or that they choose to be accountants or clerks, instead of manufacturers or mechanics. These complaints are invariably unreasonable; for how can one choose at all, or wisely, when he knows so little?

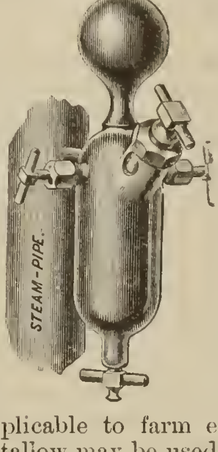
I believe that the development of the manual elements in school will prevent serious errors in the choice of a vocation. It is not assumed that every boy who enters a manual training school is to be a mechanic; his training leaves him free. No pupils were ever more unprejudiced, better prepared to look below the surface, less the victims of a false gentility. Some find that they have no taste for manual arts, and will turn into other paths—law, medicine, or literature. Great facility in the acquisition and use of language is often accompanied by a lack of either mechanical interest or power. When such a bias is discovered the lad should unquestionably be sent to his grammar and dictionary rather than to the laboratory or draughting room.

On the other hand, decided aptitude for handicraft is not unfrequently coupled with a strong aversion to and unfitness for abstract and theoretical investigations. There can be no doubt that, in such cases, more time should be spent in the shop, and less in the lecture and recitation room. Some who develop both natural skill and strong intellectual powers will push on through the polytechnic school into professional life, as engineers and scientists. Others will find their greatest usefulness, as well as highest happiness, in some branch of mechanical work, into which they will readily step when they leave school. All will gain intellectuality by their experience in contact with things. The grand result will be an increasing interest in manufacturing pursuits, more intelligent mechanics, more successful manufacturers, better lawyers, more skilled physicians, and more successful citizens.

◆

THE TOPS OF CHIMNEY-STACKS need careful arrangement, because the exit of smoke from them is very liable to be disturbed and hindered by gusts of wind; particularly when beneath other high objects in the neighborhood. There should be at the top of every flue an expanded space, within which most down draughts of air will rotate, and expend their force, without invading the flue below; and there should be louvred openings, so arranged as to direct the wind upwards, and make it assist, instead of interfering with, or retard the exit of smoke.—*The Architect.*

THE ECLIPSE LUBRICATOR.



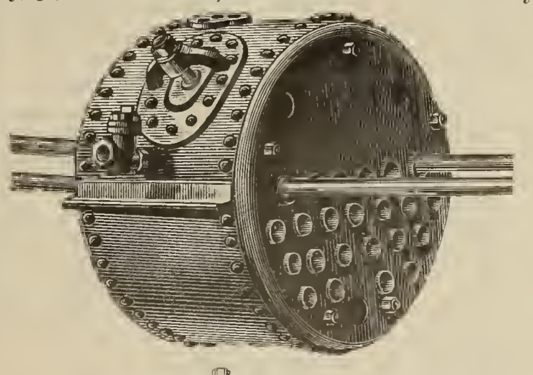
We illustrate herewith a new, visible feed, automatic lubricator for steam engines, which is called the Eclipse. This instrument has been especially designed to meet a growing demand for a first-class visible feed lubricator for small engines, steam pumps, and locomotive air-brake pumps, etc. As seen by the engraving, the "Eclipse" is very compact and simple; it is attached to the steam pipe of an engine by one connection only, and can be applied to either horizontal, diagonal, or vertical steam pipes, in a limited space, making them peculiarly applicable to farm engines. Any kind of oil or tallow may be used in it, and the regularity of feed is not affected by variations of temperature.

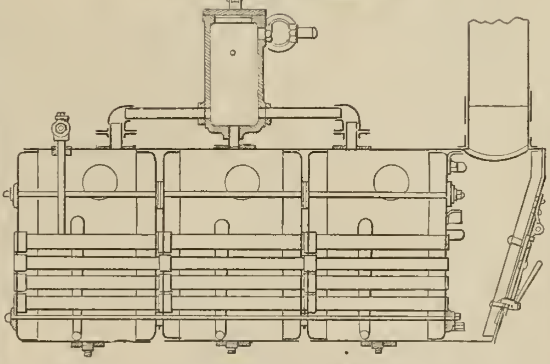
The glass tube, through which the feed, and the operation of the lubricator are seen, is not exposed and is not liable to break. These lubricators are manufactured in two classes, viz.: nickel-plated and bronzed. The price is very low indeed, as may be seen by reference to our advertising columns. Special inducements to builders of steam engines and the trade are offered by the sole manufacturer and inventor, J. Vin. Renchard, Detroit, Mich., or Windsor, Ont.

◆

A NOVELTY IN SECTIONAL BOILERS.

Our engraving represents a method of constructing boilers for transportation in mining regions or where they have to be carried over rough roads. The boiler is cut into convenient "two-man" sections, and in this form is easily handled. The several sections are then joined together, as shown in the outline engraving; the tubes telescoping into one another for that purpose. The furnace is, of course, independent of the boiler. This is an English invention, and a very clever one. We find it in *Engineering.*





◆

WE RECEIVE MANY INTERESTING COMMUNICATIONS in the course of business which would be valuable to others, but we are forbidden to print them, the writers saying they have no ambition to see their names in print.

This is looking at the matter in a wrong light. It is not a question of ambition, and no sensible person attributes any writer's motive to vanity. Persons moved by that feeling have nothing to say which is worth printing. Actual experiences that serve practical ends are always useful, and we hope to receive them constantly.

◆

THE STEAM FLOURING MILL at Morton, Ill., was totally destroyed by an explosion of the boilers, and fire. An old boiler and an inexperienced engineer are assigned as the cause of the affair. The loss on the building will be about $15,000.

It is a big price to pay for finding out so little.

MOONSHINE FOR IDIOTS.

About this time the wily publisher sends out circulars like the following, received through the mail by us last week. This is supposed to be enterprise:

> STRICTLY CONFIDENTIAL: We have received an order from the ——— Co., No. —— John street, New York City, for several thousand copies of our elegantly illustrated Christmas book, "*Moonshine for Idiots.*"
>
> These beautiful books are worth $2.50 apiece; because of the large number taken they pay only $1 for them.
>
> We understand that they purpose to sell these books to their friends and customers at only 50 cents a copy. If you had any of them you could retail them easily at $1.50 or $2.
>
> Now, as we want them to increase their order, we send you this circular to let you know that if you will call at their place of business, No. —— John street, you can get as many of these books as you want, at only 50 cents a copy.
>
> As *Moonshine for Idiots* is one of the largest and handsomest books in the country, it will pay you, and pay you well, to take advantage of this opportunity. Kindly keep this communication confidential.
>
> Philadelphia, Pa. MOONSHINE PUBLISHING CO.

We won't tell a single person.

◆

THE MYSTERIOUS AND UNKNOWABLE!

The mysterious and unknowable has great charms for some persons! Recently Mr. Keely fired off his little gun at Sandy Hook, in the presence of a large number of persons. He repeated the same things which, for the past ten years, he has done in Philadelphia, and he did no more. Here is a portion of the performance, as reported in the daily papers:

> "Mr. Keely bent over the large tube and gently tapped it with a wooden hammer in two or three places. Then he turned a cock quickly and tapped lightly on the reservoir in the butt of the gun. There was dead silence for a few seconds, then a rush of bluish vapor from the muzzle of the gun, a sharp report, and the ball buried itself in the sand to the right of and beyond the twenty-six feet square target, 500 yards away.
>
> Several shots were fired, and twice the target was hit. Then the velocity was tested, and found to be about three-fifths of that which would have been derived from a proportionate charge of gunpowder. Then three-inch spruce planks were set up about ten feet away, and a chilled steel Minie ball driven through one of them and half way through the one behind it.
>
> "That is equivalent to piercing 7½ inches of pine," said Col. Hamilton.
>
> "I have now fired nineteen shots," said Mr. Keely, "and I could fire 200 more. I have not appreciably diminished the store of vapor in the cylinders. I have enough left to give three more exhibitions of four or five hours each. The intensity in the positive tube has gone down 1·40; the negative has not been touched."
>
> In fact, for a long time, the only trouble has been to bridle the force. Its existence is beyond dispute. This I have succeeded in accomplishing, and the problem that remains is of insignificant importance."
>
> "May I say," said a reporter to the Colonel, while Mr. Keely was packing up, "that you regard this as a force heretofore unknown?"
>
> "No, you can hardly say that. You may say that it is beyond me; I do not know what it is, and whether it is a new force, or a new application of an old force, it is very wonderful. It resembles no form of compressed air that I have ever known, and it does not answer to the test of carbonic acid gas." * * * *
>
> The "etherealized vaporic force," which was so liberally poured into the ears of a large and gullible public by Mr. John W. Keely, of Philadelphia, and the directors of his company, last Saturday, does not seem to have intoxicated Lieut. E. L. Zalinski, who is wedded to science for its own sake, and is in no way connected with companies of any description. The Lieutenant witnessed the experiments at Sandy Hook, and then told President A. R. Edey that with the same plant he could perform exactly the same experiments at Fort Lafayette on any day he might name; with compressed air, and would even go further than Mr. Keely had gone. Mr. Edey said he would "speak about it to Mr. Keely," but the offer has not yet been accepted.
>
> The Lieutenant, when seen yesterday at Governor's Island, said that none of the experiments at Sandy Hook went to show that Mr. Keely had discovered a new force. If Mr. Keely, as he claimed, could obtain five times the velocity he showed on Saturday, he, the Lieutenant, would bow his head in reverence.

One paragraph seems—to the cynic—to be needlessly sarcastic. The force has been pretty effectually bridled, we should say, and it is now time to unbridle it and let it kick some.

Also, it might be pertinent to inquire what special *form* of compressed air Col. Hamilton is best acquainted with?

◆

EARTHQUAKES AND STEAM ENGINES. A 300 horse-power pumping engine at the Flatbush (Long Island) Water Works was stopped by a recent earthquake, and did not fully resume work for three days, owing to necessary repairs. The injury was caused by the oscillation of the water tower at the city line, which contains 1,500,000 gallons, and created a back pressure sufficient to break the pump.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON.

Editors and Proprietors.

150 Nassau Street, New York.

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No credits are given, and no gratuitous copies are sent out except as samples, and a few, complimentary, to personal friends.

☞Papers will be discontinued at the expiration of the time contracted for, with due notice of same by postal card.

Entered at the New York Post Office as Second-Class Matter.

We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

"OUT OF A JOB."

There are a great many persons out of work at present, to whom the prospect of immediate employment at their regular callings is remote. To them it is a serious matter to know how to provide for their support.

At such times one should lay hold of the first thing that offers any remuneration whatever, and defer to more prosperous periods the hope of greater earnings. A man is justified in turning to other sources of employment, when his trade fails him, and he suffers no loss of personal standing, in the eyes of those whose esteem is worth possessing, if he does so.

A field always open to those who wish to occupy it, is soliciting, or canvassing for trade in any line that appeals to consumers in general. Canvassing does not belong wholly to literature or works of art; it applies to staples of all sorts as well, and many a man who took up such work as the only port in a storm, has succeeded so well at it that he has abandoned his trade wholly.

Some may say that canvassing is personally disagreeable to them; that they do not like to ask persons for money, or to purchase things which, perhaps, they do not require. They feel —those who dislike canvassing—that they are only beggars which are tolerated, and they cannot get over the impression that they are following a calling which is, in reality, asking favors of every one they meet. This is a very great mistake, and any one who enters upon canvassing as an employment in such a spirit will certainly fail. Canvassing is just as legitimate and regular a business as any other, and no man should feel that any loss of dignity or personal respect is entailed thereby. It is no favor for a person to subscribe to a periodical upon solicitation, and no more an act of charity to the canvasser than it is when the subscriber mails the money direct to the publisher. Canvassers are publishers' agents, and if they carry on their business in a courteous, considerate manner, will receive courtesy and consideration from others.

Canvassing, in other words soliciting trade, of one kind or another, is about the only thing open to the unemployed in times of general stagnation. Such periods are certainly not favorable to embarking in small businesses, with the hope of making a living by them. Persons who have in view investing their savings in barter and trade, will do far better to sit down and eat the money up. In that event they will get the value of it; in any other the celerity with which their savings will vanish will astonish them.

Solicitation, to be successful, especially needs patience and perseverance, aside from any other qualifications, and those who rely upon the foolish assertions of some publishers and special agents will be disappointed. Any one who says that an agent can go out into the highway and make a handsome salary at the outset, states what is not true. Success, as a rule, is not assured upon the start. It is only after the ground has been well selected, and thoroughly studied as to its possibilities, that there is hope of return. A man might as well cast hook and line into the first puddle he meets as to canvass as some do—without method or consistency.

It is not our intention to write a treatise on canvassing, but to point out to those out of work for the moment that there is always a demand for capable and trustworthy agents. Whether this trade or that be represented, the man who can carry his office under his hat need never lack the means of support, and, in many cases, very much more. Persons who take to solicitation for the first time should be sure that they are in earnest; if they are they will impress others with their sincerity and intention, and be very much more certain of success than if they went about their occupation in a half-hearted, despondent spirit. The "knight of the rueful countenance" deserves kicks and cuffs.

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THEORETIC DISCUSSIONS.

Theory is circumstantial evidence. Therein lies a danger. If we accept speculation as demonstration then we are as likely to err as if we followed mere impulse. In all transactions of life theory enters. We cannot carry on any enterprise without speculating (theorizing) in some degree, but if we lean our whole weight upon it we risk a fall. We say certain things will happen if certain other things also happen at the same time. The first train of events transpires; the second does not; then our reasoning is shown to be defective, and the theory we have constructed is dissipated.

These remarks apply especially to material operations. The making of steam engines, and running them as well, cannot be carried on without theorizing as to cause and effect. It is not to the mental process itself that we demur, but to the habit some fall into of positive assertion upon things they have no means of proving. Proposition becomes fact only when it can be proven to occur always, and without fault, under certain exact conditions.

Say, for example, that a boiler becomes red hot, and water is thrown into it; that, under such circumstances, this boiler explodes. This is not a fact established in regard to all red hot steam boilers, because many of them, under identical conditions, do not explode. Theorizing as to cause and effect is excellent practice. It is mental exercise, if nothing more. Facts are often established by theories, when the investigator proceeds upon logical bases; but to say that mere speculation is fact, or establishes a law, is erroneous, and we should guard against mistaking circumstantial evidence for positive proof.

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A USEFUL CLAUSE.

Recently, in Elizabeth, New Jersey, a small vertical boiler exploded, and destroyed about $25,000 worth of property. Of course, every one in the vicinity was surprised that the boiler should do such a thing, and one individual, with a strong sense of injury upon him, held up a piece of the boiler and said the bottom was only as thick as stove pipe iron! He ascribed all the trouble to the water used in that city, and said it rusted out iron very fast! It does not seem to have occurred to any one that the boiler exploded through natural causes, and that it was to be expected under the circumstances.

The indifference of steam users and insurance companies to the possible results, where steam boilers are in charge of incompetent persons, is remarkable. A century of experience in this line has taught them little or nothing. It is possible now, to-day, to go into large cities, or small ones for that matter, and find a condition of things which is simply incredible. It would seem that insurance people, who are generally acute enough where their money is at stake, would have sufficient authority to exert themselves on this point. In taking risks the surveyor, or inspector, goes all over the premises; he is shrewd and sharp enough so far as fire risks are concerned, but the boiler, fertile source of many disasters, is never examined by him. Insurance companies could cover themselves against loss by inserting a clause—"not insured against boiler explosions, or damage caused by them;" but we expect to wait a long time before we see such a clause universal.

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CO-OPERATION THAT PAYS.

We are engaged in a co-operative scheme which, so far, has not only interested us but has also paid for our services. We furnish to the world at large a trade paper, and the world at large responds by paying for the same. It co-operates with us, and seconds our labors by aiding to spread a knowledge of them far and wide; this satisfies all concerned. If those who reward us for our work were dissatisfied with it the pay would soon cease—a contingency we have not yet been called to contemplate.

This scheme which we have outlined is co-operation in its best estate, for it is healthy, founded on sound principles, and returns dividends to all. Our colaborers get value for their money; it comes back to them in such a form that it is increased many times over its nominal value, and, aside from the commercial aspect of the matter, we experience a satisfaction when we know that our work is not for naught.

We have heretofore expressed our indebtedness to our connection for many attentions and evidences of their keen personal interest in our enterprise, and we are not left in doubt as to their sincerity, or vitality, for letters are frequently sent us, and sometimes published, which attest the fact. Such co-operation has commercial value, in the sense that it brings into public notice and to the attention of a very large circle, matters which would otherwise have been hidden. The making of a large crank-shaft without special tools, published in THE MECHANICAL ENGINEER, is one example out of many similar. In most cases such a shaft would be ordered of other firms, but an ingenious engineer saw a way of avoiding this, and sent the results of his thought to us. Others have seen it also in THE MECHANICAL ENGINEER, and the outcome is that a new idea has obtained currency.

Co-operative concerns are not always successful, for the reason, possibly, that sooner or later dissensions destroy them, but in a community of thought there can be no such disastrous conclusion.

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ABNORMAL INDICATOR CARDS.

Abnormal, or unusual indicator cards, are of no value as studies to locate defects, unless all the details of their occurrence are given. This is seldom done by those who present them, the object being, apparently, to obtain a series of guesses as to the cause of the irregularity. Also, there is another point: the sincerity of the exhibit. It is possible to obtain any kind of worm fence and wriggle from an indicator in unskilled hands, or when the indications are made with the intent to mislead. Taking the motion from improper places, imparting motion by hand—"letting an assistant rotate the drum by hand," as was done recently in some alleged governor experiments, published in a contemporary—all these things merely "make the unthinking laugh and the judicious grieve." They are of no value whatever to earnest students. It is making a plaything, or a toy, of an instrument which is expensive, and is diverted from its office to put it to such uses.

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THE INTELLIGENT COMPOSITOR.

We perceive that the intelligent compositor has obtained a berth on a Western paper. The editor of it quotes an article entitled "*Questions*," from THE MECHANICAL ENGINEER, and heads it: "*Conundrums for Steam Users*," which is erroneous, as the latter are not addressed in the article. Then comes the intelligent compositor, who rearranges the sentences according to length. The result is that the sequence is destroyed and confusion reigns. For instance, the new version of our article reads:

"Is the water supply regular or intermittent?"
"Are you sure the latter is properly connected?"

This is pretty bad, connecting the intermittent, but what comes after is worse:

"Have you a damper in the smoke-stack; if so, do you ever use it?"
"Do you ever try them, or merely depend upon the water glass?"

Try the damper in the smoke-stack, or depend upon the water glass to try it? Oh, no; no one does that.

Further on we are made to say:

"Do you throw in a heavy fire and then check the heat by opening the doors?"
"Do you know that, allowing for its age and time of service, it is reasonably safe?"

What is safe? the door, the fire, or that it is reasonably safe to check the heat by opening the doors?

We are much obliged for the quotation, but if we may express a preference, we think the original better than the new version. A person who had never seen our article would wonder what in the world we were trying to say.

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THE LATEST WORK ON THE INDICATOR.

The Steam Engine Indicator, and its use; a guide to practical working engineers for greater economy and the better working of Steam Engines, by WILLIAM BARNET LE VAN; illustrated with 20 engravings—reprinted from THE MECHANICAL ENGINEER with much additional matter. New York: D. Van Nostrand.

The indicator for steam engines is rapidly gaining ground with all intelligent engineers, and a demand exists for information concerning it. Special effort has been made in this work to place the action, construction and operation of the indicator before those who have not previously investigated it; to this end the matter has been plainly written, and all the calculations involved are in simple arithmetic, so that every person fit to be in charge of steam machinery can avail himself of the instrument.

In part, this work consists of the series on the indicator published in THE MECHANICAL ENGINEER in 1883-84, Vols. 6 and 7, but there are, in addition, compendious chapters on "*Heat;*" "*Steam and Work;*" "*Absolute pressure;*" etc., which contain information indispensable to all who would be thoroughly posted in their business. The author has shown good judgment in his compilation and selection of these subjects, and being himself a practical engineer, is well informed as to the needs of students

We feel that it is not improper in us to urge our friends to avail themselves of the instruction contained in the pages of this work The price is merely nominal—fifty cents—and has been purposely made low, in the hope of a wide sale. We can supply it free by mail, or it can be had of the publisher by remitting as above.

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OVERHAULING AN ENGINE.—Number 5.

"While you were overhauling your engine, would you make any other changes and arrangements about the premises?"

"If I could get the proprietors to spend the money required, there are many things absolutely essential to convenience and economy not found in the average engine room."

"What are these things?"

"One of them is a dust-tight enclosure all round the engine, and glass on all sides where it is possible. An engine-room should be as light as possible. There cannot be too much of this. Another thing is a cement floor or walk all round the engine, and four feet each side of it. This walk should be well grouted with sharp, coarse sand, so that it will give a good foothold. I do not know of anything better for a floor. Oil that is dropped sinks into it, and does not produce a slippery surface. In time it comes to look black, and gives a good contrast to the paint and bright work, and, what is better than all, it never wears out. A yellow pine floor, well oiled or shellaced, outside of this, looks well by contrast, but common board floors get saturated with oil and become dangerous; more than that, they are always slivering or starting up somewhere. A cement walk is for all time. Close to the engine I would run a hand-rail all round, from the front cylinder head around the fly-wheel, and down again on the other side. This would prevent accidents. 'It is the unexpected that always happens,' and many casualties and loss of life can be prevented by forethought. If there were any old benches, or joiner work generally, about the room I would tear it all out, and give the whole place a coat of light-colored paint, well laid on.

In a few words, I would make the entire engine-room as neat and clean as a sitting-room. In one corner I would have a strong vise and vise-bench, and a good locker or cupboard with a roomy bottom, where I could keep sheet rubber, white-lead pots and extra fixtures of any kind. I would have two oil-tanks outside the engine-room—not in it. If it was too heavy work to go outside and fill the cans, I would lead a pipe inside the room from the tanks, but I don't see the necessity for it, unless the engine-room is so situated that the tanks cannot be outside of it. The steam-pipes and cylinder would all be covered and carefully protected; so would the cylinder-heads. I would not have a bright cylinder-head. I would lag the back head the same as the cylinder; the front one I could not manage very well. I would look out carefully that the water-pipes all ran straight, with as few bends and elbows as possible, and when the place was in good order I would see that it was kept so. I spend my life in my engine-room, or a good portion of it, and I see no reason why it should be less attractive than my home. I have found that dirty people like dirty places, and I don't wish to be classed with them. If a man is judged by the company he keeps, an engineer is graded by his engine-room. If he keeps a junk-shop in it, every one who enters will think he is a junkman.

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SOMETHING ABOUT METALLURGY; FLUXES AND THEIR OFFICE.—Number V.

The resemblance of the modern charcoal blast furnace to the "stuckofen" is close. The general internal form of the truncated cones, joined at the bases, is retained, but the lower cone is very much flattened, and is now called the bosh. The flat hearth is replaced by a hollow vessel formed in the brickwork, called the crucible. The removable wall in the breast is replaced by a sort of lintel over an opening in the breast called the tymp, and a low wall before that, called the damstone. The bottom of the crucible is still called the hearth. The tuyeres are increased in number and made hollow, so that, with proper pipe connections, they may be kept filled with water circulating rapidly about to keep them cool. The tuyeres are so placed as to direct the blast into the crucible much higher than in the stuckofen. The damstone is pierced with a tapping-hole, through which the fluid metal is run, and at one side is a notch in the top of the damstone, through which the slag runs when it rises in the crucible higher than is necessary for sealing the opening under the tymp against the escape of blast.

Blast furnaces are built much higher than were the stuckofens, and for that reason a greater blast pressure is necessary to force through the higher column of materials; hence the leather bellows have been replaced by blowing cylinders and engines. Notice that in the blast furnace no means are provided for withdrawing a lump as in the stuckofen. But the object is cast iron, which is fusible under the heat of the CO_2 combustion zone in the crucible. The CO_2 generated in that zone is soon transformed into CO as it rises through the fuel, and in gasifying and taking up the second portion of O becomes cooled to a bright red heat, and has the power, while at that temperature, of imparting some C to iron sponge. When the iron receives sufficient C it is fused and trickles quickly through the oxidizing zone and through the lower carbonizing zone into the bath of liquid slag in the crucible, through which it sinks and is protected by the slag cover from further chemical action, until it is tapped off through the damstone.

The iron and slag in the crucible remain liquid, because of the heat of the fuel resting upon the slag, which is kept burning by the percolation of air downwards from the tuyeres, and this heat from combustion below the tuyeres is believed to be reinforced by heat reverberated from a sort of roof over the CO_2 combination zone, in the form of a dome, resting upon the bosh, and resembling a hollow blacksmith's fire. This roof is, of course, continually burning away, and occasionally falling, but forces are continually at work re-forming it. The pasty condition of the slag just before fusion aids very much in this matter.

If a blast furnace were charged only with coal and ore very little iron would be made, because the impurities would either remain as solid matter in the furnace, or would combine with iron oxide and form a slag, which might, or might not, be fusible in the heat of the crucible. In one case the furnace would be clogged and operations brought to a standstill, and in the other the ore would be changed to slag.

It is absolutely necessary that all the products, useful and otherwise, of a blast furnace be in liquid form at the time of removal, as no means of removing solid matter are provided. So fluxing material is always charged among the layers of fuel and ore, to render the impurities fluid.

Now the earthy impurities are mostly clay, in its proper form, or in the form of slate, and the alkaline earths combine with both alumina and silica and form a glassy slag, as they do with each other, and with iron oxide. Lime is very efficacious in this way, and is always a part of the charge of a blast furnace. By this device, all the earths which go into the furnace are made to come out liquid, and the necessity of taking down a part of the wall, as in the stuckofen, is obviated, as the cast iron is readily fusible.

Caustic lime has been used for flux, but limestone does just as well, because the heat in the furnace separates the CO_2 of the limestone, leaves the lime Ca free to combine with the S and Al, while the liberated CO_2 pays for the separation by changing to CO upon contact with hot C, and becomes a reducing gas more free from it than if all the O were derived from air.

Thus we see that the theory of fluxes is very simple, however difficult the application may be—flux being matter which, under the heat existing in the furnace, has greater affinity for the earthy matters [gangue] found in the ore and fuel than such earthy matters have for the metal, and which combines with them to form fusible slags.

When mineral fuel is used in a blast furnace, flux sufficient to combine with the ashes of the flue, as well as with the gangue, must be used.

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LET US DO THE WORKING, and we care not who does the howling about hard times.

THE PROFESSOR IN THE MACHINE SHOP.

Number 66.

A difficulty which I have no doubt has been experienced by others as well as ourselves is to get what we pay for. In other words to get the value of our money, or what has been sold to us for a certain fixed sum.

We have been trying to make bricks without straw lately. Not feeling very flush we endeavored to stave off buying a certain tool we needed, and get along by adapting another machine to the work. Of course we made a failure, and it served us right. When we wanted to use the special fixture we also wanted to use the lathe we put it on, so we had neither one thing nor the other.

"It's of no use," said Jacob; "we must have the tool, and I will go and buy one to-day." He did. He bargained for a certain machine at a certain price, and in a few days it came. When we tried it we found it would not begin to do what was claimed for it. Further, the work on it was miserably done, parts of the machine not being properly fitted. If all right in every other way the fits (alleged) would have interfered with reliable work.

We wrote immediately to the parties who sold us the machine, and advised them that it did not answer, and that we should refuse payment until the machine did what was claimed for it. No reply was made to this communication. The next week we received a bill, with a request for a remittance. We returned the bill endorsed: "See our letter of the 20th instant."

No reply came to this, either.

Next week there was another bill, and another request for payment, which we answered thus:

Messrs. Blank & Blank.

You will confer a favor by either sending for your machine, or else reconstructing it so that it will do what you claim for it, and what we want it to do. We should prefer to have you send for it, but as we like to be treated fairly ourselves, we are willing to give you an opportunity to protect yourselves. In the meantime the machine is subject to your order.

Yours truly, Moulton & Hess.

This brought a response, in the shape of a visit from a man who said he was the foreman for the concern that made the machine, and he came to see what the trouble was.

"Come out here," said Jacob, "and I will show you;" he ran the belt on and took the foreman around to one side, and said: "Look at that cone-pulley; do you see anything the matter with it?"

The foreman looked a moment and said: "It is a little out; not much; it don't amount to anything."

Jacob took a piece of iron and held it near the pulley to test it for truth, and showed the foreman that the pulley ran out over a thirty-second of an inch in all directions. "That may not amount to much to you," said Jacob, "but it does to us."

The foreman asked what else was amiss with the machine.

"Run that table up," said Jacob.

The man took hold of the handle and ran it up easily. "What is the matter with that?" said he.

"Try it, and see how it shakes," said Jacob.

The man shook it and said, "The gibs ain't set up; that's all it wants," and he proceeded to tighten them up.

"All right," said Jacob; "set 'em up."

The foreman did so, and then Jacob told him to run the table down again. He tried to, but couldn't. "I don't see how that is," he said, in a dazed kind of way.

"That's enough," said Jacob. "We don't want any one to come here and tell us what machine work is, or that they don't see how things come. That's only foolishness. We see how they come easily enough—by bad workmanship and bad management."

"Well," said the man, "I suppose you are as liable to make a bad job as others, once in a while."

"Yes, my friend, we are," said Jacob, "but we take good care to find it out ourselves, and not let others do that for us. You can't tell me that that tool was ever inspected by any one before it left the shop. I know better. You build these tools by contract, don't you?" said Jacob.

"Yes," said the man.

"You farm out this part, and that part to separate persons, who hire their own help to do the actual work?"

"Certainly we do, and so do thousands of other concerns. The best machine tool shops in the country do the same."

"Precisely," said Jacob; "I am not finding any fault with the system, but with the way in which it is carried out. Who sees the work finally, before it leaves the shop?"

"I do," said the foreman.

"You inspect every job carefully to see that it is correct in every part, do you?"

"Well, generally, yes," said the man.

"Did you inspect this one? If so, how is it that you passed such work as this?"

"It is very probable that I never saw this machine, or I certainly would not have allowed it to leave the shop."

"My friend," said Jacob, "you evidently feel that in telling me that it settles the whole business. You come here and acknowledge the work is not properly done, then you make excuses and think that lets you out of a hole. It don't; it lets you down deeper."

"Well," said the foreman, "if all of us had our heads cut off for every poor job we turned out there would be lots of dead men lying about."

"Speak for yourself," said Jacob; "there are lots of dead men lying about now, but I don't propose to join them. It is just such jobs as this that get firms bad names. It is lucky for your folks that it fell into a machinist's hands first."

"How do you make that out?"

"This way: Suppose that tool had gone into a railway shop, for example, or any place where they did not want to use it for a month or two! Then when they set it up and tried it they would have found fault. They would have written your people the machine was no good. Probably it had been paid for meanwhile, and your folks, thinking the nimble dollar better than the slow quarter, wouldn't have replied until they got good and ready, if they did then. The men who had the machine couldn't use it, but they would remember the makers of it, and take good care to let every one else remember them, too.

"I don't wish to make uncivil remarks, but I can't help thinking that inspection, in your shop, means seeing that all the legs are on the machine, and that all the pieces belonging to it are there. You are the foreman of the shop, you say?"

"Yes, sir."

"What have you to do with inspecting tools?"

"The proprietors expect me to do it. They say I saw all the work done, and ought to know whether it is properly fitted before it leaves the place; but it is the honest truth, Mr. Hess, that I am not able to do it as it should be done. I examine most of the work carefully before it leaves the premises, but who would dream that a man would plane the ways of a table bigger at the bottom than at the top, or that a fitter would not see such a botch as that before it left his hands?"

"Well, now, I'll tell you just where the hitch is," said Jacob, "and it is the fault of your contract system. Three different parties, as I look at it, had this job; the man who did the planing was one, the man who did the machine work was another, and the man who put the parts together was another. Ain't that so?"

"Not exactly, but it is near enough to the facts to pass for them."

"Each one of these men did his own work, and none of them criticised the other. If the contractor who fitted up the job found that the man who did the planing had slighted his work, and would have to do it all over again, do you suppose he would report that fact to the proprietors, or to you? Not any, my friend. He will say, if called upon to explain his job, that it is not his fault, that the table on this particular machine won't fit when run up and down, because the planing is not properly done, and that is not his job. He is not a boss over the planer man; it is out of his department wholly, and in a certain sense he is right. If he criticises the planer man and makes him do his work over, the planer man resents it and takes the first opportunity to get square with him. Then there is a kind of feud—vendetta, Italians call it, I believe—established, which plays the mischief with all hands."

The foreman reflected for a moment and said, "Yes, it works in that way, but somebody has got to be responsible for good and bad work. I ain't going to be held for contractors' mistakes."

"That is as may be," said Jacob. "I have no opinion to give on that point, but I can tell you how it would be, and who would be responsible in this shop—the man who made the botch would have to make his work good."

The foreman said it was rather hard, to ask a man who had made a mistake in his work, to stand the expense of tearing down and putting up again.

"Let him do it right on the start then," said Jacob. "He gets paid for it. Who is to pay for his mistakes—parties who buy the tools? I guess not. I have seen purchasers of tools pull them down and rebuild them, but we are not of that kind. Let every man keep his own door-yard clean. What are you going to do about this machine?" said Jacob.

"I will send a couple of men over here and fix it to your satisfaction," said the foreman.

"All right," said Jacob. "You can have shop room, power and use of tools for nothing. We don't want to be mean. We might get stuck ourselves some time in the same way. We are just as liable to make mistakes as others are—when we don't pay attention to our business.

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ELEMENTARY PRACTICE FOR STUDENTS OF DRAUGHTING.

The first essential element of success in draughting is the possession of a set of instruments and materials which can be trusted to meet all reasonable demands that may be put upon them. It is a common error with students to begin work with a cheap set of draughting instruments which can be laid aside for a better outfit later on. This is a wrong idea; the reverse is the case. A skillful draughtsman may be able, and is often obliged, to produce fair work with indifferent tools, yet any attempt to learn the first principles of linear drawing with compasses of unsteady habits, or pens of whose performance nothing can be predicated, must be unsuccessful. The instruments noted include only those necessary for the performance of the course laid down, and are thoroughly trustworthy, with much less care than the student gives to his watch that will last a lifetime.

Compasses should be five inches in length with fixed needle point, and with pen and pencil points, and lengthening bar. They should have what is known as the "Alteneder" joint; the principle of which is that the set screw which regulates the degree of friction at the head joint may itself be fixed in any desired position by means of a smaller screw at right angles to it. See that the needle point is "shouldered."

Hair-spring dividers should be five inches in length, and are best with the end of the leg of circular section, instead of the usual triangular form.

Spacing dividers should be of steel about three and one-half inches long, or less, with handle.

The right line pen should be in perfect condition. Those of Swiss manufacture are best, though others are good. It should be of medium size, about four and one-half inches long, and is preferable with a hinged blade.

Drawing board should be made of narrow strips of thoroughly seasoned white pine with hard wood ledges; the size twenty-three by thirty-one inches. It is best bought from a ready-made stock, or, if in good condition, second-hand. A drawing board is scarcely fit for use for at least six months after it is made. When purchased, the lower and left hand edges should be turned up, and the angle inclosed by them made *an exact right angle*. The condition of the other edges and angles is not of so such consequence. Care must be taken not to strike the edges of the board against the floor or other hard object, as they may be thereby irreparably injured.

The T-square should have a fixed head, and a hard-wood blade thirty inches long, which latter should be tapered on one side to insure rigidity. When not in use it should be hung up flat against the wall by a nail, to prevent warping, and the edges should be carefully preserved from injury by blows, which will produce dents and nicks.

Triangles are best of pearwood, framed. There should be two, one of 45° × 45°, with base about six inches long, and one of 30° × 60°, with base seven inches long. See that the joints are close and tight. The same care to prevent injury must be taken as in the case of the drawing board and T-square, since our ability to draw straight lines will largely depend upon the degree of perfection of our straight edges.

Having purchased the above outfit from a reputable dealer, the student may rest assured that his future success will depend upon his own industry, and that whatever failures he may encounter will not be chargeable to his instruments.

We will now proceed with the work on hand. Holding a sheet of drawing paper up to the light, let the student see that the water-mark (the maker's name, with date) reads correctly—that is, not in reverse. The right, or working side of the paper is then towards him, and two small pencil marks should be made on that side, on diagonally opposite corners, after which cut the sheet in half in the direction of its shortest diameter. The size of double elephant paper being twenty-seven by forty inches, we will now have two sheets of twenty by twenty-seven inches each. On one of these sheets the water-marks may not be visible, so that we must rely upon our pencil mark for identification of the working side of the paper, since this will not be evident on mere inspection. Then, having ready the drawing board, some clean water, a soft sponge, and a thick solution of gum arabic in water, proceed as follows: Lay the paper face up, and turn up the edges all around for a space of not more than three-quarters of an inch, after which reverse the paper, and with a wet sponge go over the back of the paper with clean water, taking care, however, not to wet the turned-up edges. See that the paper is thoroughly wet, and leave it in that condition for at least ten minutes, in order that the water may thoroughly soak in. When this is accomplished, carefully apply the gum arabic to the turned-up edges, and then turn the paper over again, face up. Beginning at the left hand edge, rub down the gummed edge hard on the board with a knife handle, or other similar implement, then immediately do the same to the *opposite* edge, pulling the paper with a steady pull so as to insure a good stretch. Proceed in like manner with the other two edges, taking care that the water does not evaporate from the body of the paper before the edges are dry and fast. This may be prevented by the application of the wet sponge very gently to the upper side of the paper, but usually it will not be necessary at all. Watch the edges closely and see that they remain firmly fixed to the board. If they have any tendency to separate, introduce on a knife blade *a little* additional gum, under such places as seem to need it, and rub down hard, as before. It is only fair to say that this "hot pressed" paper is the most difficult of all the ordinary papers to stretch, but the student will, by a little perseverance, be able to succeed in every attempt. Particular pains must be taken to prevent any gum from getting under the paper inside the margin, as it will in that case give us serious trouble when we attempt to remove the paper from the board. Care must also be taken to see that the first edge gummed down is as nearly as possible parallel to the edge of the board. When all is done, and everything secure, lay the board perfectly flat and leave undisturbed till the paper is *thoroughly* dry. The reason why we wet the under side of the paper rather than the upper, is that our working surface may be as undisturbed as possible, so as to keep in perfect condition. Beginners are very apt, in sponging the upper surface, to destroy its characteristic smoothness altogether.

While the paper is drying, let the student prepare his instruments for work. Sharpen the hand pencil to a fine and rather long point, and bring the end of the compass lead to a sharp chisel edge. Remove the steel legs of the compasses and insert in their places the needle leg and the pencil, so adjusting them that when the legs are closed the point of the needle shall project *very slightly* below the edge of the pencil. In some instruments the legs will not fit indifferently on either side, but some only on one side, and some only on the other. The right side in any case may be ascertained by examining the upper end of the leg at the shank on the inside, where, if there is a small dot to be seen, insert in that socket which has a similar dot opposite the binding screw; or, if there be no dot, insert in the other socket.

We will now proceed to draw on our paper certain preliminary pencil lines which will represent the "cutting-off edge" and the "border line," The former will be a rectangle, seventeen inches wide by twenty-four inches long, and the latter a rectangle fifteen inches wide by twenty-two inches long, whose sides will be one inch inside the sides of the first, all around. To do this the head of the T-square must be placed squarely against the lower edge of the board, and a pencil line drawn across the paper, at such a distance from the left-hand edge as will suffice to clear the gummed margin. If the work has been carefully done, an inch or an inch and a quarter from the edge will be sufficient. Proceed in like manner to draw a line near the lower edge of the paper, and from the intersection of these two lines set off, with the two-foot rule, seventeen inches the short way of the paper and twenty-four inches the long way, marking the termination of each of these measurements by a pencil point. Then, by means of the T-square, as before, draw through these points the other two sides of the rectangle.

The border line should now be drawn by making with the pencil four points, each one inch distant inside from one of the four sides of the cutting-off rectangle. Then lines drawn through these points with the T-square will give the required border line. In using the pencil, hold it nearly perpendicular, bear slightly but regularly against the edge of the T-square, and somewhat harder on the paper, taking care, however, not to make too broad a line. If it can be clearly seen it will be sufficient.—*Prof. C. Francis Osborne in Building.*

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SOME INTERESTING FACTS ABOUT THE ABUSE OF STEAM BOILERS.

Mr. G. H. Palmer, of Chicago, recently delivered a lecture before Association No. 7 of Stationary Engineers, of that city. We are unable to give the lecture entire, owing to its length, but make some extracts of general interest:

I make bold to say that no matter what we think, no matter what we do or say, no matter what the opposition, the time is coming when first-class, intelligent engineers and manufacturers will not have other than sectional, or safety boilers, of some kind, and if there still exist any mechanical defects in these boilers the same will be corrected and overcome. Even now we see that boilers of this class are used by many thousands of the very foremost engineers and manufacturers of the age, and the demand is continually growing. Like all innovations, their progress at first was slow, but to-day material progress has been made.

Take, for instance, the experience of one firm which builds water tube boilers. They commenced fourteen years ago, met with many failures and disappointments, and great and continued opposition; but, believing in the future, they are to-day manufacturing and selling nearly one hundred thousand horse-power, or two millions of dollars worth of water tube boilers a year, sending the same to all parts of the world where steam is used. This does not look like failure; and yet this is the work of only one firm in this line. The desirable requirements of a perfect steam boiler are, first, safety; second, economy of operation; third, durability I place safety foremost in the list of requirements, as I consider it of greatest importance.

It is now fully established by the experience of Boiler Insurance Associations in this country and England, that all the mystery of boiler explosions consists in a want of sufficient strength to withstand the pressure. This lack of strength may be inherent in the original construction, but is most frequently the effect of weakening of the iron by strains due to unequal expansion caused by unequal heating of different portions of the boiler, or it may be due to corrosion from long use or improper setting. If ordinary steam boilers are properly proportioned and constructed they will, when new, be safe against considerably more pressure than the safety-valve is set to. The hydrostatic test, properly applied, may discover faults in material or the weakening effects of corrosion, but against the danger resulting from unequal expansion, ordinary boilers have no protection, a fact not always appreciated.

In getting up steam many boilers will be very hot in some parts, while other parts will be actually cold. Under these conditions enormous strains must occur in some portions, and these strains being repeated every time steam is raised, if at no other time, will eventually so far destroy the strength of the line or point of greatest strain, that rupture must result. Generally the rupture is small and gradual, but sometimes larger and productive of disastrous explosions.

In the boilers examined by the Hartford Boiler Insurance Co. up to 1880, 11,757 fractures in plates were found in, at, or near the seams, or through the line of rivets, 5,079 of which (about one-half) had arrived at a dangerous state before discovery.

Want of circulation of water is a frequent and prolific cause of unequal expansions and deteriorating strains, and little, if any, provision is made for circulation in ordinary construction.

Another source of danger, in all ordinary boilers, is low water, and constant vigilance is required to keep the water at a proper height. In many boilers the fall of only a few inches in the water line will cause the crown sheet, or some other portion, to be exposed to the direct action of the fire, whence it becomes quickly overheated and weakened to such an extent that an accident is likely to occur.

There is good reason for believing that most of the mysterious explosions of boilers which stand the inspector's test, and then explode at a much less pressure, are due to the weakening effect of unequal expansion; for a boiler that will stand a hundred pounds test this week cannot explode the next week with fifty pounds' pressure, unless it has suddenly become wonderfully reduced in strength. No corrosion, or other natural cause with which I am acquainted, save expansion, can produce this result.

When we consider that strains from difference of expansion are generally greatest when firing up,and when there is no pressure in the boiler, we see that the time may arrive when a crack will be started, or the parts weakened, so as to give way under a moderate pressure, just after the test has been made. This is a probable reason why so many boilers explode in getting up steam, or soon after, or upon pumping in cold water, or even (as in a recent case in England), while cooling off.

Another, and the most lamentable cause of explosions, is the extreme carelessness of owners, who run boilers long after they should be condemned. On the other hand, while no provision can be made against carelessness or ignorance, yet it is shown that most of the causes of explosions may be removed and safety secured in boilers. Very much thought and experiment has been expended on this problem, but though many forms of boilers have been produced, which have attained practical safety from explosions, yet in many of them there have been ignored certain elements necessary to make them valuable as generators of steam for practical work. Hence, the very name of "safety boilers" has unfortunately become to some persons prima facie evidence of undesirability. But safety is not incompatible with any of the other essentials of a perfect steam generator, and may be secured without detracting from other desirable features.

The first element of safety is *ample strength.* This can best be attained in connection with thin heating surface by small diameters of parts, but this must not be carried so far as to antagonize the equally important feature of large capacity and disengaging surface. The second and most important element of safety is such a structure that the original strength cannot be destroyed by deteriorating strains from expansion or otherwise. This can be attained in two ways, by rendering unequal expansion impossible, or by providing such elasticity that, should it occur, it can produce no bad effect. The third element of safety is such an arrangement of parts that when, through gross carelessness or design, the water becomes low and the boiler overheated, a rupture, if it occurs, can produce no serious disaster.

Scarcely a day passes but we read of explosions of boilers with more or less loss of life and property, and so common are these explosions that we become accustomed to them as a necessary evil in the use of steam. What are the facts?

The Hartford Steam Boiler Inspection and Insurance Co., who are acknowledged as authority on the subject of steam boilers, report as follows: "The total number of inspections of boilers made by them since their organization up to 1881 was 331,128, and that these inspections had discovered 163,065 defects, of which 36,227 were considered dangerous." Now if this report is a fair average of the condition of boilers in ordinary use—and who shall say it is not?—we have the startling facts that about one boiler in two is defective, and about one boiler in nine in a dangerous condition. That more do not explode is probably due less to intelligent care than to the fortunate lack of all necessary conditions to an explosion existing at one time. With these conditions existing, who can say a boiler is safe or unsafe? The chances are that it is not safe. Should we not wonder that there are so few explosions?

To show how careless and indifferent some people using boilers are, I will relate some personal experience. Some time ago I visited a large manufacturing establishment employing hundreds of men. While there one of the proprietors asked if I would like to see their steam plant; wishing to do so we went to the engine room. I walked through into the boiler room, the proprietor going as far as the door, and as I stepped in he returned. There were four large tubular boilers carrying 100 pounds of steam pressure, everything being pushed and crowded to its utmost. Two firemen were putting coal into the furnaces, which glowed like electric lights. In other words everything was "booming." After remaining a few moments I went out and found the proprietor waiting my return. He said to me: "Are you not afraid to go into a boiler room like that, from fear of explosion?" I remarked that he had invited me in there, and if he considered it safe for himself, I felt safe. He answered: "I do not consider it safe; I seldom go there, and wish I could avoid it altogether." Now, what do you think of a rich manufacturer who will imperil the lives of men by putting them in places of danger where he would not go?

Not long ago the superintendent of a large works in this city said to me that he never went home at night but that he expected to be called before morning and told that his boiler had exploded; that he knew they were in bad condition, and actually unsafe, but the firm did not feel able at present to replace them with new boilers, so he was taking the chances. Suppose in either of these cases there should be an explosion, a number of persons killed, a coroner's jury be called to determine the cause of death, would either of these men say before such a jury that their boilers were unsafe, and that they had expected an explosion? Assuredly not; but the almost certain result of such investigation would be a report by the jury in the stereotyped words, "No cause found, or ascribed to a mysterious dispensation of Providence." What blasphemy, added to murder—deliberate murder! Again, the Hartford Steam Boiler Inspection and Insurance Co. report that during the years 1880–1–2 and 3, there were in the United States 685 explosions of boilers, by which 1,044 persons were killed and 1,567 persons seriously wounded. They also say that their records are not complete, being a report of only those that came under their immediate observation, and that the actual number of explosions, number killed and number wounded, was probably double that reported above.

Just think of it! Over 2,000 persons killed, over 3,000 persons wounded by explosions of steam boilers in four years! Two whole regiments of men killed and three regiments wounded, altogether 5,000 men killed and wounded—for what? Is it not terrible when we aggregate the number? The list of disasters does not tell half the story of suffering and loss occasioned by such explosions, how many homes made desolate, how many children fatherless, and what sorrow and suffering to all concerned. Am I not right in saying that *safety* is the first and primary consideration in steam boilers? Yet I am sorry to say I often hear engineers and manufacturers say they care nothing about the matter of safety, that they want to buy cheap and will take the risk.

Ignorance, when it is possible to be informed, is criminal, and should anything occur that, by reason of their action, lives should be lost, should they not be held responsible? I believe the time is coming when our courts of law will hold owners or managers responsible for the lives of those lost by boiler explosions, on the ground that said explosions could have been avoided. Should we not do all we can to change this condition of things? Should we not overcome our pride, our opposition to that which will surely remedy the evil, at no matter what cost?

THE SOFTENING OF WATER.

From the remotest period of antiquity the art of softening water for the purposes of washing and cleansing appears to have been known and adopted. Soap is very largely used (or rather wasted) in many places at present for softening water, for it is now well understood that no useful effect in washing is produced until sufficient soap has been used to soften the water.

For the purposes of this investigation water may be divided into two classes, hard and soft. Hard water is a water which contains salts of lime, magnesia or iron, and sometimes an amount of free carbonic acid. It destroys soap in washing, while a soft water is one that does not destroy soap. A soft water may derive its properties from an absence of earthy salts, or it may have become soft by reason of the presence of certain alkaline salts in the water, notably the salts of soda and potash.

Hard waters may be divided into two classes, those which are permanently hard and those which are temporarily hard. Generally a single sample of naturally hard water partakes of both these properties. A water which is said to be temporarily hard becomes soft by boiling, as the hardness is due to salts of magnesia, or lime dissolved in the water by the agency of carbonic acid, or is due to the presence of this gas in a free state in the water. Under either circumstances the effect of boiling the water a sufficiently long time is to drive off the carbonic acid gas. A natural softening of the water takes place from the absence of this gas, and the earthy salts that have been held in solution by it in the water.

Water that is perfectly hard derives this property from the presence of the same salts as are in water temporarily hard, but instead of being combined with carbonic acid they are combined with sulphuric acid. To soften water that is permanently hard, requires very different conditions than in the case of waters that are temporarily hard.

Although many authorities insist that for the sake of health a soft water is beneficial, there are those who contend that there is no evidence to show that hard water has any influence upon health. It is clear, so far as the health statistics of England are concerned, that, if anything, the results are in favor of persons inhabiting districts having hard waters. Some waters which are of remarkable softness, due to the presence of certain alkaline salts, especially those of soda, may be quite unfit for drinking purposes. Water, however, which has been softened by means of a process like Dr. Clark's, which does not add any new element to the water, has great advantages for many purposes. It prevents incrustation of steam boilers, it results in a saving of fuel, saves soap in all washing and cleansing operations, and, it is stated, leads to greater economy in brewing. Whether this is correct or not is doubtful, as water used for such purposes is always boiled, and when in that state should be soft water.

In the ordinary Clark process, lime water in known quantity is first admitted into a tank, to which the water to be softened is added. In some cases the lime water and the hard water are allowed to flow together into the tank, but it was considered by Dr. Clark to be an advantage, in carrying out this process, for the hard water to be brought into contact with an excess of lime water in the first instance, which was led into the tank before the water to be softened was added. In the ordinary Clark process, not less than 16 hours were required for the softening and subsidence of the matters separated.

In the Porter-Clark process, instead of allowing the particles of carbonate of lime to separate and subside, a brisk agitation is maintained, so that these particles remain in suspension, to permit chemical reaction with the lime, and the purification of the hard water. This, when completed, is passed onward to filter presses, where the carbonate of lime adheres to the filtering cloth. The subsequent operations of filtering through the deposit on the cloth then take place, and the water is passed away at once, fit for use. The process is continuous in its action, and may be carried on just as quickly as water may be pumped from a well, provided the apparatus is of sufficient capacity to allow time for the water to remain in contact with the lime in passing through the machine. The lime in this case is passed through horizontal cylinders, which are termed lime-churns, and is constantly churned up with water. The lime water so made is, by suitable arrangements, allowed to mix with the ordinary water in proper proportions, after which it is again agitated.

The Atkins process is a modification of the Clark process, by which the space formerly required is reduced. The lime is put into a vessel where lime water is formed. This water is allowed to mix in proper proportions with the water to be softened in a specially arranged vessel, after which it passes into a reservoir. From this reservoir it is conveyed to vessels which contain a special arrangement of filter, consisting of a series of chambers mounted upon a central hollow shaft. These disc chambers are covered with prepared canvas, upon which the deposit of chalk adheres, and through which the softened water filters.

Ice taken from hard or other impure waters, if found to be perfectly crystalline and free from air bubbles, will produce, on melting, a water as soft as common distilled water. If, however, the ice contains air bubbles or cavities of any description, such water will not be entirely pure. The act of freezing may be carried to such an extent as to produce in the remaining water a precipitation of the salts in solution; but ice frozen upon very shallow water is liable to have the impurities frozen in it. Water which has been largely deprived of air, by boiling or exposure, upon being frozen, if perfectly crystalline, will produce absolutely pure water.—*The Building News.*

GOOD BRICKS AND BRICK-WORK.

There are certain criteria of good bricks, which, being infallible and readily applied, constitute the best practical tests as to the quality of these valuable materials. In the first place, good bricks are always heavy—always solid and compact, ringing with a clear, sharp sound, when struck together, and well and truly formed with nice, sharp edges. Neither will they absorb much water. If you have to choose between two bricks of equal or nearly equal weight, immerse them in water after weighing them dry. Twenty-four hours after take them out, and reject the one which has acquired most weight, and therefore imbibed most water. Over-burnt bricks may be heavy, but they are also cracked and distorted in form by undue heat, and may be readily distinguished from the better sort by their general appearance. Bad bricks, on the contrary, are light, will not ring at all when struck together, are ill shaped, hollow on one side and round on the other, readily abrade on the edges, suck up water like a sponge, and indeed are sometimes so soft that a strong thumb may force off the edges, such as they are.

Good brick-work is laid truly and accurately to a level, every joint answers truly to the line, and every part of the face coincides with the plumb. All the beds and joints are well filled with mortar until it is fairly pressed out in the faces; all deficiencies are carefully pointed up as the work proceeds, and the whole well flushed in course by course. The mortar is well mixed, lime and sand thoroughly blended, and the sand, if handled alone, is found to be clean and sharp to the touch, feeling thoroughly gritty, and free from all slimy, greasy, and tenacious qualities. The joints are never to exceed three-eighths of an inch, and should never exceed one-quarter of an inch in thickness, and the vertical lines must be truly plumb over each other in such courses as intended, according to the kind of bond employed. The work is also carried up uniformly level throughout, and no difference permitted even for a temporary purpose, under any circumstances whatever. By these means only can unequal settlements be prevented. Contraction of bulk or settlement we know must occur from the combination of materials in an expanded condition, as mortars and cements are, when in plastic form; and therefore all walls must sink or settle down as the mortar becomes dry; but it is essential, to prevent dislocation, that this settlement be uniform throughout, and this can only be secured by adopting the precautions prescribed above. For the same purpose the back and interior of the work must be brought up, laid, and finished as completely as the front, and no gaps or crevices left for subsequent patching. One other rule has to be observed, and we reserve it to the last, and separate, and emphatic statement, to show our estimate of its importance, in order to produce good brick-work, which is this—that the mortar should be as thick as it may be, or as nearly approaching the solid form as is consistent with the degree of plasticity essential for its proper distribution and penetrating into the joints, while the brick should be thoroughly wetted on the surface. By these means the adhesion between them is rendered the more perfect, and the subsequent amount of shrinking and settlement is reduced to a minimum. The watery mortar, on the contrary, suffers extreme contraction, while the essential properties of the lime are actually dissipated, and when the wall becomes thoroughly dried, if ever it does, little remains in the way of cement but the sand compounded with it.—*The Northwestern Improvement Record.*

HOW THE CHINESE MAKE VERY THIN IRON CASTINGS.

For making the very thin rice pans, which are cast without handles, pure native iron alone can be used; as, being smelted with charcoal, it is more fluid than iron smelted with coal. The moulds in which the pans are cast require weeks of tedious and patient labor to bring them to perfection. They are composed of two parts—an upper and a lower—and are made of carefully puddled clay, the upper portion about an inch and a half, and the lower somewhat thicker. The lower, or under half, is full of holes, about half an inch in diameter, which pierce about two-thirds the thickness of the mould; these are made in order to allow the clay to dry thoroughly. The moulds are turned through on a revolving potter's table of the usual pattern, and when quite dry receive a final coating of fine moulding sand, and are made perfectly smooth. The two portions of the mould are then luted together with clay and placed in a large round oven some six feet or more in diameter. The pans are cast bottom uwwards, each mould having a runner but no riser; the upper portion of the mould has three little legs in order to support it when drying previously to the two moulds being luted together. After being placed in the oven, which is some two and a half feet deep, the moulds are surrounded with charcoal, which is fired, and the ovens closely covered with a dried clay cover, kept together with iron straps. The process is so timed, that by the time the moulds are at a bright red or almost white heat, the iron is melted, and ready for tapping. The molten metal is then run out into ladles made for the purpose, and quickly poured into the moulds. When these are all filled, the cover of the oven is readjusted, and the whole left to anneal or cool gradually.

The great secret about this process, which enables the Chinese founders to cast their iron pans of such large diameter, yet so thin and light as to be scarcely thicker than a sheet of paper, appears to be the use of these highly heated moulds, and pure iron smelted with charcoal. When the ovens and their contents are cooled down, which takes about two days, the luting attaching the upper portion of the mould to the lower is carefully removed, and the moulds being separated, the pan can be extracted. When the operation has been successful, the same mould can, with a little touching up, be used several times. The pans now have each attached to its bottom a runner, or lump of iron, of greater or less size, which, from the extreme thinness of the pans, making them but little less brittle than earthenware, requires the greatest care in its removal; these runners are carefully sawn off, the use of the cold chisel being obviously impossible.
—*The Chemical News.*

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Air From The Exit Pipes of a crowded hall darkens sulphuric acid, decolorizes potassium permanganate, and causes water, or a sponge saturated with it, to putrefy.

Think of this when you sit in a church that smells like a this year's hen's nest!

STEAM THE BEST MOVING FORCE.

Perhaps no principle in the whole range of physical science is better established and more generally recognized than that which asserts the maximum efficiency of fluid in heat engines to be a function, simply, of the temperatures of reception and rejection of heat, and to be absolutely independent of the nature of the working fluid. This was shown by Carnot sixty years ago, and has been considered one of the fundamental principles of thermo-dynamics from that time to this. Nevertheless, so rarely is it comprehended, and so difficult is it for the average mind to accept this truth, that the most magnificent fallacies of the time are based upon assumptions in direct contradiction of it.

The various new "motors" recently brought before the public with the claim of more than possible perfection, have taken hundreds of thousands of dollars within the past two or three years from the pockets of credulous and greedy victims. It is not sufficient to declare the principle; the comparison of steam with ether, and of air or gas with carbon-disulphide or chloroform, must be made directly, and the results presented in exact figures, before the unfortunate investor —whose rapaciousness is often such as to cause him to give ear to the swindler rather than to the well-informed professional to whom he would ordinarily go for advice—can be induced to withdraw from the dangerous but seductive scheme.

It is true that the principle does not as exactly apply to a comparison of efficiencies of machine, and that the vendor of new motors usually seizes upon this point as his vantage-ground; but a careful comparison of the several fluids, both as to efficiency of fluid and efficiency of machine, throughout the whole range of temperatures and pressures found practicable in application, shows that the final deduction is substantially the same for all the usually attainable conditions of practice; and, further, that of all the available fluids, steam is, fortunately, the best.—*Thurston.*

THE BEST TOBACCO-PIPE.

If all pipes were equally durable they might be classed as follows: First, soft earthen pipe; second, meerschaum; third, hard earthen pipe, white or colored; fourth, wooden pipe; fifth, porcelain pipe; sixth, metallic pipe.

The white earthen pipe, porous and permeable to liquids, is first, because it is a good absorber of nicotine; the metallic pipe is last, because it allows all the noxious products formed during the combustion of the tobacco to reach the mouth of the smoker. The meerschaum, which follows the clay pipe, deserves its place only on condition that it is not too old. If it is seasoned, it is as bad as a wooden or porcelain pipe. The seasoning may be full of charms to the amateur; but to the hygienist it simply indicates that the pipe has had its day, is saturated with tobacco-juice, and must be replaced by another, or be passed through the fire to purify it, as is done in the coffee-houses of Holland with clay pipes.

Every old pipe, browned with long use, leaves on the lips and tongue an acid and strong smelling liquid which irritates the tissues and corrodes the mucous secretions. When it has reached this condition, the finest meerschaum is no better than the meanest scorch-throat. Independently of the substance, the form of the pipe has an influence on the proportion of noxious ingredients which tobacco smoke contains. Turkish and Indian pipes, in which tobacco is burned slowly, discharging its smoke through a liquid, arrest a large portion of the poisonous ingredients. The bowl of the German pipe retains a greater part of the oily products; the Dutch and English clay pipes retain less. The metallic pipes of Thibet, becoming heated, carry to the mouth not only brown liquids saturated with nicotine, but also a smoke hot enough to burn the tongue.—*Popular Science Monthly.*

THE LARGEST DOCK IN THE WORLD.

Sealed proposals were opened at Milwaukee lately for the construction of the ore docks at Ashland. The work will be one of great magnitude, the estimated cost of the dock being in the neighborhood of $600,000. The plans and specifications of the structure show that it will not only be the largest on the lakes, but the largest ore dock in the world. Its extreme length over all will be 1,400 feet, 46 feet wide and 40 feet high. There will be 234 pockets, with a capacity of 25,000 tons of ore. Two train loads of ore can be dumped at the same time, and the largest vessels can be loaded in from six to eight hours. The superstructure will rest upon 7,000 piles, forming a dock basin which will be filled solid from the bottom of the harbor to 19 inches above high-water mark. The dock will draw 20 feet of water, so that the largest vessel afloat upon the lakes can be loaded. The work of construction will be under the immediate charge of Superintendent L. S. Barr, and will continue through the winter, and employment will be given to a large force of men.—*Press dispatch.*

PEANUT OIL.

Peanuts furnish about thirty per cent. of oil, which, when prepared by cold pressing, is colorless and tasteless, and suitable for culinary purposes, or as an excellent substitute for olive oil, although in a slight degree more prone to rancidity. By exposure it changes very slowly, but thickens with time, and assumes a rancid odor and flavor. As an illuminating oil it has feeble power, and its chief industrial uses are for soap making and lubricating, particularly the former. Very large quantities are passed off in European markets as olive oil. The most extensive foreign trade in the oil takes place with China, where it is made on a large scale and known among the English residents as "tea oil." Considerable is imported to California, where it is known as China nut oil, and used for culinary purposes.

Some years ago, peanut oil was used as an adulterant of lard and sperm oils. An effort was made to push the sale of it about ten years since, but without success, and outside of a light demand from special sources, it is comparatively unknown here.—*Oil, Paint and Drug Reporter.*

THE MISSION OF SCIENCE.

Government has two main objects to secure: the suppression of crime and the promotion of industries. It is in the latter that applied science finds its plainest and its most obvious line of application, and in such application, as we shall readily perceive, the department of science which must find widest and most important fields of application will inevitably be that of "Mechanics."

Mechanics directs the advancement of the world in an astonishingly greater degree than does any other department of science, and it has, therefore, correspondingly great importance as one of the agents of civilization. Every industry is largely mechanical; nearly all of the products of the labor of the world are given form, to a greater or less extent, by mechanism. It is applied mechanics that sows and reaps grain, grinds flour, and transports it to domestic markets, that carries it across the ocean to the half-fed people of Europe. It is applied mechanics that prepares cotton for the mill, compresses the product of acres into a bale that may be handled by a single strong man, that spins cotton and wool, weaves them into cloth. It even cuts the cloth to pattern, and, by its most ingenious of minor applications, the sewing machine, gives the garment permanent form. Applied mechanics gives to the astronomer his telescope, enables him to calculate the elements of the planets and the stars, teaches the mariner his system of navigation, gives him the ship that he thus directs, and guides the engineer in his magnificent work of designing the machinery which impels the enormous structure. Even the sister sciences, physics and chemistry, are departments of applied mechanics, and are coming to take their place in the widespreading department of "molecular mechanics," and in a still more comprehensive but younger branch of our science—that of "energetics."

Even vital forces are gradually coming to be grouped under the same head, and all the natural sciences are more and more generally recognized as properly falling into the department of energetics, and as illustrations of the application of the laws of mechanics. The mission of Science is to be fulfilled mainly, then, through the application of mechanics.—*Thurston.*

◆

A Gentleman asserts that he proves time is money when he gives twenty-five cents to a couple of tramps, because it is a quarter to two.

Chippings and Filings.

Press Dispatches show a marked increase in large orders for iron.

◆

Have You Never Made A Mistake? If you have, don't be too positive that you cannot make another.

◆

Paterson And Newark, N. J., engineers, are inquiring into the National Association, with a view to organizing.

◆

The Firm Of Weightman & Wolff, consulting engineers, formerly of 85 Astor House, this city, has been dissolved by mutual consent, Mr. W. H. Weightman retiring. Mr. Alfred R. Wolff continues in business at the same number.

◆

The City Of Durango, Col., has applied the Curtis regulator valve to street mains, to reduce the reservoir pressure on 10-inch pipe from 160 lbs. to 100 lbs., as desired. The regulator is so made that, in case of fire, the full pressure may be had, as needed.

◆

Lovers Of The Game of cribbage will be pleased with a handsome board, made for the game by C. W. Le Count, of South Norwalk, Conn. It is made of black walnut highly polished, has a metal top, and is nickel-plated. It is sold for $1.25 free by mail, and is worth the money.

◆

The Massachusetts Association Stationary Engineers, No. 1, have lately purchased about fifty volumes on steam and kindred subjects, for their library. They have also been presented with indicators by Mr. Clarke, of the Crosby Steam Gauge and Valve Co., and a Tabor indicator by the makers of the same.

◆

A Green Mountain Farmer's Boy purchased a bicycle, but tiring of the task of turning the treadle, laid it aside. The old gentleman saw it and concocted a scheme. He dismembered the machine and hung the large wheel in a frame. Then he took the tire off, and put a rope belt over it, and on to a grindstone. Then he made the now thoroughly unhappy son mount, and furnish power for the same.

◆

A New Association of Stationary Engineers was organized at Wichita, Kansas, on the 21st ult., with the following gentlemen as officers: President, R. P. Faries; vice-president, John McFarland; treasurer, Jos. M. Snyder; financial secretary, Robert Clark; recording secretary, Wm. Stockinger; conductor, Jas. W. Dugan; doorkeeper, S. B. Smith. A vote of thanks to the deputy organizer, George Trindle, of the National Association, for his assistance, pecuniary and otherwise, was tendered.

Communications may be addressed to the corresponding secretary, Ed. C. Smith, box 259, Wichita, Kansas.

◆

This Is From the *American Miller*: "Parties had been working in a saw-mill, and work had grown so dull that it was decided to shut down. They worked nearly all night and succeeded in loading the engine and boiler (a large 24-horse stationary), and when the sun rose the next morning they had it hidden out in a wood ten miles away. The next night they drove thirty miles and secreted it in an old barn. Two years afterward they started a saw-mill, and the owner of the boiler happening to be around that way, recognized it. He tried to get it back again, but could not prove that it was his property, and was unable to either get it or punish the thieves."

◆

A New Telephone is in market, which is operated without electricity. "The secret lies in the diaphragm, which is made of an imported wood; layers of it woven together are screwed to the mouthpiece, and the telephone is complete. The wire used is made of phosphor-bronze, but ordinary steel wire can be used. The diaphragm is so sensitive that it can reproduce vocal vibrations distinctly, even at a distance of two miles. Aspirates and sounds that it is impossible to transmit over any known telephone are easily reproduced by this telephone. When the operator blew his breath on the diaphragm the listener at the other end detected at once what had been done."

◆

A Contemporary says that a person in Norwich, Conn., has obtained a patent on a new method of truing grindstones. He places two grindstones in one frame, one of the stones being so arranged that it can be traversed laterally across the face of its mate; suitable means are provided for bringing the face of the stones together as they wear. One grindstone is made to grind the other true.

This is old; the difficulty with it is, that it is impossible to obtain two stones of exactly the same grit. Where there are hard spots and soft spots, as there are in most stones, they wear out of truth, in spite of anything yet devised—except the celebrated gas-pipe.

◆

Read This: A. O. Proute, of White Plains, who keeps a country store, weighed out lately half a pound of powder for a customer. He was smoking when the order was given, but laid his cigar down when he went to weigh out the powder. [This was thoughtful.—Eds. M. E.] While bringing it to do up he picked up his cigar again and commenced puffing. Some ashes and sparks fell into the powder, which at once blazed up. Mr. Proute was badly burned about the face, and his hair, whiskers, and eyebrows were singed off. For a few minutes there was great excitement in the neighborhood.

No doubt!

◆

Prof. Douglass, of the Michigan State University, it is said, produces miniature cyclones at will by suspending a large copper plate by silken cords. This plate is charged heavily with electricity, which hangs down like a bag underneath (?) and is rendered visible by the use of arsenious acid gas, which gives it a green color. The formation is a miniature cyclone as perfect as any started in the clouds. It is funnel-shaped and whirls around rapidly. Passing this plate over a table, the cyclone snatches up copper cents, pins, pith-balls and other objects, and scatters them on all sides.—*The Millstone.*

[We don't understand how electricity can "hang down like a bag!"—Eds. M. E.]

◆

Respecting The Hyatt Filter in the St. Louis Exhibition, the *Age of Steel* says:

So many efforts at mechanically cleansing the waters of the Southern and Western valleys have been attempted, all resulting in entire failure, that the people of these sections have but little faith in filtration; but by the Hyatt filter this important question is evidently solved, bright, clear water being produced with great economy. The water is delivered to the filter, which is 40 inches in diameter and 9 feet high, from the city pipes, and, passing through the filter at the rate of 40,000 gallons per day, is furnished clear and sparkling to the drinking fountains, lemonade and candy stands, restaurant, and other parts of the building, besides supplying the pump tank holding 25,000 gallons of water.

Among the St. Louis establishments now using the filter is the Belcher Sugar Refining Company. The capacity of this filter is 80,000 gallons per day, and it has afforded entire satisfaction.

◆

Parsimonious Steam Users seem to be trying to depopulate certain portions of the country, and impoverish themselves at the same time.

The Mill of Emison & Collender, at Vincennes, Ind., was demolished on Sept. 20 by the explosion of the boiler, the engineer receiving fatal injuries. The engine-room was swept away. The interior of the mill is a wreck, and the damage is estimated at $10,000. The engineer was fearfully scalded. He was conscious for a long time, and said that he was carrying eighty pounds of steam —that amount being required to run the mill. The boiler leaked, and was very old, and the proprietors of the mill asked a man to do some repairing on it, when he refused, as he said he had patched it all it would stand. Examination disclosed the fact that in many places the boiler was very thin. The mill was not insured against such an accident. If this is not manslaughter what is it?

◆

For The Manufacture Of Toilet Soap, an important machine is the kneader. Its function is to reduce soap shavings, after they have received the coloring and odorous substances, into a homogeneous mass. The arrangement consists of two or three cylinders of smooth granite, or other hard stone, connected by toothed wheels in such a manner that the first and second rollers move with the same speed, but in opposite directions, while the third cylinder runs a little slower than the other two. A hopper permits the soap shavings to drop between the cylinders, where they are seized and pressed into a very thin ribbon. The end of this soap ribbon is next pushed between the second and third cylinders, consequently the soap ribbon is stretched and the soap is kneaded again. In order to produce perfect homogeneity of the soap mass, it is passed through a second, and, if necessary, a third time. These stone cylinders rest upon iron frames, and, as previously mentioned, are connected by toothed wheels; they are generally of from 20 to 25 centimeters in diameter, and 30 to 40 centimeters in length. A scraper clears each cylinder from the adhering soap mass. Before the introduction of these simple machines stone mortars were used, in which the soap was belabored with the pigment and perfume until it was uniform—a costly process, since it was possible only to treat small quantities of soap at one time.—*Independent Record.*

◆

The Success Of The Babcock And Wilcox Water Tube Boilers, using blast furnace waste gas, as fuel, at the Lucy Furnaces, Pittsburg, Pa., is leading to other trade in this direction. Sales have recently been made to blast furnaces as follows:

Pottsville Iron & Steel Co., Pottsville, Pa., 150 H. P.; Woodward Iron Co., Wheeling, Ala., 292 H. P.; McCormick & Co., Harrisburgh, Pa., Paxton Furnaces, 416 H. P.; Lochiel Rolling Mill Co., Harrisburgh, Pa., 416 H. P. Total, 1,274 H. P.

The following is a list of other sales made by the Babcock & Wilcox Co. within the last sixty days:

H. I. Kimball House Co., Atlanta, Ga., 122 H. P.; Woodland Fire Brick Co., Woodland, Clearfield Co., Pa., 92 H. P.; Cin., St. Louis & Pittsburgh R. R., Indianapolis, Ind., 146 H. P.; Louisiana Sugar Refinery Co., New Orleans, La., 240 H. P.; Williamsburgh Gas Light Co., Brooklyn, E. D., 164 H. P.; Pratt Manufacturing Co., Brooklyn, E. D., 208 H. P.; Colwell Bros., N. Y. City, for export to Mexico, 122 H. P.; New Orleans Cotton Exposition, New Orleans, La., 656 H. P.; Leonard Bros., Plymouth, Pa., 15 H. P.; G. Reynaud, N. Y. City, for Ing'o Santa Maria, Cuba, 73 H. P.; Ohio Edison Electric Installation Co., for Middletown, O., 52 H. P.; Oliver & Roberts Wire Co., Pittsburgh, Pa., 416 H. P.; McCormick Harvesting Machine Co., Chicago, Ill., 480 H. P.; Sperry Electric Light Co., Omaha, Neb., 120 H. P.; Walter Aiken, Franklin Falls, N. H., 30 H. P.; A. N. McNeal, Burlington, N. J., 104 H. P.; Lombard, Ayres & Co., Constable Hook, N. J., 208 H. P.; Susquehanna Water Power & Paper Co., Conowingo, Md., 164 H. P.; Booklyn Sugar Refining Co., Brooklyn, E. D., 1,464 H. P.; American Bank Note Co., New York City, 240 H. P.; U. S. Naval Training Station, Newport, R. I., 122 H. P. Total, 52,788 H. P.

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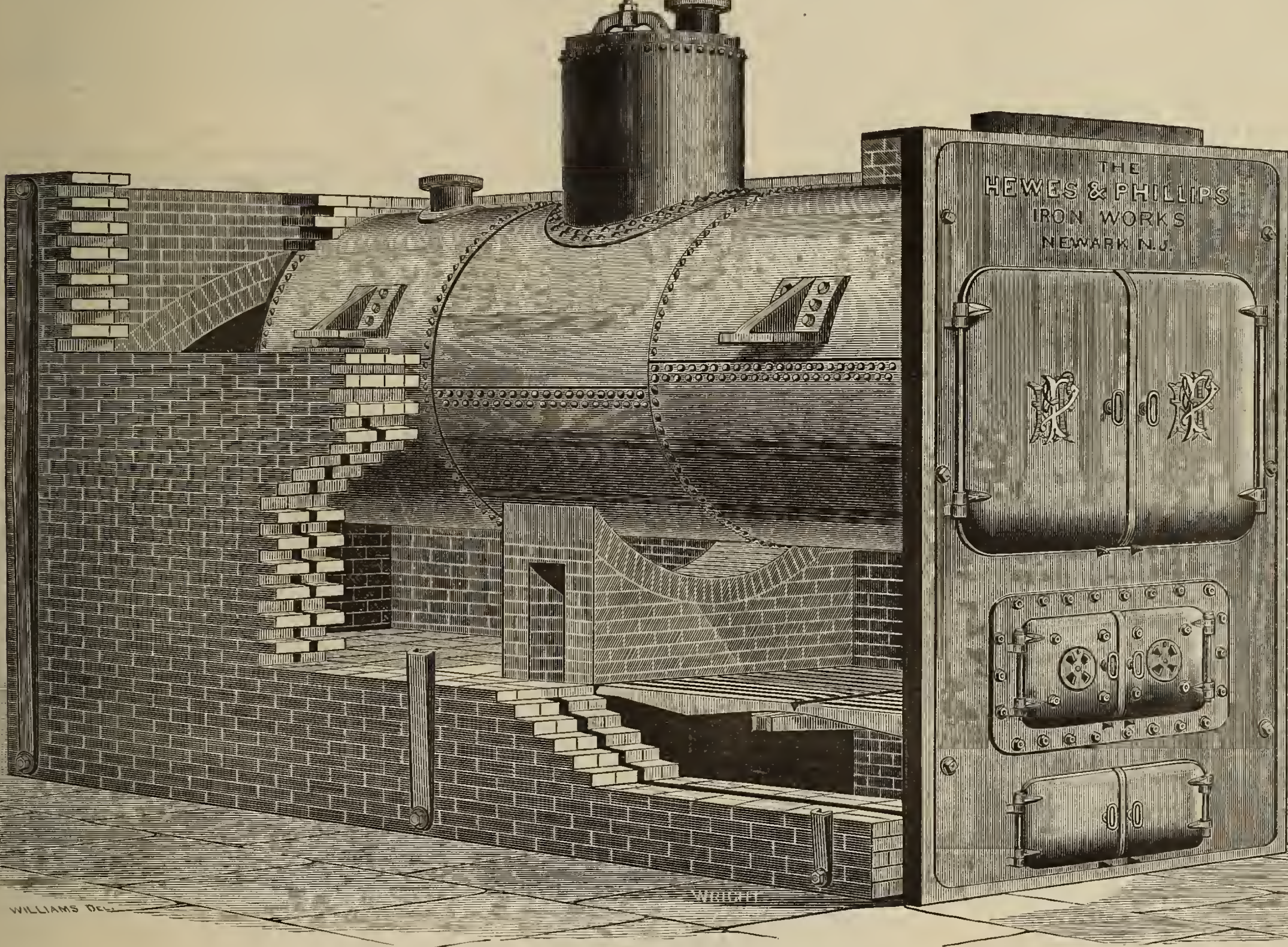
TUBULAR BOILER, BY THE HEWES & PHILLIPS IRON WORKS, NEWARK, N. J.

Boiler settings have interest for a large number of persons, for upon the correctness of the principles employed depends, in a very great degree, the efficiency of the boiler itself. The engraving is so clear as to the plan, that nothing remains to be added by way of explanation. The measurements, however, we are not able to give, these being the property of the company.

The heat passes under the boiler first, and returns through the tubes into a smoke chamber, and thence into the flue leading to the chimney. The boilers themselves are constructed according to the best modern practice, all the flanges being turned on curves of long radii, and, in all sizes above 50 h. p., the longitudinal seams and domes, where joined to the shell, are double riveted. The rivet holes themselves are truly laid out, punched and reamed afterward, and no drift-pins are employed. There are two large manholes, one on the top and the other on the lower part of the front head; affording every facility for access in cleaning, and for inspection. The tubes have an extra wide space, vertically, in the center, adding to the circulation. The iron used is of the best quality, and each boiler is tested hydrostatically to 150 lbs. per square inch. The fronts of these boilers present a very pleasing effect; having no square corners or projections anywhere to catch dust, they are easily kept clean. Prices, etc., given on application to the Hewes & Phillips Iron Works, Newark, N. J.



Tubular Boiler, By The Hewes & Phillips Iron Works, Newark, N. J.

◆

An Inventor Of This City has devised an apparatus for melting snow in the streets instead of carrying it away in carts. The machine is described as simply a tubular boiler with an open shell, into which snow is dumped as fast as it can be shoveled. At a recent experiment with ten tons of ice, made as nearly like snow as possible, that quantity was melted in about forty minutes; the amount of fuel used is not stated. The cost of carting a *load* of snow—weight not stated—is 75 cents, without the labor of loading it. The test of efficiency will, of course, lie in the amount of fuel burned for snow removed, and we fancy for large cities the system will prove available and economical. Time is an element, as well as relative cost, in relieving the streets of snow, and if the machine can do it at the same expense in half the time that carting requires, it will be a great gain.

◆

Carbons For Arc Lights are formed by thoroughly incorporating a mixture of finely divided carbonaceous materials, the purer forms of coke, or gas retort carbon, with some liquid substance, such as oil, tar or sugar syrup, that, when subjected to high temperature, is capable of being carbonized. The finely-divided ingredients are made into a stiff paste with the liquid, and forced by hydraulic pressure through apertures in plates. The continuous cylindrical rods thus obtained are cut into suitable lengths, carefully dried and then heated to incandescence in ovens while out of contact with air. Experience has shown that the higher the temperature and the greater the length of time during which the carbons are subjected to the baking process, the greater their hardness and the higher their electrical conductivity.—*Electrical Review.*

◆

The World Is Full Of Food And Goods. Barns, elevators, warehouses, and wholesale stores are overflowing, but there is a grievous blight on trade the world over. The general impression is that the trouble is due to overproduction, yet all the nations swarm with hungry and half-naked people. May not the difficulty be under-consumption due to lack of money? In various epochs of the past there were great discoveries of gold and silver, which stimulated the trade of the world; but the yield, especially of gold, has largely fallen off during late years, and commercial nations have combined to discredit silver, and thus lessen by one-half the specie reserve of mankind. Hence the blow at prices, the declining markets, the distress of borrowers and all engaged in trade transactions, in spite of the gifts of nature.—*N. Y. Record.*

◆

The Skill necessary to carry on a first-class factory of lubricating oil in the present age, can only be realized by a visit to such an establishment. A consulting chemist is necessary, as the range of products is almost illimitable. The consumer of lubricating oil in 1884 is hard to please. The locomotive must have an oil that will stand a fire-test of six hundred degrees, and a cold-test of thirty degrees, Fahrenheit, without impairing its qualities. The mill-owner can select just what the machine demands, whether it is the spindle of a cotton loom, the cogs of gear-wheels or the bearings of journals, exposed to the cold of January or the heat of August. Mineral oil rules the world in this respect, and in only a few cases is the presence of a vegetable or an animal oil tolerated in a lubricant. Making these oils, and the production of the numerous "stock" oils used in compounding lubricants, has grown to a magnitude and importance which call forth vast capital, and the highest skill and enterprise.—*Independent Record.*

◆

Russia Sheet Iron is always made 28 × 56 inches in size. A salesman for a New York house says that in a recent trip he came across a lot of American imitation sheet iron, which was sold for genuine Russian, but which measured 28 × 60 inches, the measure being the only thing which gave it away.

◆

Mr. William Kent, a professional engineer of experience, says: "Any test of a boiler at high pressure, with American anthracite coal and natural draught, which shows a result exceeding 12 pounds water per pound of combustible, should be discredited until competing tests by a board of experts shall have shown that a higher result can be reached in practice."

NOTES FROM THE ELECTRICAL EXHIBITION.

A correspondent of the Burlington, Vt., *Free Press* writes to that paper as follows:

Small electrical appliances for various uses are numerous, and electrical measuring instruments are innumerable. The chronoscope is composed of a tuning-fork and a cylinder. On each side of the fork is an electro-magnet. The current is alternately interrupted in each magnet, so that the tuning-fork is attracted by one and then by the other, and kept in constant vibration. By means of a quill attached to it, these vibrations are marked on the revolving cylinder, each one representing a small interval of time. Immediately over the tuning-fork is a tube with a small wire. A rifle is placed at the mouth of a long pipe and fired. At the commencement of its progress the bullet breaks a wire, whereby the circuit is broken and a spark is thrown on the cylinder from the glass tube. As the bullet strikes the target at the end of the pipe the current is broken again, and another spark is thrown on the cylinder. The number of vibrations between the two sparks give the time taken by the bullet in going the length of the pipe.

Another way of accomplishing the same object is perhaps more striking. Two rods, one long and one short, are suspended by means of electro-magnets, which remain magnets only so long as a current is maintained. On firing as before, when the wire is cut, one current is interrupted and the long rod drops. When the bullet strikes the target the current supplying the second magnet is broken and the short rod drops, striking a lever that causes a knife to shoot out, and nicks the rod still falling.

Of more popular interest than any of these, however, are the means used for telling how much rain has fallen, how fast the wind blows, and how soon it is likely to rain, judging by the barometer. This particular barometer is called the tele-barograph. The word may be roughly translated as "distant weight-writer," which explains the use of the instrument. The barometer may be placed in Burlington, and its rise and fall will be accurately recorded in Washington.

A little float rests on the top of the mercury in a syphon barometer. A silk string attaches the float to a lever, whose ends hang nicely, just between two metal points. If the barometer falls, the end of the lever is pulled up and touches one of the points. This completes the circuit, and almost immediately the fall is registered on a cylinder that may be many miles away. Even more than this is done. A current is sent back in return, and by means of clock-work the lever is restored, automatically, to its midway position, ready for another change. Of course, when the barometer rises, contact is made on the lower point. In the rain-gauge, electricity is again employed to record the rainfall by means of a float, which, on rising, completes a circuit.

The absence of foreign exhibits is very noticeable. Nothing of any importance is shown from foreign inventors, except some small instruments for various purposes, the Faure storage battery and the Jablochkoff lamp, and the latter is of interest only from the fact that it was the first really successful arc light. But it sinks into insignificance beside the later lamps.

Little attention is given to the storage batteries; their practical advantage has not yet been demonstrated.

◆

About The Most Notable example of fortune's unfavorable treatment is that of James W. Marshall, the discoverer of gold in California, in 1848. His discovery has made millionaires of thousands of men, while to him it has proved a continuous stream of misfortune, or ill luck. He gave his discovery to the world, and thousands of fortune-seekers squatted on his land, killed his oxen for food, stole his horses, staked off his homestead into town lots, and threatened to hang him. To-day James Marshall is still alive, near the site of his old home, poverty-stricken and uncared for.

◆

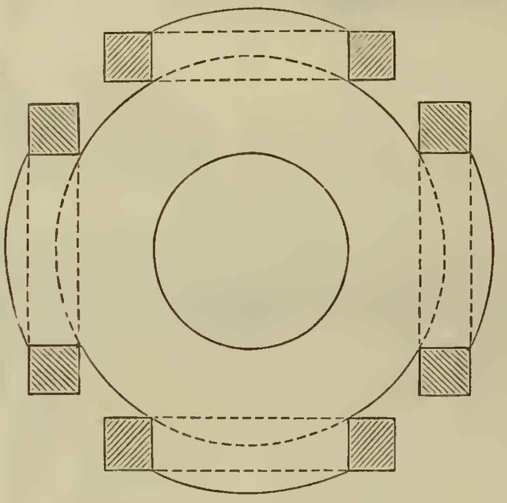
An American Firm Of Silk Manufacturers in this city, tired of seeing their goods palmed off as foreign makes, have opened a retail department, from whence they will sell the product of their looms direct. Customers can design their own patterns and have them made on the premises.

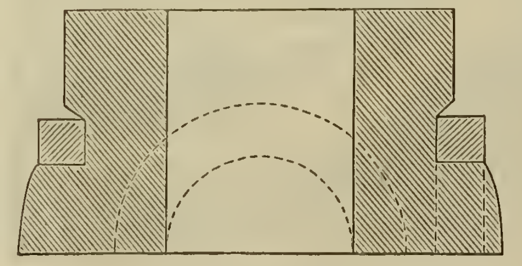
A NEW FORM OF SHAFT COUPLING.

By E. S. Chapelle.

That "necessity is the mother of invention" was well illustrated by an experience of mine. I had charge of the machinery of a rolling mill where some one who preceded me had located two fly-wheels, seventeen feet apart, on twelve-inch shafts, which were coupled with a flange coupling thirty inches in diameter in the flange, and twenty-two inches in diameter in the hub, originally bolted together with ten $1\frac{3}{4}$ inch bolts. Owing to the varying resistance of a train of rolls extending each way beyond the fly-wheels, the bolts in the coupling were continually working loose, though fitted to drive with a sledge, and the nuts secured by a half-inch pin through the point of the bolt. The power to drive the rolls was applied by gearing to one of the coupled shafts. I once reamed the bolt-holes and fitted new bolts, but in time they went the way of the old bolts, and the holes began to break out to the outside of the flanges. But the thing had to be secured somehow, as the power to drive one train of rolls was transmitted by this coupling. I thought of drilling new holes and fitting new bolts, but considered that too expensive, and when done, of doubtful efficiency. So I hit upon the plan of shaping the part of the flanges between two bolt-holes to receive a wrought iron band, which could be put on by a blacksmith.

Selecting four places, I set two men with sledge and chisel to shape them, and as fast as they were done the blacksmith made bands of $1\frac{1}{2}$ square iron, putting them on hot. After this I had no further trouble, until I had the satisfaction of arranging the power to drive each train of rolls independently. Then a hole was drilled in each band to weaken it so that it was easily broken and removed.





Subsequently, having occasion to put up a line of 4-inch shafting to stay, I made the couplings about the proportion of the drawings herewith. Scale 3 inches to 1 foot. Fig. 1 represents a face view of one-half the coupling, the wrought iron rings being shaded. Fig. 2 is a longitudinal section of the same. I hope the drawing is sufficiently plain to enable those who use such things to know where the castings require to be finished, and whether the two parts should be centered—by the shaft of one projecting into the other—or by facing the parts themselves to fit each other. There is no patent on this coupling and it is cheap and substantial. It can be used where it is inconvenient to drive bolts.

◆

The *St. Petersburg Herald* reports that Captain Kosztowitz is building at Okhta a large cigar-shaped balloon, 200 ft. in length and 80 ft. in height, including the car, which he has furnished with a screw and also with wings. He considers that he will be able to take a crew of sixteen men and 250 lb. of ballast, at the rate of forty German miles an hour, and the experimental trip is expected to take place early next month.

THE MILEAGE OF LARGE RAILWAYS.

The total number of miles covered annually by large railways is something astonishing. The London and Northwestern—says Frank Webb—has increased some 8 millions of miles per annum. "Our mileage to-day is over 48 millions of miles. Going into days, hours, and minutes, that means 131,520 miles a day, 5,480 miles per hour, 91 miles per minute, and $1\frac{1}{2}$ miles every second of time. This will represent a journey round the world about every four hours; and I am glad to say that our machinery is so perfect that we can go round the world an average of three times without losing either a split pin or a cotter. Our engine stock to-day is 2,462, our wagon stock nearly 50,000, and our carriage stock 6,000. To show you the progress of the railway during the last twenty years, I have taken, as a sample, the weight of the limited mail train. In 1864 the total weight of the carriages was 54 tons 19 cwt. In 1874 the total weight was 75 tons 3 cwt. In 1884 the trains weighed 165 tons 4 cwt. The problem I have had to solve was how to move this weight of train (which is constantly increasing) without having two engines, or without making an engine so cumbersome as to destroy the road. We have endeavored to solve that problem by compounding our engines, and thus economize in fuel and water. It has been stated that I am 'nursing' these engines. I have nursed them to such an extent that I have had nearly a million of miles out of them, the first compound engine turned out two years and a half ago being responsible for 150,000 miles in that time.

◆

A Correspondent says he notices that The Mechanical Engineer seems to take a kindly interest in the social welfare of machinists and engineers, and he thinks that it might be a good idea to publish something for the domestic department, such as the cost of living, house rent, wages, how to make a little money go a long way, etc., etc. Such topics, in his opinion, would have very great value and interest for a large number of persons.

We are obliged to him for his hint, but we fear we must dissent from his view—so far as regards the publication of such matter in this paper. Our correspondent is no doubt correct in his surmises as to the utility of hints on domestic economy in the proper place, but it is outside of our province. Our interest is, as he states, keen in regard to all things which affect our connection, but it seems to us that if we followed the suggestions made we should get off our course. The matter is incongruous, and would not harmonize very well with the rest. How would directions for making a pudding, for instance, look beside a description of a new cut-off?

◆

"The Water Supply in London is nowhere continuous. The stream is turned on from the main once only in the twenty-four hours, and each cistern fills till its own private ball cock drops and shuts out the supply. But these ball cocks are not by any means to be implicitly trusted. They work with dangerous independence and caprice, sometimes absolutely refusing to let the water in on any terms, sometimes giving it such access that it overflows and swamps kitchen or loft. In winter it freezes, then pipes burst in all the inaccessible places, where the ingenuity of the builder has secreted them. If from these or other reasons the water does not come, you are without it till the hour when the turncock—an official in a sort of uniform—comes around to turn on the supply."

◆

Respecting An Article On "*The Intelligent Compositor*," in our last issue, the editor of our contemporary says in explanation:

> "Charge that jumble in '*Conundrums for Steam Users*,' not to the intelligent compositor, but to the '*esthetic foreman*,' who thinks no paragraphic matter looks well unless 'sorted' according to length. The proof left the proof-reader's hands in good shape."

Thanks; the esthetic foreman is a new terror we have not as yet encountered. We rallied a friend once upon introducing an article on obstetrics in his technical paper, upon which he stated that it was not his fault; when he was away the foreman of the press-room did it, with his little hatchet.

MACHINERY UNADORNED.

Within a few years great changes have taken place in the external appearance of engines and machine tools. Of old the ogee and the "squirlycue" held sway, and branching devices, of one sort or another, played over the front and down the sides of bed-plates and lathe-beds without reason or fitness. These ornaments, so-called, were more than useless, for while they were material in the wrong place, they were also convenient receptacles of grease and dirt. Paint and varnish, in the shape of gaudy "decoration," have also disappeared, and the higher-class machines of to-day are of a dull and somber hue, which shows off the bright work to advantage. Aside from this, the plain faces are easily cleaned, affording no lodgment to dust, which is soon turned into a greasy mass by dripping oil. A steamship out of this port has the engine-frame painted dead-white all over, from keelson to cylinder-head, and woe be to the man who lays a grimy hand upon it. It would seem impossible to keep a marine engine-frame of such a color spotless; but an inspection of the vessel just after a six days' trip, proves that it is not, when neatness and care are inculcated. These two virtues, in this instance, are greatly encouraged by the smooth, unbroken surfaces of the frames themselves. Save in a few isolated instances, the modern practice of the best makers is as indicated above; but a barbaric splendor still illuminates—may we say disfigures—some machines. It is not long since that we saw a new engine being shipped, which was an example to be avoided. There is an "art" beloved of maiden ladies termed "potichomanie;" so called, doubtless, from a maniacal desire to cover pots or jars with lithographed designs in all colors and of all subjects. This engine was "potichomanied." In the center of the bed-plate was a staring landscape, and at various intervals along the side of the frame the familiar arabesque curveted and tumbled. A correct taste would have suppressed all this misplaced finery, and substituted instead a solid color that would stand the wear and tear of daily work. An engine with pretty pictures on it is not apt to be overwiped anywhere.

◆

Not A Pound Of Coal or wood is consumed at Creighton, 20 miles from Pittsburgh. Glass factory and residences are heated and lighted by natural gas. Gas was struck at 1,200 feet, in a 5-inch bore. A torrent of what the owners described as "pure nitrogen gas" (?) burst out with a force of 250 pounds to the square inch, and after three years is flowing with as much energy as ever. The visitor sees no coal, no wood, no cinders, no ashes, no smoke. In the furnaces is a lurid, steady heat, regulated by clock-work. No grimy stoker sweats his life away at furnace doors, but instead a calm person with a stained glass shield invites you to look through the glass at the open furnace doors, where glares a heat sufficient to deter a modern Shadrach, Meshach and Abednego from entering. Overhead, gas-burners are ablaze in broad day, because it is not worth while to take time to turn the burners off and on, as there is plenty of gas and to spare.—*Lumberman's Gazette.*

◆

The *Etruria*, a new steamship for the Cunard line, was recently launched. The *Etruria* is built of steel, on lines that resemble those of a yacht. Her gross measurement is 8,000 tons, and her dimensions are: Length, 520 feet; breadth of beam, 57 feet, and depth of hold, 40 feet. The hull is divided into a number of water-tight compartments, and is provided with five decks.

The engines are of 12,500 horse power and of the compound inverted vertical surface-condensing type. There are three cylinders, two of which are each 105 inches in diameter, the other is 71 inches in diameter, while the stroke is 6 feet. There are nine circular steel boilers, which are heated by 72 furnaces. A working pressure of 110 pounds to the square inch will be allowed.

◆

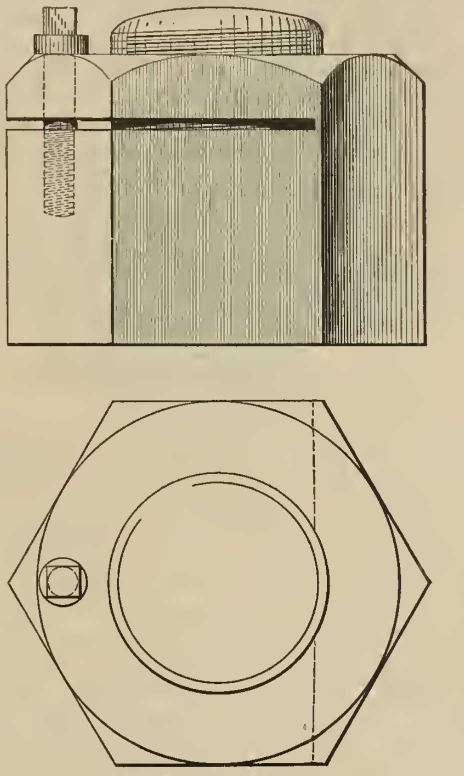
An Item going the rounds says:

"Of the three branches of engineering, mechanical to-day pays the best. The average civil engineer makes $2,000 per annum, the mining $2,200, and the mechanical $2,800. This includes bridge and locomotive construction."

We fear there will be a blind rush of every one into the profession !

AN INGENIOUS NUT LOCK.

A method of locking nuts which are liable to jar loose under high velocities is here shown. It is employed by Thornycroft on his torpedo boat engines, and has the merit of being entirely self-contained, or in one piece; there being no separate details to get mislaid or lost. It can also be instantly released and set up, and the nut itself is not marred or liable to jam, as in the case with the common collar and set screw in use here.

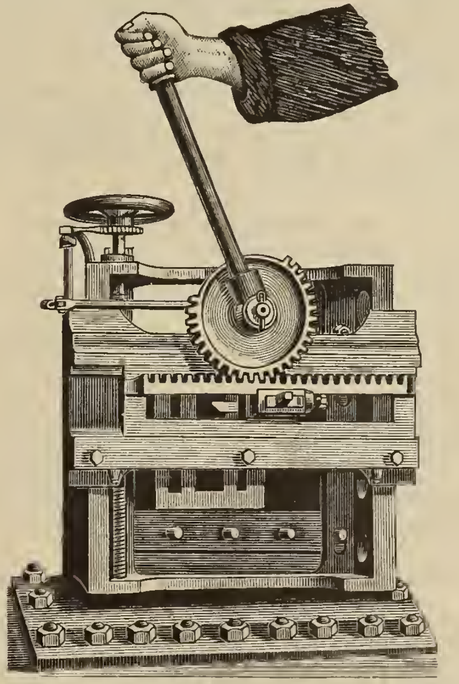


◆

NEW VALVE-SEAT PLANER.

The engraving shows a very simple and effective machine for dressing up defective valve-seats in place. It is portable, and may be bolted on the steam-chest. As will be seen, it is self-acting when once adjusted, feeding the tool downward without any attention, other than working the rack back and forth.

This is an English invention, and may be very useful to our readers.



◆

Jas. Mahony & Son, 73 Astor House, city, have recently put two new steel boilers and appliances in for Smith, Boswell & Co., Newport, R. I., and their furnace improvement to all the boilers in the Hecker Mills, this city. Also to the boilers of the New York Life Ins. Co., Broadway and Leonard st., H. J. Livy & Co., White and Franklin. New boilers set for Simon Strauss, Lewis st.

◆

The Brotherhood Of Locomotive Engineers is 21 years old, and has a membership of 16,000, and it has paid out in that time $1,533,169 to the families of deceased members, besides disbursing $500,000 to the sick and needy.

RAZOR STEEL.

The best razor steel contains 1½ per cent. of carbon. It must be melted from evenly converted steel. It will not do to mix hard and soft steel together, or to melt it from pig "let down" with iron; though in either case the exact 1½ per cent. of carbon may be the result. Steel made by the latter process will not possess the requisite amount of body; consequently the cutting edge of the razor will not stand. It must be melted from steel, converted from iron made from ore containing manganese. It will not do to add the manganese in the form of spiegeleisen, or ferro-manganese.

Carbon and manganese exist in combination with iron, not chemically combined in certain definite proportions, but as alloys, as mechanical mixtures in any proportion. We know that carbon exists in combination with iron in two forms, either as combined carbon or free carbon; is it not possible that manganese may also exist in two forms, and though the razor steel must have been boiled in the pot for half an hour after it was melted, to kill it and make the ingot pipe, is it not possible that the mechanical mixture of the carbon and the manganese, is less homogeneous in steel made by the cheap processes, than it is by that made by the old-fashioned method?

It has been stated that the finest qualities of steel, when hardened, show a more perfect regularity in their crystallization when examined under a microscope than commoner qualities, and I venture to suggest that a possible explanation of "body" in steel may be absence of injurious ingredients, combined with the perfectly homogeneous presence of the advantageous ingredients. Hardened steel is crystallized steel; and perfect regularity of crystallization in steel, which is required to be ground to a fine cutting edge, may be a necessity which can only be secured by the slow and expensive old-fashioned method.—*Seebohm.*

◆

Here Is A Piston which the steam is expected to "upset" on every stroke, so as to keep it packed !

"A piston for steam engines, which does not require any packing, has been patented in the United States and in several foreign countries. The two faces of the piston are curved inwardly, thus presenting two concave surfaces to the action of the steam. The edges of the concave surfaces which are in contact with the cylinder walls are made tapering, diminishing in thickness toward the ends of the piston. When steam is admitted into the cylinder it will, besides moving the piston, bear laterally against the tapering edges of the piston, and thus drive them against the cylinder walls. The amount of lateral pressure will be proportionate to the amount of pressure on the piston, and thus the frictional contact between piston and cylinder will always be proportionate to the total pressure. In this way the piston, it is claimed, is always properly tightened without the use of any additional packing."

◆

John Stathem, of Monongahela City, Pa., who is on a visit to his old home in England, writes from there to the *Monongahela City Republican* as follows:

"Trade is very dull about here, but better in other parts. The harvest is abundant, and it is expected that flour will be cheaper than for twenty years. Provisions are very cheap; white sugar, four to five cents; loaf sugar, five to six cents per pound. Potatoes are abundant and good, and so are many other eatables, but wages are very low. No wonder you want a tariff in America, for your workmen could never compete with any product here, as people have to work so cheap, and labor is so poorly paid. The big warehouses are just full of goods waiting to see the door swing half-way open, when they would flood the United States with English goods.

"You do well by your workingmen to keep out this product of low wages by a high tariff. Uncle Sam could have no chance in the markets of the world against Johnny Bull, unless he would bring his workingmen down to the same wages. Although I am an Englishman born, and dearly love my own land, yet I have seen some happy days in the Monongahela valley, and I never want to see wages come down there to what they are here."

Well, they won't.

◆

The Ferracute Machine Co., of Bridgeton, N. J., are working on full time, and have lately added some new machinery. They are just finishing a large lot of tools for the Standard Oil Co., and are building a thousand small machines for a Western company.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

RELATING TO BOILERS.

Editors Mechanical Engineer:

The cylinder boiler with hemispherical heads was formerly the strongest and simplest type, but as the use of steam increased, and the consumption of fuel per foot-pound of work done began to receive serious consideration, engineers quickly perceived that a departure from the simple types was absolutely necessary, and began to study the form which would give best results from the fuel. To some extent this had to be gained at a sacrifice of other important considerations, and there is shown a growing preference for the fire and water-tube types of to-day, and no one can say what the boiler of the future will be. As a rule, the designs that give best economy are the weakest, most expensive to build or repair, short-lived, and difficult to examine and clean, and this, for half a century, has baffled engineers and blasted the hopes of many an inventor. Although we are, in many instances, using steam with great economy, we are not a great way ahead of James Watt in evaporative efficiency. In marine service a fraction of an ounce of coal saved per H. P. is of great importance, hence the design of boiler and furnace, on sea-going steam vessels, has been well studied by engineers. Also, the weight of marine boilers has been decreased, to some extent, by using steel in place of iron, and by simplifying the design. Some entertain a belief that modification in this direction has been pushed almost to its ultimatum, and it remains to be seen what engineers will do in future, to meet the ever increasing demand for higher steam and higher speed.

Many who have boilers in charge do not imagine the force there is harnessed by the iron shell. A boiler 60 ins. diameter, 16 ft. in length, having 60 fire tubes 3½ ins. in diameter, and carrying 100 lbs. pressure per sq. inch, would be subjected to a total strain of 8,367½ tons. If this force be illustrated by a cast iron block suspended by a wrought iron rod, the sectional area required would be 1,673·5 ins., and over 46 inches in diameter, to carry the load safely. If the weight on each head was sustained by round iron rods of 50,000 lb. tensile strength, and a safety factor of five was allowed, it would require 29 rods of the size and strength mentioned to carry the load on the head.

This kind of theorizing amounts to nothing, practically, yet shows what we may expect when so great a force is instantaneously liberated, through failure of the envelope sustaining it.

Many persons have asked what becomes of the water when a boiler explodes, but a moment's thought should convince them that the water is instantly converted into steam, and deals destruction to every one in the vicinity. Pressure alone is not the only agent that has to be considered. Corrosion, incrustation and deposits can be detected and dealt with, but no one can measure, estimate, or prevent unequal expansion, except to a limited extent. Smoke Arch.

Beverly, Mass.

◆

MR. HUGO BILGRAM'S RESPONSE TO "MACHINIST."

Editors Mechanical Engineer:

Your correspondent "*Machinist*" (page 248) says that he never expects to be able to understand an article on the "*Center of Gyration,*" written by me.

Will you kindly permit me to ask "*Machinist*" where he saw such an article, as I do not remember having written on this subject; possibly owing to a shortness of memory.

To tell you the truth, Mr. Editor, I consider "*Center of Gyration*" one of those misnomers which seem to be designed to create confusion and make *dynamics* appear to the learner like an unfathomable part of the science of mechanics.

If your correspondent can see that the proposition $x \times y = y \times x$ requires proof to be acceptable, and he is one of the few that can prove it without somebody else proving it for him first, I don't think I would have much difficulty in explaining to him the meanings of "*momentum,*" "*momentum of gyration*" and "*radius of gyration,*" but if he would ask me what the "*center of gyration*" is, I could only tell him that I don't know that there is such a thing. As a rule, writers on this subject mean any point having a distance from the axis of rotation equal to the radius of gyration, and in a few cases the location of that point is still further defined by some other conditions, but a strictly dynamical location of that center is not possible. Why such a point should be called a "*center*" I am unable to say, nor am I surprised to find that your correspondent never expects to understand the article of which he speaks. Hugo Bilgram.

Philadelphia.

◆

BACK DRAUGHT. LETTER FROM A LADY.

Editors Mechanical Engineer:

Do you ever answer questions from ladies? If so, I would thank you to give me the cause of a trouble I have with my range. I am not an engineer (it is needless to say), neither is my husband, but I have a nephew with me who takes your paper, which we all read with great satisfaction. Although there are many things in it which we do not understand, from the nature of them, there are many others that we do; the sleight-of-hand articles by Mr. Watson, Jr., were very interesting.

The trouble is this (like a woman, I go all round the subject before I begin): Our range has a disagreeable habit of belching out flame and smoke when the fire is first started, accompanied by more or less explosion. It appears to be a sort of surging back and forth of the flame in the pipe; one minute coming and another going. It fills the house full of smoke, and is very disagreeable. I have had the chimney examined, but it is perfectly clean, and the mason says the flue is too small. I cannot think this is so, as, until recently, we have never had any trouble. We have lately changed the way in which the pipe enters the chimney; this may have something to do with it. It now enters through a piece of sheet iron in the mouth of the chimney, which has a fireplace. Can you oblige us by suggesting a remedy?

Philadelphia, Pa. Mrs. A. Hanmer.

[The trouble apparently arises from back draught. This latter is caused by air leaks into the chimney. The flame from the fire draws in cold air through the sides of the throat-latch, doubtless. This destroys the draught by cooling the current in the chimney, momentarily, and the flame belches out through the front as the shortest road. Then the draught is restored again by the heat rising through the pipe, and again destroyed by the cool currents, until such time as the fire gets under sufficient headway to overcome the air leaks. Make the throat-latch air-tight, and we think the trouble will stop. Engineers have the same difficulty through too much air entering bare spots on the grates. Probably the flue is too small because the mason wants the job of making a new one!—Eds.]

◆

REMOVING SUBSTANCES FROM THE EYE.

Editors Mechanical Engineer:

Recent articles about removing foreign substances from the eye remind me of a case I once had. A shopmate got a piece of iron into his eye and went to a doctor, who told him there was nothing there; only a clot of blood which would soon be absorbed. But when he returned to the shop, and looked at it again himself, he thought that the iron was imbedded in his eye, and he sharpened his knife and gave it to me, telling me to cut it (the iron) out. I cut until I released the iron and got it out. This may seem a dangerous operation, but knowing the structure of the eye I knew what I was about.

The inner surface (mucous surface) of the eyelids is sensitive to the air, and when operating on the eye, the lid should not be pulled away from the eye if it can be avoided. When the eye is inflamed, pulling away the lid is positively painful. Foreign substances lodged on the cornea are best removed with a sharpened pine stick, though I have had cases which would only yield to the point of a knife. A steady hand is indispensable in dealing with the eye, and the patient must have entire confidence in the operator. A Shopman.

Maine.

◆

AS TO GOVERNORS AND HEATERS.

Editors Mechanical Engineer:

I am running a small engine and wish to increase the power by increasing the speed. The governor is marked to run 120 rev.; will it do to reduce the speed, or must I put on a new governor; which is best?

In using exhaust steam for heating, is it usual to use the condensed water again in the boiler? If so, how does the oil or grease from the cylinder affect the boiler? By answering this through The Mechanical Engineer you will oblige one who cannot get along without it.

Brooklyn, N. Y. J. Ives.

[To get more speed on the engine, run the governor slower; it is not necessary to get a new governor. There need not necessarily be trouble in using the condensed water from the exhaust, unless grease is used extravagantly in the cylinder.—Eds.]

◆

TO WHOM IT MAY CONCERN.

Editors Mechanical Engineer:

In No. 8, current vol., is an extract from the *Railroad Gazette* in reference to my letter published by you in No. 7.

So far as the origin of the article in question is concerned, I first read it in the *National Car Builder* several days before the *Railroad Gazette,* containing the apparent copy, came to hand.

U. S. Patents Nos. 304,970–72, if compared with No. 252,224, will be found to be identical. The latter was issued to Mr. David Joy two years and more ago, so that it is only another instance of duplication similar to the two other cases mentioned by you in Vol. VII., No. 13, and Vol. VIII., No. 2. Walter W. Scott.

New York.

◆

LEAVENWORTH ASSOCIATION STATIONARY ENGINEERS.

Editors Mechanical Engineer:

Our association is in good working order, and we are well pleased with the proceedings of the National Association. I am in hopes that at the next meeting we will be able to show more than double the number that we now have. It is the duty of all deputies to work to increase our membership, and, through The Mechanical Engineer, keep us posted. We look for the paper anxiously, and devour the contents the same as a hungry man does a good square meal. All engineers should have the paper, as it is a benefit to them. The information derived from it is well worth ten times its cost.

604 T St., Atchison, Kansas. T. C. Logan.

◆

SMALL DRILLING MACHINE WANTED.

Editors Mechanical Engineer:

I wish to ask through your columns where I could get a small drilling machine, foot power, that could be fastened to a table, and drill holes $\frac{1}{64}$th of an inch? By answering, you will oblige a constant reader. S. E. A.

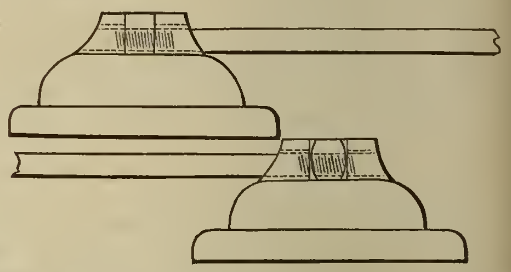
Pittsburgh, Pa.

[Any one knowing of such a machine will confer a favor by answering.—Eds.]

GOSSIP ABOUT THE STEAM ENGINE.

Number 1.

What a trifling thing will sometimes prevent an engine from turning over! A neighbor, who is an engineer also, bought a small twenty-horse vertical engine some time since, and set it up in his shop. When he tried to start it, with forty pounds of steam, it would not budge. He looked at it all over, examined the valves, and all details thoroughly, and found everything as it should be. The valve was set right and nothing seemed to be amiss. After connecting up again he tried the engine once more, with the same result, it wouldn't move. He owned that he was puzzled, after a couple of hours study, and asked me to come over and help him out. I said I would be glad to help him, but he knew as much about an engine as I did, and I did not think there was much use. Nevertheless I went over, and we opened the steam chest and took a look at things. I rapped the valve on the back and it was down iron and iron, square and solid, on its face and seat. Then we took hold of the fly-wheel and traveled the valve up and down and rapped it on every part of the stroke, and it still sounded solid. Then it was my turn to be puzzled. Looking at the valve-stem where it joined the valve, I saw that the end of it was screwed into a brass nut, as in the diagram, a fashion that is common enough. This nut had wide flat faces, and very wide surfaces, and it was let into the valve as if it had grown there. Thinks I to myself, you are the chap that is making all this trouble, and I will soon fix you. I took the stem out and eased up the nut so that it bore only partially, as in the second diagram, and not all the way across; then we connected up and gave her steam and away she went, first pop. The valve-stem was very long and the connection was rigid; that is, between the stuffing-box and the nut on the valve back there was no chance for it to accommodate itself to change of form, by springing of the whole valve under steam pressure. The consequence was that, when the pressure was on, the valve buckled, left its seat, and steam got into both ends of the cylinder at once. When the pressure was off the valve looked to be all right.



I don't like such connections for valves, and an inspection of a great many engines with all kinds of valve gear, shows me that there is too little attention paid to change of form under pressure. This latter sets up entirely different conditions, and they should be taken into account.

◆

Considerable Difficulty is experienced in the manufacture of arc light carbons in obtaining the pencils free from curvature. Since in most of the arc light lamps the carbons are placed vertically over each other, in the direction of their length, if the upper carbon has even a slight curvature, when the mechanism of the lamp feeds it towards the lower one, it is quite apt to pass. In this case an unsteadiness in the light results, and often complete extinguishment, from the lateral welding together of the carbons. For the same reasons, carbons that burn away to long conical points are considered very objectionable in practice.—*Electrical Review.*

◆

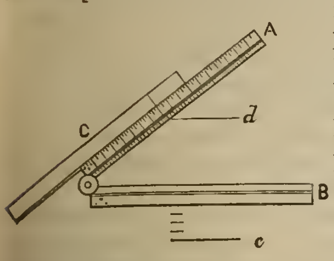
Concerning The Gimlet-Pointed Screw an insurance journal says this:

"There is a most ingenious automatic device which shapes the auger-like point of the screw. It may seem strange to assert that the form last named can influence fire risk, yet so it is. This invention, though so small, was mighty in the changes effected in work. The time saved by not boring holes, and by easier screwing home, has been enormous in comparison with the old blunt screw, and we think the axiom correct that whatever saves time, other things being equal, diminishes fire risk."

The connection between gimlet-pointed screws and fire risks is a trifle obscure.

MARK'S LINE DIVIDER.

The instrument illustrated below is made by Mr. W. F. Stanley for dividing any space into a number of equal parts. The following is a description of the parts: A B a hinged rule with firm joint, the limb A, fitted to slide in an undercut groove upon the plain rule C. C has needle points on the under side to prevent it from slipping when placed in any position. The limb A, of the rule is divided on both edges into eighths, quarters, half-inches and inches, which are consecutively numbered so that any set may be taken. As an example of the use of the line divider, suppose the space *d* to *e* is to be divided into any number of parts—say thirteen. Taking the half-inch line, hold the rule B, on the line *e* and open the rule A, until the division marked 13 on the inside edge is coincident with the line *d*; now notice that the single line on the rule C, is opposite the 13, and in this position press it down so that the needle points on the under side get sufficient bite to prevent it slipping; placing the fingers firmly on C, slide the part A upwards so that it may stop consecutively opposite each of the thirteen divisions, as indicated opposite the line on the rule C, a pencil line drawn along B, across *d e* at each stoppage opposite the numbers 12, 11, 10, 9, etc., will give the required divisions. To produce the lines in ink, the rule after setting may be moved to the upper line first, and the division lines be drawn downwards. The rule may be worked in any direction for drawing line, vertical, horizontal, or oblique, and for any division of a space from 2 to 80 parts and for several other purposes.—*The Engineer.*



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A Writer In A Daily Paper falls foul of trade papers and calls them bad names, and the *Paper World* flings itself "into the imminent deadly breach" in defense of said trade papers. It says:

> "But it is charged that many trade journal print little else than advertisements. Such journals are useful as trade directories, but they have no one's respect, and the better trade journals are ashamed to own any affiliation with them. Relegating them to the oblivion that is their due, we want to speak a few words for the trade journals that have an honorable standing in journalism.
>
> "The good trade journal exceeds the daily paper in its special information, and takes the lead in reliability and accuracy. A reporter for a daily paper has no time to get technical knowledge, and seizes the sensational at the expense of the facts of trade, manufacture, and business, that are sought by manufacturers and traders. The desideratum lacking is supplied by the well-conducted trade journal, whose writers have the time to do what is wanted, and do it well. Many of the best trade journals have much interest for the average reader, and get extensive reading outside of the trades that are their specialties. A liberal portion of their contents appears in the daily and weekly papers of the country, which are thus known to appreciate this fact."

May we add to the above, that the average reporter is not competent to do trade matters, for the very good reason that he knows nothing about the technical portion.

The *Paper World* charges that some alleged trade papers levy blackmail, one form of which is specified as follows:

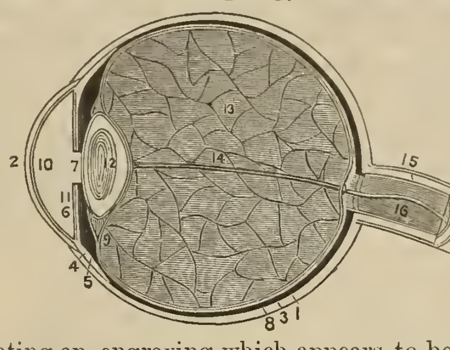
> "A polite and safe way is the offer of the publisher to buy something from a dealer or manufacturer, paper, for instance, if the latter will place an advertisement in his journal. Still another method is to go to a man and ask to write an account of his business, taking advantage of the occasion for a subscription or advertisement. Business men may make up their minds that when any of these games are played upon them, neither an advertisement in the journal, a subscription to it, or an account of the business, will be of the slightest benefit to them."

◆

William A. Harris, Providence, R. I., is very busy, having under way some heavy machinery, among which is one engine thirty inches by seventy-two inches; fly-wheel, twenty-four feet by eight feet face, weighing forty tons without the shaft, intended to give 650 horse-power. Also, a pair of 26 × 60 inch engines for Fall River; one 650 horse-power for the Chelsea Rubber Company, Chelsea, Mass.; a 26 × 60 for the Darlington Cotton Mill, Darlington, S. C., and a number of smaller engines, running from sixteen inches up to twenty-six inches, for different purposes.

YOUR EYE.

Machinists and engineers have frequently to deal with the eye, by reason of specks lodging in it through the nature of their work. Sometimes these flying particles are driven with great force, and are so firmly imbedded in the cornea that they can only be extracted with great difficulty. Removing such specks or splinters is a delicate matter, and some one man is generally the surgeon, experience having given him a delicate touch and a firm hand. It is proper that those who have to perform such work should know the structure of the organ itself, for, in that case, they are less liable to injure that priceless gift—sight. We make no apology, therefore, for presenting an engraving which appears to be more suited to a medical than to a mechanical paper.



The engraving shows a transverse section through the eye, with the arrangement and offices of its several parts. From this it will be seen that it is protected in front by a dome-like structure, which covers the "working parts," if we may use a trade term. This dome is the cornea (2), and it is supported or framed in the sclerotic coat (1), which is merely a shell carrying the eyeball proper. The cornea is transparent and firm in texture, like horn, and while protecting the delicate inner organs from injury, permits every ray of light to pass through it. The choroid membrane (3) carries the nutritive vessels, and is black on the inner side, so as to absorb any rays of light that might confuse the vision. The ciliary ligament and ciliary processes (4, 5), we need not enlarge upon. The iris (6) is simply a shield which expands and contracts so as to admit more or less light to the retina, and in the center of this iris is the pupil (7). This is merely an opening through which the light falls directly upon the crystalline lens (12), and which lens transmits the image of the object looked at directly upon the retina (8.) The chambers (10, 11), directly behind the cornea contain a colorless watery humor, and the "eyeball" itself is filled with a vitreous humor which constitutes its principal bulk. This is shown by the shaded, geometrical, central portion in the engraving. The other figures (14) are the sheath of the hyaloid membrane, etc., which are not essential to our readers, except 16, which is the central artery of the retina imbedded in the center of the optic nerve. This latter goes to the brain, and conveys to it the impressions on the retina.

As briefly as possible we have described the principal details of the eye, and it will be seen that flying chips or particles must first strike the cornea or horny dome which covers the whole eye. Sharp pieces of steel may become imbedded in it and cause great pain, not because of the sensitiveness of the cornea itself, for it is not acutely sensitive, but through the irritation caused by the presence of a sharp body on it, and the injury to the mucous surfaces of the eyelid which rub upon the sharp chip, and speedily become congested and inflamed.

It is almost needless to say that the cornea should never be touched with a knife, and that the greatest caution is necessary in dealing with the eye in any case requiring treatment.

◆

Mr. A. M. Davy, 175 Elmwood avenue, Detroit, is open to an engagement as representative of any firm manufacturing engineers' goods. Mr. Davy has a wide acquaintance, and is a thoroughly capable and reliable man. Any one needing an energetic agent should correspond with him.

◆

A Convention Of Illinois Inventors will be held at the Sherman House, Chicago, Oct 23d to 25th, for the purpose of organization.

SOME NEW ENGLISH MACHINE TOOLS.

In profile milling machines there is one of very large size, specially designed for connecting rods. This milling machine will work up to 9 ft. long, 15 in. wide, and 6 in. deep, and combines all the latest improvements, being self-acting in all directions, with self-acting chuck for bosses of levers, etc. In the straight milling machines, one is being made to mill a surface 15 in. wide and 10 ft. long, and is of massive construction, the spindle being 5 in. diameter. A number of Hure's new patent milling machines are also being made. The novelty in these machines is that they have two spindles, one horizontal and the other vertical. By this arrangement almost any variety of milling work can be accomplished, and the change from horizontal to vertical milling is effected almost instantaneously. Two of these machines have been made with a range of 40 in. horizontal traverse. A number of vertical drilling machines, with steel spindles of 2½ in. diameter, have just been finished. In these machines an improvement consists in the driving gear being so arranged, that instead of the cone pulley being longitudinal with the body it is placed at right angles, and by this means the machines can be fixed to work in line with other tools, an arrangement which possesses the important advantage that it effects a considerable saving of space. A horizontal boring, drilling and tapping machine has a special feature, which is in the arrangement of the tapping and studding, the machine being capable of completing a stud 1 in. diameter in five minutes—that is, the hole can be drilled, tapped, the stud screwed home, and then cut off, in the space of time above mentioned. A 54-in. lathe, differing only in detail from the one recently made for the English Government, has just been completed for Russia. This machine, which is of massive construction throughout, with a bed 49 ft. in length, has quadruple gearing and four carriages, each acting independently in the longitudinal and transverse motions, whilst, in addition, each pair of carriages can be worked by a steel screw 5 in. diameter.—*The Engineer.*

◆

In A Recent Article upon "*Two Great Forces*," we alluded to an instance of shafting being thrown out of line by the influence of a transient sun ray. A writer in the *Popular Science Monthly* speaks of a similar case with permanent derangement as a result. We quote:

"A very good instance could be seen some years ago on the wooden bridge leading from the elevated railroad station at 155th street, in New York City, toward Ninth avenue. A gas-pipe of wrought iron was laid on the floor of the structure. As if to render it more susceptible to the rays of the sun, it was painted of dark color. On cold or cloudy days it lay in its normal position. On sunny days the writer has frequently seen it bowed nearly or quite a foot out of line. The surface of the foot-planks under this part of it became worn by the daily friction. Finally, an arrangement of bends was introduced that operated as an expansion-joint, and now no bowing takes place. Even 50° F. seems a large rise in temperature. But it must be remembered that the temperature of rails, or similar objects, is affected by the radiant heat of the sun as well as by the atmospheric temperature. The latter is only their initial factor. The sun's rays could easily raise their absolute temperature above 100° F."

◆

Respecting The Cutting Of Gears accurately, or producing theoretically perfect teeth, a friend recently said to the editor that he had long ago despaired of success. The argument was that, supposing the tooth to be laid out correctly, making templets from the drawing, cutters from the templets, hardening the cutters, and then operating them in the machine, produced wide departures from the original design. Between the drawing-room and the wheel turned out from the gear cutters, there were many chances of error very difficult to eliminate.

There seems to be foundation for the remarks, for all machinists know that there may be wide departures in fitting templets to drawn lines, to say nothing of changes of form by hardening the cutters; and machines which produce gears by ordinary straight tools—planing them out instead of milling—would seem to have an advantage.

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

REDUCTION IN RATES FOR 1885.

In common with many other publishers, at this season, we have been in the habit of giving the last four issues of the current volume gratuitously to all new subscribers, and we herewith announce that we will do the same this year. We will furnish this paper from the current issue until Jan. 1st, 1886, to all new subscribers who may send in their names prior to Jan 1st, 1885, and we hope that the number who will take advantage of these terms will be large. This offer will not extend beyond the period named, and we shall not be bound by it for any favors arriving after Jan. 1st.

Also, we announce, as a concession to old subscribers, that we will send two copies of this paper for $3.50, or $1.75 each. If our constituents, who have so long encouraged our efforts, can see their way to obtaining a friend to join them, they can save a trifle by so doing.

We have also reduced our club rates in accordance with the times. Realizing that many are out of work, and that those who are employed have been cut down, we have cut ourselves down as well,

Our club rates for 1885 will be as follows:

Five	copies	to any	address	each	$1.60
Ten	"	"	"	each	1.40
Fifteen	"	"	"	each	1.30
Thirty	"	"	"	each	1.20
Fifty	"	"	"	each	1.00

These rates, it will be observed, are a material reduction from last year all through, and we hope to be favored with a response to them in such increased ratio as to, at least, cover the reduction. No form for subscription paper is necessary, and those who feel that they are willing to aid us in our enterprise to the extent of soliciting their friends to come in, can merely send the names with the money, being particular to have the addresses distinctly written and correct.

◆

FORECASTING THE FUTURE.

Two years ago, before the enlargement of THE MECHANICAL ENGINEER to its present dimensions, we made certain promises to its supporters. We said that in the event of their co-operation with us in the development of our plans we would endeavor to show our appreciation by giving better value in the paper itself, by enlarging its scope, engaging writers on special topics to contribute, and in all ways raising the standard where possible.

Our friends took us at our word, and rallied to our support in large numbers. Notwithstanding the proverbial dullness of a presidential year, combined with commercial stagnation, we have not only retained our connection, but added largely to it. If we may judge from communications expressing satisfaction, our friends feel that they have received, and are receiving, value for their outlay.

We take all these manifestations—the good will expressed, and the increase in our business—as so many endorsements of our efforts to furnish a plain, practical, common-sense journal for people in our line of trade everywhere, and we shall, in the year approaching, endeavor to show our appreciation of the support so liberally bestowed.

This year we shall not publish a prospectus. The scope and intent of THE MECHANICAL ENGINEER are now so well known that it is unnecessary to state it in so many words, but we have no hesitation in saying that 1885 will show a decided advance over 1884 in all respects. THE MECHANICAL ENGINEER has gained steadily in appreciation from the start, and there is no limit to the development of a journal when its publishers are in earnest, have fertility of resource, and study their business with a view to improve it. There will be papers of interest to all classes of readers, young and old. The expert and the inexperienced engineer will find topics discussed which will aid them, and the general reader will find papers on abstract science which will enable him to keep informed upon the progress made.

While original papers will not be lacking, we shall also continue the feature of republishing the best and most pertinent articles in foreign engineering papers. These articles are in nearly all cases greatly condensed, a liberty upon our part which in no wise detracts from their value. By condensing them, and cutting out all matter irrelative to the subject treated, local allusions, etc., etc., we are enabled to get more matter in, while the article itself is clearer. As we understand it, mechanics in our line of trade should be well informed men upon all topics of general interest, and we shall not confine our selections wholly to boilers and engines, or machinery. It is possible to get even a surfeit of these, and it matures and enlarges the mental scope to read up other subjects than those immediately connected with our callings.

To this forecast of our plans for 1885 we add that we shall at all times be glad to receive hints and suggestions from our readers, as to their preferences in any special line. Criticism is particularly valuable. By it we are enabled to avoid errors, and to correct those which we may have made. If our friends feel that they are warranted in doing so, we shall be glad to send out sample copies of THE MECHANICAL ENGINEER to any names they may furnish.

◆

DOES VIBRATION AFFECT THE BALANCE OF MACHINES?

A machine is said to be in balance when it moves harmoniously and without visible vibration, but this occurs only at certain speeds. That is to say, a machine balanced for one velocity will be out of balance at others. The cause of this is obscure, aside from centrifugal disturbance, and many good observers confess their inability to discover it.

The relative velocities of moving parts of a machine remain the same at all speeds, but the relative vibrations do not. At certain velocities the connecting rod of a steam engine transmits the power without vibration or jar, but urged faster it trembles visibly.

These vibrations do not occur in equal times, but are greater or less according as the rod is approaching or leaving the center, and when it is pushing the load or pulling it. Circumstances also affect the vibration. This want of synchronism affects the balance, in that it transfers the jar of the vibration to the moving parts in unequal times. Vibration is not a force, but is an action caused by it, and is undoubtedly a disturbance to harmonious motion.

Again: it is an oft-stated point that a reciprocating mass cannot be balanced by a rotating mass. If this is true what becomes of the notorious fact that engines of all kinds move in equal times as far as we can see? They do not show any want of balance, though cast loose from fastenings and held down only by their weight. An engine out of balance should give evidence of it by horizontal motion (supposing it to be a horizontal engine) of the bed-plate on its supports. Engines, when run at certain velocities, under such circumstances sway the bed-plates to and fro, but at higher speeds remain stationary. What has counteracted this tendency when they remain motionless? Has not vibration entered into the question, and by its infinitesimal swayings of masses—like the beats of a pendulum—acted as a balance?

Our argument is for and against; we do not know what causes the disturbances and erratic action mentioned, but it would seem that the vibration of masses of metal at certain velocities may affect the balance of machines in a marked degree. We do not allude to mere tremor, but to visible movements. Even the former may have its influence when large masses are disturbed.

◆

IMPORTANT TO STEAM USERS.

From ocular evidence it is plain that a great many persons, who buy coal and turn it into steam, do not attach the value that they should to having all hot surfaces carefully protected against loss by radiation. Discussion of this matter, or dissertations upon it, seem almost like a stock subject, but the facts are that the matter cannot be too frequently insisted on, for the interests of steam users. When arguments in favor of covering steam surfaces are presented they fall on dull ears, too often, for the reason that the steam user cannot see at the moment where the return for the outlay is to come from, but a very little consideration of the matter settles it on a common-sense basis, let alone any philosophical one. Every one knows that unprotected surfaces are a source of loss, and the hotter they are the greater the waste. This refers, of course, to steam surfaces, where the heat is needed internally, not externally, but it is not at all uncommon to find persons expending a great deal of money in heating up "all outdoors."

Experimenters have industriously tabulated exact statistics of gain in fuel by protected surfaces, but these tables appeal more to the imagination of the steam user than to his pocket, and we fancy but few persons are moved by them, if, haply, those chiefly concerned even know of their existence. It should not be difficult, however, to convince architects—who are educated men—of the importance of saving money by preventing radiation. Yet architects are the very men who need to be converted. If we go into the basements of large buildings where the boilers and elevators are, we find an atmosphere that is perfectly intolerable, made so by hundreds of feet of imperfectly clothed, if not entirely naked, hot surfaces. It matters not whether these are boiler-shells, steam pipes, heaters, feed pipes, or all and sundry; every one of them which is over and above 75 to 80 degrees of heat should be protected. The feed-pipe to a boiler should be lagged quite as much as the boiler itself, but in how many cases is this done? We cannot now recall a single instance, which we can locate, where the practice indicated is pursued.

Our readers can do much toward reducing expenses for fuel if they will give their attention seriously to the source of loss pointed out. If they will insist upon having all hot surfaces covered, they will realize in dollars and cents the value of a good lagging; in no one of the many details of steam management is so much indifference to loss displayed generally.

◆

WANTED, A SAFETY-VALVE INSPECTOR.

We fancy sometimes that the increase of technical papers, and the greater general diffusion of knowledge on the subject of steam boilers, is leading to greater care of them; but we are led to doubt this at times. Whether it is owing to the fact that every incident of daily life is now made public property, or that more boilers are in use, whatever the cause, disasters arising from them are alarmingly frequent.

In all cases reported the greatest recklessness is shown, principally in the use of the safety-valve. A safety-valve inspector, a person whose sole office it was to go the rounds of a certain district and look after the safety-valves, would be a useful person. It is not alone in this country that the safety-valve is regarded as an obstruction; abroad there are some persons with similar views, as witness this extract from the *Mechanical World:*

"In the case in question the safety-valves were loaded by means of springs which had not only been screwed down until the valves were jammed fast on their seats, but one of them had a thin nut fixed between the safety-valve and its spindle, to insure that the valve should be effectively jammed. The water-gauge had been dispensed with, because the glass tubes were apt to break, and one of the owners was afraid of being cut; and the pressure-gauge was so insanely wrong, that when the actual pressure on the boiler was 280 pounds per square inch, the pressure shown by the gauge was only 140 pounds; and when the gauge registered 144 pounds, the actual pressure was about 300 pounds. 'As the gauge, which was graduated to 200 pounds,' remarks our contemporary, 'was seen to indicate 180 pounds, it is probably beyond the power of any one to say what pressure was on the boiler.

This is in England, but inspection, like charity, begins at home, and we need not go far to find a similar state of things.

◆

AN ABSURDITY.

Merely as a curiosity, this is worth impaling. A writer in a technical paper says:

"A non-condensing engine, working with a steam pressure of 30 pounds (which is fifteen pounds above the atmosphere) is required to exhaust against a resistance of 15 pounds, the atmospheric pressure. This is a loss of 50 per cent. of the power exerted on the piston. An engine working with 100 pounds pressure on the piston exhausts its steam against 1 atmosphere, only losing 15 per cent. of its power, while an engine working with 300 pounds pressure on the piston, and exhausting as before stated, loses only 5 per cent. For the above reason it will be seen that, for a non-condensing engine, the higher the steam is carried the more economical it will work."

We do not know why the writer quoted says this, when he should not. He fails to consider the relative areas of exhaust pipe and piston. Even if the exhaust pipe was equal in area to half that of the piston the loss in efficiency would not equal fifty per cent., or anything like it, for the reason that there is no comparison between steam acting in a confined space and steam exhausting into the atmosphere, as regards relative resistances.

The back pressure shown on the indicator card gives the loss of efficiency by exhausting into the air, and it varies from four pounds in a very bad engine to nothing at all in a good one, whether the pressure carried is 15 pounds or 50 pounds.

We find this in a contemporary which recently read us a lecture for presuming to question the fitness of mathematical problems for elementary technical works; the burthen of its lay being that by so questioning we only displayed our own ignorance. When we read the lecture we thought that it would not be long before ignorance would be displayed elsewhere, and our presentiment is verified in the quotation above.

◆

DON'T FORGET IT.

It should be borne in mind that the onerous tax of $2 for a license was imposed upon engineers of this city and county by Grover Cleveland, who approved of and signed the bill which made it a law. By this outrageous proceeding local engineers are compelled to pay $2 annually into the Police Pension Fund, which latter appears to be a sort of pool for the absorption of revenues from all sources.

As to the diversion of moneys paid into the State treasury we have nothing to do; but we can and must protest again at the annual imposition of $2, instead of a merely nominal charge, for the simple service of bestowing a license to run an engine. Engineers will not be likely to forget it at this particular juncture, and our local friends ask their fellows everywhere in the United States to make a note of it also.

◆

A CUSTOM OF THE COUNTRY.

When a man makes a failure with a newspaper all the other papers, great and small, with one accord shout and halloa. John Swinton, who is a local celebrity with twenty-five years' experience on daily papers in this city, has passed through one year's experience as a publisher. He says he thought he knew it all before he began, but in comparison with what he knew when he started, and his present knowledge, he feels that there is a vast gulf.

"*The Continent*" began with a loud hosannah, as to what it proposed, but "a change has come over the spirit of its dream." It is less sanguine; in other words it is defunct. The *Sun* thus shouts its requiem:

"The 'Hon.' Albion W. Tourgee has finally edited *The Continent* into a condition of permanent repose. Considering the amount of capital —[said to be $200,000.—Eds. M. E.]—invested in that literary venture, the 'Hon.' Albion effected its extinction with singular celerity. Subscribers whose terms of subscription to *The Continent* have not expired are advised that they shall be consoled with such intellectual dissipation as is afforded by the columns of *The Christian At Work*. The transition is one of the least violent that could have been afforded to them."

◆

The Chalmers-Spence Co., of this city, have recently filled many large orders for their non-conducting covering for all surfaces, hot or cold. Among these orders are the St. Louis Post Office, the Philadelphia Post Office, the U. S. Dispatch Boat *Dolphin*, the Metropolitan Opera House, N. Y.; the Standard Oil Co., the Union Ferry Co., Riverside Iron Works, Wheeling, W. Va.; Bellaire Nail Works, Bellaire, O.; Trenton Iron Co., and at the late electrical exhibition in Philadelphia. Subscribers in any of these places can have an opportunity of investigating the merits of the covering, which has been in market many years, by application.

◆

Prof. Chandler says the chief objection to carbolic acid as a disinfectant is its smell, which leads persons to think they have been successful when they have not used enough to amount to anything.

SOMETHING ABOUT METALLURGY.—Number VI.

By Norman W. Wheeler.

The simple blast furnace, which we have been considering, does its work in a wasteful manner as regards fuel, because the gases which escape are chiefly of the CO grade, and are able to give larger amounts of heat by a second combustion to CO_2. When C is burned to CO_2 it gives off about three times the quantity of heat that it does when only burned to CO.

In a high blast furnace a much greater part of the C is degraded to CO_2 than in a bloomery fire. A reason for this is found in the fact that the kindling temperature of O from ore, burning with CO, is lower than that of CO_2 burning backwards to form CO. CO_2 burns to CO at a temperature of about 750° Fah., while roasted iron ore suffers reduction at about 400° Fah., so that in the upper part of a furnace, where the materials are above 400° but below 750°, C continues to take O from the ore, and the resulting CO_2 does not burn back to CO, because the temperature is not high enough to kindle it.

The presence of a large proportion of CO_2 in furnace gases indicates economy, because CO_2 is the lowest grade to which carbon gas may be reduced, and all work exhibited by the burning of C and O is because of their degradation.

When the air blast is heavily charged with the vapor of water the temperature of the CO_2 combustion zone is reduced, and the general action of the furnace impeded. The air, and whatever vapor it may contain, is heated when it enters the furnace at the expense of fuel burning in CO_2 combustion zone, where the greatest heat is needed. If water vapor goes in, the gases composing the water—O and H [hydrogen]—are shaken by the heat, each from the grip of the other, and their condition is changed from that of a cool vapor to a very hot mixture of gases, and as the temperature of the CO_2 combustion zone is barely sufficient for the melting of the iron and slag, the presence of very little water vapor in the blast causes trouble, by thickening the slag and changing the rate of carbonization. Water gases appear to do no harm in the furnace after they have passed above the bosh, as the free O seizes C, producing CO, and H is itself a reducing gas, burning with O from the ore in the cooler parts of the furnace.

If the blast be heated, even so little as to the temperature of boiling water, much trouble and cost is avoided, on account, among other things, of the higher temperature and greater carbonizing power of the hot zone; the yield is also increased, from which it appears that the reducing power in a common furnace is greater than the fusing power.

In a hot-blast furnace plant, the blast is heated in a stove on its way from the blowing engine to the tuyeres, to 400° or 1000°, the temperature being limited by the enduring qualities of the heating apparatus. Formerly, a separate coal fire was used for heating the blast. Afterwards a pipe, or funnel, was suspended within the furnace throat to catch a part of the gases, which was led by pipes to the stove and then burned in lieu of other fuel. Now the top of the furnace is completely closed by devices which can be opened for charging, and nearly the whole of the gases are led off and burned for heating blast and making steam, and usually more gas is obtained in this way than is needed for fuel.

The large blast furnaces of the present day are essentially like the primitive charcoal furnace described. The chief differences lie in details and in internal shape: the shafts have grown to be very high, the bosh is large, and less flattened, to suit hard coal and coke, and the double cone shape has come to be a spindle shape, which makes it hard to say where the crucible ends and the bosh begins.

◆

The Destruction Of The "*Yung Wo*," Chinese flagship, during the recent naval battle, shows what a torpedo can do when properly handled. As soon as the fight began a torpedo darted toward the vessel, and in an instant there was nothing left but some drifting timber and broken spars. The "*Yung Wo*" was full ship-rigged, of about 2,000 tons displacement, and a beautiful vessel. Her destroyer, the torpedo boat, was about fifty feet long, cigar shaped, very low in the water, and capable of steaming about twenty miles an hour.

THE PROFESSOR IN THE MACHINE SHOP.

Number 67.

Going into a machine shop in a neighboring town last week, I found the proprietor in an unhappy mood. He was naturally a merry, pleasant-spoken man, but on this occasion he was in the doleful dumps; his sand-box was empty.

"What's the matter with you?" said I, taking the privilege of an old friend. "You look as though the bottom had fallen out of things."

"The bottom has not fallen out," said he, "but it is mighty shaky."

"Has anything special happened?" said I; "if so, maybe we can lend a hand, and push a pound or two on behind?"

"No," said the proprietor, with an effort, "you can't do anything; thanks all the same."

"Any bad debts?" said I, ignoring his rejection of help.

"No, none to speak of; people are slow, but pretty sure—in time. I haven't lost any money to speak of."

"Do you owe any money you can't pay?"

"I?" said he. "You know I never owe any one; what I have is my own."

"Work all played out, and no more coming in?"

"There isn't so much work as there might be; but there is some. I suppose I get my share."

"Bank account run down, and can't pay the boys Saturday night? If that is all the trouble, draw on us for $200; we haven't much, but we can help a friend over a muddy spot on a pinch."

"No, sir; thank you; I can pay the help for a good while yet, if I don't get a cent for three months."

"Pet dog run away and can't be found?"

"Oh, what's the matter with you, Moulton? you make me tired."

"Well, now what's the matter with you? that's what I want to know. Here you are, a man in the prime of life, in the best of health, owing no money, no bad debts to speak of, a fair run of work in the shop, and the pet dog hasn't run away; but you sit down in your chair and turn up the whites of your eyes like a duck in a puddle. I say what's the matter with you—have you lost your grip? Rouse up, man, and get a new hold."

After much pressing, I learned the cause of my friend's dejection, which was simply this: He had put a new machine on the market some year or two since, and it was not selling as he thought it should. It was not unique—that is to say, there were others like it; but it was a useful tool, and sold fairly well; but not to the extent that he thought it should. When he related these facts I stopped my banter and sat down for a little friendly encouragement.

"John," said I, "have you lost any money on this machine?"

"No, I haven't; on the contrary, I have made a little."

"Is there any call for it, regularly?"

"Well, folks haven't torn the shop down to get it; but we have four under way now—all ordered."

"What do you mean by saying that the machine don't sell, then?"

"I mean that it don't sell, compared to Jenks's machine. Just look at the orders they get. Why, last week I saw twenty of them shipped, and that is more than I have made in a year. My machine will do more in an hour, and do it better, than theirs will in two, but they sell four to my one."

"Well, that's in the nature of things," said I. "You leave some details out of consideration in looking at the matter in that light. You don't reflect that Jenks's folks have $500 invested where you have $1; that they have ten times the facilities that you have, both in shop and in business; that they have been established four times as long as you have; that their agents are in every large city, and that they spend a small fortune in advertising every year. What's more, you don't know whether these twenty machines are sold on order or merely consigned to their agents. You only see the shipments, and that's all; and for such a little thing as this you squat. There is nothing to repine over, because some one else is doing, apparently, more business than you are. How can you tell what they are doing by their shipments? Nothing is more deceptive. As I remember, you began here in a small way some five years ago. In that time you have built up a good business, which is growing regularly; because it does not swell up and boom, you sour on it. That ain't the way to make it grow. The best course to follow to achieve what you have set out to, is to keep right on, the best foot foremost, and let Jenks & Co. do what they like. Build the best tools you know how to build, spread the fact that you make them as far as you can, and if they are what you claim you will have orders enough; or, at any rate, in proportion to the amount of capital and energy you have put into the business. Don't forget this latter remark. You must not look for 200 acre crops on a 40 acre farm; you get out in the same proportion that you put in."

"Well, that is about so," said my doleful friend. "I guess your head is level every time, Moulton. I didn't look at it in that light. What did you come over here for—anything special?"

"I came over here to see if I could steal an idea or two, of some kind. I am getting mighty short of them lately, and lie awake nights trying to thrash some out; but I am going home now. The charge for the advice is $5," I said.

Instead of paying me, he pushed me out of the office and closed the door.

THE PHILOSOPHY OF AN OPEN FIRE.

The normal temperature of the human body is 98° Fahr. If it rises much above, or falls much below that, death will ensue. But the human body is a furnace in which the process of combustion is continually going on. Therefore, in order to preserve the normal temperature, the body must continually give off a certain amount of heat. By the laws of radiation, a heated body parts with its heat, more or less rapidly, in proportion to the low or high temperature of bodies near it. Thus, if a hot body be placed near a cold body, the hot body will radiate heat rapidly. If the hot body be near a body less hot than itself, but still hot, it will part with its temperature slowly.

Let us apply this to a room. If you are sitting in a room near a cold wall, you feel what you think is a draught. It is not necessarily a draught. The side of your warm body turned next the wall parts with its heat rapidly, and you experience a local chill. If you hang a piece of carpet against the wall, the draught is no longer felt, because the carpet checks the rapidity of the radiation. Now, the chief source of heat in the open fire is its radiant heat, and as it warms the walls of the room and the furniture, it takes off any sensation of chill from them, although the air may be comparatively cool.

You must next bear in mind that the proportion of radiant heat, to the total heat given out by a heated body, depends on the temperature of the body. Thus, with a red-hot piece of iron, or a flame, the great part of the heat given out is radiant heat, whereas, with a body heated to from 150° to 200°, like a hot-water pipe, a comparatively small proportion is radiant heat. Therefore, when you heat a room by means of hot-water pipes, or by means of warmed air, the walls do not get warmed in the same proportion, and although the air may feel warm, the walls may remain cold, so that the heat of the body may be radiated to the walls and give the sensation of chill. The comfort of the open fire is due to the warmth it imparts to the floor, the walls, and the furniture. The air of the room is warmed, not by the rays from the fire, but by the warmth imparted by those rays to the various objects. Therefore, the air of the room is somewhat cooler than the walls. Now there is, undoubtedly, greater exhilaration produced by breathing cool air than by breathing warm air. This is readily accounted for. One cubic foot of cold air contains more oxygen (because it is condensed) than the same volume of expanded warmer air. It is thus desirable that air admitted to a room should not exceed from 55° to 60° temperature, for comfort in breathing.—*Captain Douglas Galton.*

PUNCHING SOFT STEEL PLATES.

A Russian journal published at St. Petersburg, gives an account of some experiments made by W. Beck-Gerhard, in punching soft steel plates. We quote portions of interest to our readers:

"On bending samples of soft steel which had been punched cold, through the holes, it was invariably found that the specimen would bend without cracking if the punch side of the hole was on the convex side of the bend; but if the bar were bent in the opposite direction the specimen broke. This phenomenon led the author to investigate whether there was any foundation for the generally received opinion that the edges of a punched hole on the die side are injured by a ring of minute radiating cracks. For this purpose a large number of specimens, 5 in. by 3 in. by ½ in., of all kinds of steel were prepared. The edges were planed, the surfaces polished, holes were pierced in various ways, and the metal surrounding them carefully examined with a microscope, but no trace of cracks could be found, though the nature of the steel ranged from 0·1 to 0·6 per cent. of carbon.

Although the search for cracks proved fruitless, Mr. Beck-Gerhard observed, he believes for the first time, certain markings on the polished surfaces of the plates around the cold-punched holes, which seem to possess interest. Visible to the naked eye, and surrounding the holes, were bunches of lines starting tangentially to the holes, and curving slightly toward them. These lines branch out in opposite directions, and intersect with some degree of regularity. They do not appear in the vicinity of drilled holes, but are distinct in cold-punched holes reamed out. An increase of thickness in the plate caused a corresponding increase in the number and clearness of the lines, upon which the shape of the hole was also found to have an effect. Heating the plates to redness did not obliterate the rays, though it rendered them less pronounced.

In order to determine how far the rays extended around a cold-punched hole, a 10-in. square sample was cut out of a ⅝ in. steel plate, the surfaces were polished and a 1-in. hole was punched in the center. The curved rays appeared very strongly marked on the die side, and less pronounced, but still very distinct, on the punch side. The surfaces of the plate were then washed with aqua regia, when the rays disappeared, but the surfaces became streaked with elongated bubbles and hair-lines arranged in the direction in which the plate had last passed through the rolls. The sample was then cut into eight test pieces, four on each side of the central hole, and subjected to rupture by tension. The result was an average ultimate strength of about 27 tons per square inch, with an elongation of 20 per cent. All the fractures took place at one of the elongated bubbles, and the polished surfaces of the specimens developed ridges and indentations which could not only be seen, but felt. On placing the specimens together in their original relative positions as a 10-in. square plate, it was at once seen that the markings on the strips formed together a system of curved rays around the central hole, precisely analogous to those which the solid plate had exhibited, only the rays extended much further over the surface. Test bars cut from a similar ⅝-in. plate, 10 in. square, which had not been punched, exhibited none of the marks above described, hence it must be concluded that the effect or influence of the 1-in. cold-punched hole had extended all over the 10-in. plate."

CLARK'S PROCESS FOR SOFTENING HARD WATER.

In 1841 Dr. Thomas Clark, of Aberdeen, took out a patent for softening water. Dr. Clark thus described his process in May, 1856:

In order to explain how the invention operates, it will be necessary to glance at the chemical composition, and some chemical properties, of chalk; for while it makes up the great bulk of the matter to be separated, chalk also contains the ingredient that brings about the separation. The invention is a chemical one for expelling chalk by chalk.

Chalk, then, consists, for every one pound of sixteen ounces, of lime nine ounces; carbonic acid, seven ounces. The nine ounces of lime may be obtained apart by burning the chalk, as in a lime kiln. The nine ounces of burnt lime may be dissolved in any quantity of water not less than forty gallons. The solution would be called lime-water. During the burning of the chalk to convert it into lime, the seven ounces of carbonic acid are driven off. This acid, when uncombined, is naturally volatile and mild. It is the same substance that forms what is called soda water, when dissolved in water under pressure. So very sparingly soluble in water is chalk by itself that probably upwards of 5,000 gallons would be necessary to dissolve one pound of sixteen ounces; but by combining one pound of chalk in water with seven ounces additional of carbonic acid (that is to say, as much more carbonic acid as the chalk itself contains), the chalk becomes readily soluble in water, and when so dissolved is called bicarbonate of lime. If the quantity of water containing the one pound of chalk with seven ounces additional of carbonic acid were 400 gallons, the solution would be a water of the same hardness as well-water from the chalk strata, and not sensibly different in other respects.

Thus it appears that one pound of chalk, scarcely soluble at all in water, may be rendered soluble in it by either of two distinct chemical changes: soluble by being deprived entirely of its carbonic acid, when it is capable of changing water into lime-water, and soluble by combining with a second dose of carbonic acid, making up bicarbonate of lime.

Now, if a solution of the nine ounces of burnt lime, forming lime-water, and another solution of the one pound of chalk and the seven ounces of carbonic acid, forming bicarbonate of lime, be mixed together, they will so act upon each other as to restore the two pounds of chalk, which will, after mixture, subside, leaving bright water above. This water will be free from bicarbonate of lime, free from burnt lime, and free from chalk, except a very little, which we keep out of account at present, for the simplicity of this explanation. A small residuum of the chalk always remains, not separated by the process. Of $17\frac{1}{2}$ grains, for instance, contained in a gallon of water, only 16 grains would be deposited, and $1\frac{1}{2}$ grains would remain. In other words, water with $17\frac{1}{2}$ degrees of hardness arising from chalk can be reduced to $1\frac{1}{2}$ degrees, but not lower. These explanations will make it easy to comprehend the successive parts of the softening process.

Supposing it was a moderate quantity of well-water that we had to soften, say 400 gallons. This quantity would contain one pound of chalk, and would fill a vessel 4 ft. square by 4 ft. deep. We could take 9 ounces of burnt lime made from soft upper chalk; we first slake it into a hydrate by adding a little water. When this is done we would put the slaked lime into a vessel, where we intend to soften water gradually. Add some of the water, in order to form lime-water. For this purpose at least 40 gallons are necessary, but we may add water gradually until we have added thrice as much as this; afterwards we may add the water more freely, taking care to mix intimately the water and the lime-water or lime. Or we might previously form saturated lime-water, which is very easy to form, and then make use of this lime-water instead of lime, putting in the lime-water first and adding the water to be softened. The proportion in this case would be one bulk of lime-water to ten bulks of the hard water. It is of importance that the lime or lime-water, that is, the softening ingredient, be put into the vessel first, and the hard water gradually added, because there is thus an excarbonate of lime produced in the process more easy.

But what you will wish to know now is, how the conductor of the process can find out when there is enough of water to take up the last of the excess of lime—enough, but no more. This is done by the silver test, the only test necessary to the operator after the process is fairly set a-going. This test is a solution of nitrate of silver in twice distilled water, in the proportion of an ounce per pint. In making use of the silver test in ordinary water we get a white precipitate; but if the water has in it a notable excess of lime-water, there is a light reddish brown precipitate produced; if the excess be very slight, we only get a very feeble yellow precipitate. The way to make use of the test is to let two or three drops of it fall on the bottom of a white tea-cup, then add the water somewhat slowly; if there be the slightest excess of lime, a yellow color will show itself.

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THE BOILER MAKERS of the United States and Canada, in convention at New York, decided to raise an endowment fund, from which $350 shall be paid to the family of any member who dies.

RED LEAD, WHITE LEAD, SHOT, ETC.

The various commercial products derived from lead are thus described, as to modern methods of manufacture in England, by *Engineering.*

The manufacture of red lead commences with the process of "drossing," which is carried on in ovens which resemble those used by bakers. There is no chimney; the smoke and products of combustion collect in the dome above the sole on which the dross is placed, and pass out at the oven door, there being a hood in the front into which they ascend.

The operation is commenced by forming a dam across the front with dross left from the last operation. Behind this dam a charge of pure pig lead is melted, and as soon as it reaches a dull red heat, the workman works it with a long-handled rake, suspended in front of the door. By a peculiar action the bath of lead at a dull red heat is splashed about, being thrown to the back and sides as formed. A small quantity of antimonial lead is thrown into the bath from time to time, as antimony in small quantities has the effect of increasing the oxidation of lead. The whole charge is drossed and converted into yellow oxide of lead in about six hours. The dam is then broken down and removed, and the dross is left in the oven to calcine for several hours longer, during which time it is turned over for the purpose of draining away the metallic lead entangled in it. This trickles down the sloping bottom of the furnace, and flows out at the oven door.

The dross is taken away and wet ground in an ordinary mill, and levigated. The coarser particles are collected in a settling vat, whilst the finer dross is carried forward to other settling tanks. The ground and levigated product is now yellow oxide of lead, and is taken forward to undergo the third stage, which consists of the process of coloring. A charge of about 35 cwt. is introduced into the bottom of the coloring oven, which resembles the last described. Here the dross remains forty-eight hours, being subjected to a low red heat, which has to be carefully regulated, and during which time it is carefully turned with rakes. By the absorption of oxygen from the atmosphere a higher oxide of lead is gradually produced, having the red color characteristic of red lead. Great care is needed during the final process, as, if the heat in the ovens be allowed to become too high, the red lead already formed may be destroyed; if, on the other hand, the temperature be too low, the proper coloring does not take place. In order to complete the material for use, it is again ground and levigated, and finally dried in stoves.

SHOT.

The shot-tower is 156 ft. high, and of the ordinary construction. In the summit of the tower are two furnaces, each having one pot, the general charge for which is 30 cwt. of lead. Each pot will be charged three or four times a day, making six to eight castings in all. When the lead has been melted, it is taken by ladle from the melting-pot, and is poured into what is technically known as a "card." This consists of a flat tray of wrought iron, with a long handle, and which is pierced with a number of holes in the bottom; the diameter of the holes regulating the size of the shot. The bottom of the card is covered with a layer of "bed-scum," or "skimmings;" this is simply the dross that collects on the surface when lead is melted. The use of this bed-scum is to keep the lead from running through the holes in the card too rapidly, so that it will fall in globules, rather than in a continuous stream, as in the latter case lead wire, instead of spherical shot, would be produced; but the bed-scum being porous, the lead simply filters through it gradually. Its melting point being higher than lead, it will not melt and float to the top, as it is firmly bedded in the bottom of the card. Should the lead be superheated, however—a contingency that may easily arise—the scum would melt, and the card would require recharging.

The cards are placed in small wooden frames, opening from the top platform on to the interior of the tower, and the molten spheres of lead are allowed to fall through the air to the bottom, where they are caught by tubs of water. In this way the globules do not meet with any hard substance until they have been cooled and hardened. From time to time the operatives at the top of the tower draw up samples of the shot being made, and judge from its appearance whether they have the right amount of bed-scum in the card, according to the gauge of shot and grade of metal used. The art in dropping shot lies in these details, and in keeping the lead at the proper temperature. The shot is run from the tubs through shutes into an adjoining building, and on to a dryer; this is a flat tray, with a steam space below. From here the shot are run into a polishing machine, consisting of a cylindrical iron vessel revolving rapidly in a horizontal position, and by their friction against each other are polished bright. From the latter machine a small bucket ladder elevates the shot, and pours it into a distributing box, whence it is taken by spouts to the hopper of the sizing apparatus. This consists of a revolving cylinder, placed horizontally, or very nearly so, and pierced with different sized holes which gauge the shot. As the shot pass from the cylinder they fall on an inclined plane set to a certain angle, and a few inches in front of this, and a short distance below, is placed a vertical partition. The truly formed spherical shot roll down the plane with considerable velocity, and are carried right over the partition by their impetus, whilst bad specimens lag on the way, and drop dead at the end of the plane, not having way enough to shoot clear of the partition, inside which they therefore fall, and are taken to the tower again to be remelted.

The larger molded shot are made in the familiar manner in which pistol bullets are cast by an ordinary bullet mould. In place, however, of one being produced at a time, 20 to 40 are cast at once in some cases. When the shot are taken out of the mold, the gate is cut off by a pair of hand shears, and the polishing is done in a machine similar to that last described, but into which large pieces of rough stone are placed.

In another part of the works is a mill for making the larger kinds of shot. This consists of a fluted brass roller, which revolves against a grooved plate. A solid lead wire is fed in by a pair of pulleys, and is cut into required lengths by a pair of shears working automatically, and at the same time is pushed on to the roller. The way in which the shot is formed in the corresponding grooves of the roller and plate will be obvious, twenty-five shots being made from each length. The patent, or dropped shot, which is made in the tower, ordinarily ranges from that known as A A, in which forty-one go to the ounce, to No. 8, of which it requires 482 to the ounce. Very fine shot, known as "dust," is, however, now frequently made, and is used for shooting small brids for the sake of their plumage, or for firing into "antique" furniture, in order to render it "worm-eaten."(?)

LEAD PIPE.

For making the solid drawn lead pipe, hydraulic presses are used. These are placed vertically, the ram being on the ground level, and a floor above affording a working platform for the men. The machine consists of a cylinder for holding the molten lead from which the pipe is to be made. Fitting into this, and forming the bottom, is a ram which can be forced upwards from below. The top of the cylinder is closed by a die, with a circular hole containing a core, the annular space thus obtained forming the cylindrical pipe. The press is heated by fires which are placed round it, in order to prevent the molten lead being suddenly chilled and setting when first poured into it. It would be naturally impossible to make pipe from lead in a perfectly molten state, as it would all run into a shapeless mass immediately upon emerging through the die; it is therefore allowed to cool until on the eve of setting. In this way it is sufficiently firm when it emerges into the air to support its own weight, and is wound on reels into coils. A pressure 2,240 lb. to the inch is used for drawing ordinary pipe, but this is somewhat lessened as the operation proceeds. If the lead be allowed to get too cold in the press, the power is not sufficient for the purpose, and the pipe will not form; if, on the other hand, the lead is in too molten a state, it will spirt through the die with great violence, upon pressure being applied. Lead pipe lined with tin is thus made: Molten tin is poured into a recess in the mold, so that the pipe rises in a bath of tin, sufficient of which adheres to the sides of the pipe. A certain quantity of tin is also poured inside the first length of pipe that comes through, and this forms on the inside in a similar way.

WHITE LEAD.

White lead making is an important feature in these works. This is carried on by the well-known "stack process." The pig is melted in a large pot holding 6 or 7 tons, from whence it runs by gravity through a spout on to the "wicket molds." The flow is regulated by a valve. The "stacks" in which the lead is "corroded" are 65 in number, and are simply rectangular brick erections about 22 ft. square and 20 ft. to 30 ft. high, and hold about 50 tons each. In charging a stack several rows of cylindrical earthenware open-topped pots 7 in. in diameter and 10 in. high are placed on the ground. Above these are placed the "spars" or boards. Between these rows are placed smaller pots, and the whole is filled with dilute acetic acid.

Above the smaller pots the leaden wickets are stacked, seven or eight being placed one above the other. The whole is then covered by planks placed at right angles to the spars on which they rest, so that their weight is taken by the larger pots, which act as columns of support. Above the planks a layer of damped spent tan about 9 in. or 10 in. thick is finally placed. These operations are repeated, layer being placed above layer until the stack is complete, when it is allowed to remain for about three months. The tan heats spontaneously to a temperature of from 140 deg. to 175 deg., and this promotes the corroding process by which the action of the acid changes the blue lead wickets into the dry white lead of commerce, or carbonate of lead. When the stack is opened the load is collected in small wooden trays and taken to the washing apparatus. This consists, firstly, of a hollow wheel, into which each tray is placed, and in that way the contents are tipped into a trough through which a stream of water flows. The lead is raked upwards against the stream, whilst such portions of bark as may have been in it are carried away. The lead then passes through a pair of grooved rollers of brass, and such fragments as may have resisted the action of the acid have all the carbonate separated from them. These are collected, to be recast into wickets to go into the stacks again. The pulp of white lead is then passed through smooth rollers and thence to a riddle, where small fragments of blue lead that may have escaped the first process are arrested. Under these riddles are backs from which the pulp is fed into the hoppers of mills which have pairs of 4 ft. French burr-stones. From these again it is taken through a shute to an agitator, by means of an additional stream of water. The agitator is a vertical cylindrical vessel 7 ft. in diameter, with a vertical shaft revolving in it. From this an arm projects at right angles, to which are suspended a number of copper chains that serve to agitate the mass of white lead and water. After passing through a second agitator somewhat smaller, it is run into a series of settling tanks, whence the water is pumped back to be used for the same purpose again, whilst the damp lead is placed in small earthen pans and conveyed to the drying stoves. There are six of these, and they consist of large brick chambers having iron racks round the walls sufficient to hold 30 tons of lead. It is computed that the usual temperature is between 200 deg. and 300 deg. When dry the white lead is packed for delivery.

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STEEL MAKING, BY A STEEL MAKER.

Pig iron is melted direct from the ore in a blast furnace, and contains from 3 to 5 per cent. of carbon. When remelted it is called "cast iron" or "metal."

Spiegel iron is precisely the same, but contains in addition from 5 to 15 per cent. of manganese.

Bar iron, often called wrought iron, is pig iron which has been smelted and deprived of nearly all of its carbon, either in a puddling furnace or other analogous process; the spongy mass, or ball of iron, is usually hammered or rolled into a bar, generally 3in. wide, $\frac{5}{8}$in. thick, and from 6ft. to 12 ft. long.

Puddled steel is precisely the same as "bar iron," except that the process of puddling is stopped when rather more than half the carbon has been removed from the pig iron. There is consequently no hard and fast line between bar iron and puddled steel, the one intergrading to the other by imperceptible degrees. Although there are an infinite number of intermediate stages between the softest bar iron and the hardest puddled steel, and although it is impossible to state the exact percentage of carbon which marks the dividing line between one and the other, it is usual to call all puddled bars which cannot be hardened in water, bar iron, and all those which can, puddled steel. This dividing line falls somewhere near a mixture containing a half per cent. of carbon, and although it looks very vague and unscientific to use two terms which thus intergrade, no confusion of any kind, or misunderstanding, has ever been known to arise from their use.

Blister steel is bar iron which has been converted into steel in a converting furnace, and varies in the amount of carbon which it contains from $\frac{1}{2}$ to $1\frac{1}{2}$ per cent. There are, of course, an infinite number of degrees of carbonization between "hard heats" and "mild heats," but for the convenience of the trade six of them have been selected, and have received names as follows:

		per cent of carbon.
No 1.	spring heat	$\frac{1}{2}$
" 2.	country heat	$\frac{5}{8}$
" 3.	single-shear heat	$\frac{3}{4}$
" 4.	double-shear heat	1
" 5.	steel-through heat	$1\frac{1}{4}$
" 6.	melting heat	$1\frac{1}{2}$

Bar steel is blister steel which has been tilted or rolled down to the size required.

Single-shear steel is produced by welding half a dozen bars of blister steel together. Only those bars are chosen in which the process of conversion has been so far carried on that the outside of the bar is steel and the center of the bar iron. When these are welded together, and tilted or rolled down to a small dimension, the result produced is a mechanical mixture of iron and steel, a material which combines great tenacity with the capability of carrying a moderately hard cutting edge, and is much employed for certain kinds of knives.

Double-shear steel is produced by drawing down single-shear to suitable-sized bars, and rewelding two of them together, so that the mixture of iron and steel may be more perfect.

Cast steel is steel that has been melted in a "pot" (called a crucible in the encyclopedias), and poured into a "mold" (called a "form" in the learned books), thus becoming an "ingot," which is afterwards hammered or rolled to the size required. It may be made of various "tempers," varying in the percentage of carbon which they contain, from three-quarters or less to one and a half or more The different tempers may be arrived at in various ways. For the great majority of purposes there can be no doubt that the best way is to put into the melting pot broken pieces of blister steel converted exactly to the temper required; and the more evenly the steel is converted, and the more carefully all bars which are harder or softer than the temper required, or which are "flushed" or "aired," are rejected, the better. Blister steel, when carefully "taken up" or selected, will produce a cast steel which combines the greatest amount of hardness with the maximum amount of elasticity when hardened. It may, however, happen that for certain purposes "soundness" in the bar, the result of absence of "honeycomb" in the ingot, may be the most important quality required in the steel; for others the poperty of welding most perfectly may be the *sine qua non;* or the great evil to be avoided may be the tendency to water-crack in hardening; or the steel may be used for some purpose where it does not require to be hardened, and the object to be secured is the combination of the greatest amount of hardness and toughness when unhardened. In all cases the mode of manufacture must be adapted to the objects which it is most important to secure.

In addition to the operations already mentioned there are two other ways in which the same percentage of carbon may be secured. You may either put cut bar iron into the pot and "fetch it up" to the required temper with charcoal, or you may put broken pig iron into the pot and "let it down" to the required temper with cut bar iron. A fourth *modus operandi,* which for most purposes is the best of all, might be enumerated, namely, the selection of blister steel slightly harder than the temper required, so as to admit of being slightly let down to the exact temper by the addition of a small quantity of somewhat milder cast steel scrap.

The process of converting iron into steel is carried on in a converting furnace. This consists of two stone troughs, technically called "converting pots," each of them about 4 ft. wide, 4 ft. deep, and 12 ft. long, and placed side by side, with a fire underneath them, the flues of which conduct the heat all around each pot. These troughs or pots are built up of slabs of a peculiar kind of firestone, obtained in the neighborhood of Sheffield, and possessing the property of not cracking if heated slowly to a high heat and allowed to cool slowly. The slabs are united together with a mortar made of ground fireclay. Over the two pots is built a vault of firebrick, and the whole is inclosed in a dome of red brick, to prevent as much as possible the heat from escaping.

At the bottom of each pot is placed a layer of charcoal, broken up into small pieces, from a quarter to half an inch square. On this a layer of bars of iron is placed, which is covered with charcoal; another row of bars of iron follows, and so on until the pot is filled with alternate layers of charcoal and iron; it is then carefully closed with a thick cover of "wheel swarf," or mud, which accumulates in the troughs of the grindstone, a substance which will resist long exposure to great heat, and renders the top of the pot practically air-tight.

In order to test the progress of conversion, and to ascertain the precise moment when the fire should be allowed to go out, two or three bars of iron are allowed to protrude through a hole in one of the pots made for the purpose. These bars, technically called "tap bars," are drawn and inspected at or near the close of the process, and are tightly packed in white ashes where they pass through the end of the converting pot, so that no air may find its way to the charcoal inside.

The converting pots, full of alternate layers of iron and charcoal, and for all practical purposes hermetically sealed, are gradually raised to nearly a white heat, and kept at about that temperature for a week or more, according to the amount of carbonization required. Another week is occupied in the process of cooling, which must be done slowly, in order to prevent the pots from cracking, after which the cover is broken up and removed, and the bars, which went into the furnace bars of iron, are taken out of it bars of "blister steel," so called from the bubbles or blisters which have arisen on the surface during the process of conversion. Some of the charcoal has been consumed during the week at which it was white hot, but a considerable portion of it remains, and is taken out of the furnace as black as it went in.—*Henry Seebohm.*

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TRAINING FOR MECHANICAL ENGINEERS.

We publish herewith a paper by Prof. S. I. Alden, read before the American Association for the Advancement of Science, Philadelphia, Sept. 5th, 1884, which is exhaustive of the subject, and presents it with some arguments which we cannot approve. Not wishing, however, to manufacture opinions for our readers, we present the article as fully as our space admits, having excerpted only some general remarks and illustrations which are not necessary to the author's positions. This matter has special interest for our readers, for the reason that we have been in receipt of letters from working machinists recently, asking if it was possible for them to enter such a school.

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The close relation which the machine shop bears to both the scientific attainments and practical achievements of the engineer is strikingly obvious. The machine-shop is an institution in itself. It has its own methods and processes; its standards of machine design and workmanship; its tools and facilities. It has been developed by long experience. It has struggled with its own peculiar difficulties and obstacles, and its progress has set bounds to the practical achievements of engineering science. Forms which the mind conceives in a moment, it has had the tedious and laborious work of executing in metal. Subtle qualities of matter, whose effects may escape the thought of the designer, are certain to obstruct the progress of the mechanic. It seems clear, then, that the engineer or designer, in order to properly prepare his work for the shop, must know the shop methods, limitations and possibilities. While the schools have always aimed to teach drawing as a recognized means of presenting ideas to the shop, it has been found difficult, as might be expected, to make good drawings for the shop without a knowledge of machine shop practice. The attainments of graduates from the schools have by some been set aside as worse than useless; as unfitting them for success, because at this vital point in practical work they were eminently impractical.

By all it has been felt that the schools might do something to supply a deficiency so fully realized. This has been attempted. By general consent, a shop department has become a recognized element in the engineering course of nearly every technical or polytechnic school. Of the methods and results of instruction in these shops, the practical engineers of the country are eminently fitted to judge. I therefore ask your most careful attention to a brief consideration of the questions: What should such a shop be? and what should it do?

The object of the shop department is to supply to the school a new means of instruction in practical mechanical and engineering work. It is made a department in the school, in order to add to the school methods, as well as to its facilities of instruction. The shop, therefore, should not be such a department as would be developed by, or out of, the school by those who never had experience in shop work. A room fitted with machinists' tools, where curious things are made, by odd processes, for no purpose but the practice of making them, is not a machine shop in any practical sense. The school shop should be superior in all its appointments. It should have not only the tools, methods, and facilities, but also the skilled workmen and the business of a first-class shop. All these, together with additional employees to act as instructors, should be turned to one object, viz.: The advancement of the students in knowledge and skill. Only in this way can the shop yield its full benefit as a department of the school. To aim at anything less than the best practice of the leading manufacturing shops is to defeat one of the main objects of the shop department, and one of the special aims which, in some cases at least, has led to the establishment of the department. One argument for the truth of this statement is the fact that such a shop is able to adopt, in their full measure, the methods of teaching which, in other departments, the best teachers are practicing, as far as their facilities will permit. * * * * * *

Let me briefly outline the two methods to which I have referred as applied to instruction in mechanical and engineering practice. Following the method of teaching analysis separate from synthesis, we should say that machine-shop practice consists in performing certain operations with machines and tools; that by careful analysis and the actual performance of these operations upon isolated pieces, the student will have learned the use of tools in all the necessary shop operations. Some time he may be called upon to make a machine, and then all this skill and knowledge thus acquired will be valuable. This is the plan which we have seen is largely abandoned in other subjects, and uneconomical in principle. Adopting the method of combining in the instruction both analysis and synthesis, we should say that a certain machine required in its construction the processes we desire at present to teach. * * * We give the student a part in the work of constructing this machine—a part requiring such tools and methods as his attainments permit. He is taught the analysis of each process he is to undertake, and is at once set about the work. The instruction is fresh in his mind; he is impressed with a feeling of responsibility, and stimulated by the end in view. It is reasonable that real work on an ingenious, well-designed and useful product should be a stimulus to effort and enthusiasm. But the advantage which is gained by doing real, practical work in the shop, is by no means confined to economy of time in the acquirement of skill and stimulus to enthusiastic endeavor. It has valuable elements of training which are not included in so large a degree in the methods of teaching processes by work on isolated and useless pieces. It cultivates practical judgment by introducing more elements of thought and more conditions into each problem. The part of a machine cannot be intelligently made without thinking and knowing about other parts which it is to fit and supplement. Often a good knowledge of the construction and operation of a whole machine will be acquired by the student while he is making and fitting one piece. He studies the drawings to see that his own work is consistent with the completed product.

It must be harmonious in style, material and quality of workmanship, as well as have a definite size and form; and the standard for the machine, as a whole, is that set by the best manufacturers and engineers. Much of this training of the practical judgment would not be secured if the same piece had been made to size and form by rule and gauge alone.

Practical work, in a real shop, gives the student a degree of valuable experience. He works with skilled mechanics such as he will meet in other shops. He gets some of their ideas, which have been acquired by long experience, fairly lodged in his mind. He is obliged to respect their ways of doing things, or else suggest better ones. He feels more responsibility and more pressure to get his work right, if he knows it is really to be made use of. He is more willing to remedy what he would otherwise deem a slight mistake, or to repeat his work if wholly wrong, when he sees the degree of perfection necessary to the successful completion of a valuable machine. Such work in a shop results not only in skill, but in the kind of skill which practical foremen and superintendents recognize as valuable—a skill available because of the practical judgment and experience which have been simultaneously acquired.

It is clear that such a shop as I have outlined must have a business, and that its superintendent must be a thorough, practical mechanic and a good business manager. The business of such a shop should give variety of work. It should not, for the best results, be confined to the manufacture of a few things which give practice in routine work, though this is important, but should, if possible, include work of an engineering character, carried on and completed under all the exactions and requirements of contract work. The high standards of practical achievements which characterize the shop departments are kept up by the requirements of the open market. Machines which are sold at the highest current prices must be as good as the best. If sold, they will not be criticized with charity for the institution or for the students, but from the merciless standpoint of competition, or the just consideration of business equity. While the productive capacity of the shop, in proportion to its current expenses, is diminished by the instruction given to students, especially when the proportion of students to skilled workmen is large, the quality of the shop products need not and must not be lowered.

Summarizing, we say that the shop for instruction of students in engineering should be a complete, well-equipped machine shop, with the necessary pattern room, drafting rooms, forging and moulding shops, with unusual facilities for experimental work on mechanical problems, administered by a skilled superintendent and a corps of suitable instructors and journeymen.

Turning to the question, What will such a department accomplish? I reply:

First—It will stimulate to breadth and thoroughness of instruction in the theoretical studies of the course. If the shop department is carried on as an integral part of the school, in sympathy with the aim of high scientific attainments, any failure of the theoretical instruction to furnish the solution of practical problems that arise in the work of the shop will be felt, and, as far as possible, remedied. The shop department will raise rather than lower the standard of scientific attainments in the school, because such attainment is not likely to be in excess of the practical demands which the shop operations offer.

Second—It will give the students who spend in the shop about ten hours per week for the entire course a good general knowledge of the best machine-shop practice, sufficient to serve and greatly aid them in their future engineering work.

Third—It will give the student as much practical skill as an apprentice of three years in an ordinary shop. In support of this statement, I may say that the results of constant instruction, combined with actual experience on practical work, have surpassed the expectations of the most earnest advocates of this system of training. You would not doubt that the average boy would learn more algebra in a month under a good teacher than in five months by himself. Experience shows that constant construction is fully as effective and economical of time in learning a trade as in studying a science. This attainment in practical skill opens for every graduate a wide door to the engineering profession. The lowest man in the class can start on wages as a journeyman as soon as he graduates. If called at once to a higher position, his practice of course will still furnish much of the knowledge he will be likely to use in the earlier years of his professional work. The effect upon character, of a consciousness of independent self-support, is worthy of consideration as a commendation of the shop training.

Fourth—The addition of the shop department promotes the unity and efficiency of the professional training, without detriment to any of its qualities. By making the study of theory and practice simultaneous and coincident, their union, which is the necessary condition of educational success, is more readily secured, and its prominence in the subsequent progress of the graduates more certain.

Fifth—It promotes economy of the student's time by utilizing in variety of occupation the time devoted to the school training, and also by the operation of the principle of combining in study those elements which enter into the desired attainments.

A single question remains for consideration. If such a shop and system of instruction as I have outlined has been shown to be desirable and practicable, how can it be started, and what outlay of money will be required to found it and carry it on? A shop may be started on this plan by adopting, as the corner-stone of the system, the doing (with the aid of skilled journeymen) of actual marketable work. The plan may be developed to such an extent as the means at hand will allow. Experience indicates that as much or more can be accomplished with a given sum of money on this plan as on any other. If it is adopted, whatever is spent will be so much help toward a more extensive department, because the plan includes whatever it is desirable to accomplish by such a department. From fifty to one hundred thousand dollars invested in the shop and its equipment would give a good start for the instruction of one hundred students in this department.

There would be needed for annual running expenses from eight to twelve thousand dollars. If the products of the shop should pay only for the cost of their production, this sum for running expenses would have to be provided from tuition and endowment. With good business management and fair opportunities, less than half this sum might be required for annual expenses. It should be distinctly in mind that the business of the shop is no part of the educational work of the department. The plan does not contemplate any union of education and money-making. The shop is no more justly subject to this criticism than are academies and colleges, because they rent rooms in their buildings and receive money therefrom—a purely business transaction incidental to the educational work of the school, but no part of it.

No outlay of money for educational purposes promises to yield so large immediate returns, both to the student and the engineering profession, as that expended in founding and fostering such a department; and, while the plan admits of the expenditure of large sums, especially in providing for the higher work which may be done with suitable facilities and instruction, the work may be begun on a small scale, and be efficient as far as it goes.

Whatever is done, be sure that the management and efficiency of the shop meet the approval of practical manufacturers, superintendents, and engineers known to be interested in the thorough instruction of boys in this department. The training of mechanical engineers is now a subject of such magnitude and importance as to demand patient and candid consideration. Old methods of instruction should be examined and improved, and new methods should be critically shifted before they are adopted. Candor and the well-digested results of experience are always hopeful.

Bringing these to our aid in perfecting a system of training for engineers, we may hope to secure by such training that union of scientific attainments and ability for practical achievements which result in a well-educated and developed man and a successful engineer—one who, through knowledge, is enabled to combine in his constructions that harmony of the laws of matter, force and energy which the Author of the created universe saw in His own works when he pronounced them all very good.

◆

CRUCIBLE STEEL THE BEST FOR CERTAIN PURPOSES.

The accumulated experience of a century has convinced the manufacturers of crucible cast steel that the finest qualities can only be made from bar steel which has been converted from iron manufactured from Dannemora ore. This iron is expensive; its average cost for the last forty years has been at least £25 a ton. The process of converting it into steel is slow and costly; the process of melting in small crucibles is extravagant both in labor and in fuel, and consequently the best qualities of crucible cast steel can only be sold at a high price. So-called best crucible cast steel is sold at low prices by unscrupulous manufacturers and bought by credulous consumers, but though it is quite possible for high-priced steel to be bad, it is absolutely impossible that low-priced steel can be good. The finest quality of steel cannot be made of cheap material or by a cheap process. Every year the attempt is made, and every year it signally fails. No one ever made a better try than Sir Henry Bessemer, but his failure was as complete as that of his predecessors. He attempted to produce an article at £6 a ton to compete with one at £60 a ton, and failed absolutely. When railways were first introduced many people thought that the price of horses would permanently fall, but exactly the contrary took place. Similar fears were entertained that the demand for crucible cast steel would seriously decline when Bessemer and Siemens steel came into the market. This has not been the case. The commoner qualities of crucible cast steel have been to a large extent superseded by Bessemer and Siemens steel, but the enormous quantities made by the latter process have required for their manipulation, directly or indirectly, such a large quantity of the better qualities of crucible cast steel, that the total amount of the latter now produced in various parts of the world is probably double that which was required before the birth of its rivals.

The analysis of steel shows the amount of other ingredients which it contains besides the nine-tenths or more of iron which forms its basis. The amount of carbon, silicon, manganese, sulphur, phosphorus, copper, etc., may be ascertained with tolerable accuracy, and the information thus obtained is often of the utmost importance; but it is quite possible to make a comparatively low-priced steel which shall show precisely the same chemical analysis as the best crucible cast steel; nevertheless it is found by practical experience to be inferior in quality. That this is a fact has been proved over and over again beyond all possibility of doubt. It is a sufficient reason why Sheffield manufacturers have been willing to pay such a high price for Dannemora iron for so many years; but it is not a sufficient reason why so many Sheffield manufacturers should ignore the results of chemical analysis altogether. Of every fact there must be some explanation, though we may, for the present at least, be ignorant of it.

To say, with the Sheffield devotees of the rule of thumb, that the one steel possesses "body," and that the other does not, explains nothing, but merely adds to the synonymy of the subject by altering the nomenclature.

The principal reason why Bessemer and Siemens steel have failed to supersede crucible cast steel for purposes where the better qualities are required, is that they cannot be made sound without the addition of silicon or manganese. In melting common steel (containing, for example, from 0·15 to 0·05 per cent. of phosphorus), the steel must be poured into the mould as soon after it has become perfectly fluid as possible, and as hot as the tensile strength of the pot will allow. In making the higher qualities of crucible cast steel (where the percentage of phosphorus ranges from 0·01 to 0·001) a similar mode of treatment would produce very strange results; the molten steel would boil over in the mould, the fracture of the ingot when cold would show a series of bubbles like a sponge, and its specific gravity would scarcely exceed that of wood. Some of these bubbles or honey-combs would weld up when the ingot came to be forged, but by far the greater number would be coated with an oxide which would make a weld impossible, and the bar, if it was not burnt up in the fire, would be so full of the imperfections technically called "seams" or "roaks," as to be perfectly useless. To obviate this disastrous result, it is necessary to boil the steel for nearly half an hour after it has become fluid, and then to allow it to cool down to a certain temperature before it is poured into the mould. This process is called, in the language of the votaries of the rule of thumb, "killing" the steel, and it is an axiom amongst them that the higher the quality of the steel the more "killing" it takes. It is in this part of the process of crucible cast steel melting that its special virtue consists, and the cost and quality of the cast steel produced depend in a large degree upon the skill brought to bear upon it. There is an old proverb in Sheffield, usually expressed in the terse vernacular of the country, but which may be refined into the expression that if you put the devil into the crucible, the devil will come out of the crucible. The converse of this is by no means the case. Though you may convert iron into steel in the crucible, you cannot convert bad steel into good steel in the crucible; but though you may put the most angelically pure steel into the pot, you may by bad management, by not "killing" it properly, pervert it into satanically bad ingots. Now this "killing" of the steel is precisely what cannot be done in the Bessemer or Siemens processes without the addition of such a large amount of manganese or silicon that the steel becomes brittle when hardened.—*Seebohm in Engineering.*

Chippings and Filings.

The More Valuable time is, the swifter it flies.

◆

It Puzzles the average railroad man to understand how it is possible for corporations to spend large sums in decorating ferryboats, laying tracks, and rebuilding bridges that do not need it, when it is so hard for him to get his wages. The ways of railways are mysterious, and reason for their expenditures past finding out.

◆

If Some One Would Devise a letter-file, wherein business letters could be stored and found when wanted, it would be a great convenience. Those in market at present have the trifling defect of being wholly impracticable. They have to be turned over several times, and conceal what they should expose. A good letter-file would be a saleable article.

◆

At No Time in the history of the country has copper been so cheap as it now is—thirteen cents per pound. Brass castings are correspondingly low—from eighteen to twenty-one cents per pound. The low price of copper is due to increased sources of supply, from Arizona and elsewhere, which has broken up the monopoly held by the Lake Superior mines so long.

◆

A Petrified Forest exists in Arizona, and a company has been formed to manufacture objects of art, etc., from the petrifactions. The parties engaged in this work state that the petrified wood is rapidly driving California onyx from the market as a material for mantels, etc., as it is susceptible of a much finer polish, and is also more permanent and lasting than that of the onyx.

◆

Most Of Our Exchanges are full of items about cutting down wages, discharge of help, accompanied with mournful prognostications of a hard winter. They seem to like it. Exactly what end this publicity serves is not apparent. It is decidedly mischievous, in one sense, for it gives unscrupulous parties a pretext for making capital out of the hard times, when there is no occasion for it.

◆

A Series Of Careful Experiments made lately in Germany, in regard to the expansion of metals on cooling from fusion, appear to indicate the existence of a general law that all metals expand on solidification. Of the eight metals—tin, lead, zinc, bismuth, antimony, iron and copper—submitted to these investigations, six of them expanded at the moment of solidification, so that the solid was less dense than the liquid metal. These six were zinc, tin, bismuth, antimony, iron and copper. The results obtained from the other two metals were not decided, but rather favored the fact of expansion.

◆

More About Oil On Water. The master of a vessel which arrived at Chicago during the height of the blow of the 8th inst., says he took a quantity of common lard oil and allowed it to drop over the weather quarter; while the oil lasted not a sea broke over the vessel. Monstrous waves would rush toward the vessel with terrific force, but when they reached the oil they seemed to lose their force, and instead of breaking, ended in long, rolling billows. There was none of the fierce pitching, rolling and driving which is usually the result of a big sea. It would seem that if this matter was more thoroughly studied it would result in saving many vessels from foundering.—*Inter-Ocean*

◆

A Paragraph in the *Pall Mall Gazette* says:

"It is so common a remark that the spirit of invention does not dwell in woman, that it is well to notice an exception to the rule. Mme. Delong-Tuyssusian, after experiments lasting over 18 years, has succeeded in constructing an instrument to cut metal plates of considerable thickness to any elaborate design. Mme. Delong has received no less than 18 medals and diplomas at the different European exhibitions. It is now on exhibition in London, where the metal cut window blinds have been put up for inspection, and may be seen by skeptics who maintain that women never invent anything."

The mysogonist, or woman hater, who reads this says that eighteen years is a long time to waste over a useless invention.

◆

A Writer in the Boston *Com'l Bulletin*, in comparing wages in Lowell in 1857 and 1884, also speaks of the cost of living, as follows:

	Board in 1857.	Board in 1884.
"Men, per week	$1 75	$2 90
Girls, per week	1 25	1 85

In October, 1857, we had a cut-down of wages, but no reduction on board. Cost of living is cheaper to-day on all things than it was then, except rent.

Some will ask why board is not as cheap in our corporation boarding-houses now as then. I will simply say that we will not eat the food now that they gave us then."

In 1857, as we recall, the fare consisted largely of brown bread and beans, which are generally acknowledged to be palatable. Can it be that Eastern people now repudiate these honest viands? Two dollars and ninety cents per week will scarcely provide all the luxuries of the season.

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THE TEMPERATURE OF THE SOLAR SURFACE.

The power developed by the sun motor,* recorded in *Nature*, vol. xxix., p. 217, has established relations between diffusion and energy of solar radiation which prove that the temperature of the surface of the sun is extremely high. I have, therefore, during the summer solstice of 1884, carried out an experimental investigation for the purpose of demonstrating the temperature of the solar surface corresponding with the temperature transmitted to the sun motor. Referring to the illustrations previously published, it will be seen that the cylindrical heater of the sun motor, constructed solely for the purpose of generating steam or expanding air, is not well adapted for an exact determination of the amount of surface exposed to the action of the reflected solar rays. It will be perceived on inspection that only part of the bottom of the cylindrical heater of the motor is acted upon by the reflected rays, and that their density diminishes *gradually* towards the sides of the vessel; also that, owing to the imperfections of the surface of the reflecting plates, the exact course of the terminal rays cannot be defined. Consequently, the most important point in the investigation, namely, the area acted upon by the reflected radiant heat, cannot be accurately determined. I have accordingly constructed an instrument of large dimensions, a polygonal reflector (see Fig. 1), composed of a series of inclined mirrors, and provided with a central heater of conical form, acted upon by the reflected radiation in such a manner that each point of its surface receives an equal amount of radiant heat in a given time. The said reflector is contained within two regular polygonal planes twelve inches apart, each having ninety-six sides, the perimeter of the upper plane corresponding with a circle of eight feet diameter, that of the lower plane being six feet. The corresponding sides of these planes are connected by flat taper mirrors composed of thin glass silvered on the outside. When the reflector faces the sun at right angles, each mirror intercepts a pencil of rays of 32·61 square inches section, hence the entire reflecting surface receives the radiant heat of an annular sunbeam of $32{\cdot}61 \times 96 = 3130$ square inches section. It should be observed that the area thus stated is 0·011 less than the total foreshortened superficies of the ninety-six mirrors if sufficiently wide to come in perfect contact at the vertices. Fig. 2 represents a transverse section of the instrument as it appears when facing the sun; the direct and reflected rays being indicated by dotted lines. The reflector and conical heater are sustained by a flat hub and eight radial spokes bent upwards towards the ends at an angle of 45°. The hub and spokes are supported by a vertical pivot, by means of which the operator is enabled to follow the diurnal motion of the sun, while a horizontal axle, secured to the upper end of the pivot, and held by appropriate bearings under the hub, enables him to regulate the inclination to correspond with the altitude of the luminary. The heater is composed of rolled plate iron 0·017 inch thick, and provided with head and bottom formed of non-conducting materials. By means of a screw-plug passing through the bottom and entering the face of the hub the heater may be applied and removed in the course of five minutes, an important fact, as will be seen hereafter. It is scarcely necessary to state that the proportion of the ends of the conical heater should correspond with the perimeters of the reflector, hence the diameter of the upper end, at the intersection of the polygonal plane, should be to that of the lower end as 8 to 6, in order that every part may be acted upon by reflected rays of equal density. This condition being fulfilled, the temperature communicated will be perfectly uniform. A short tube passes through the upper head of the heater, through which a thermometer is inserted for measuring the internal temperature. The stem being somewhat less than the bore of the tube, a small opening is formed by which the necessary equilibrium of pressure will be established with the external atmosphere. It should be mentioned that the indications of the thermometer during the experiment have been remarkably prompt, the bulb being subjected to the joint influence of radiation and convection.

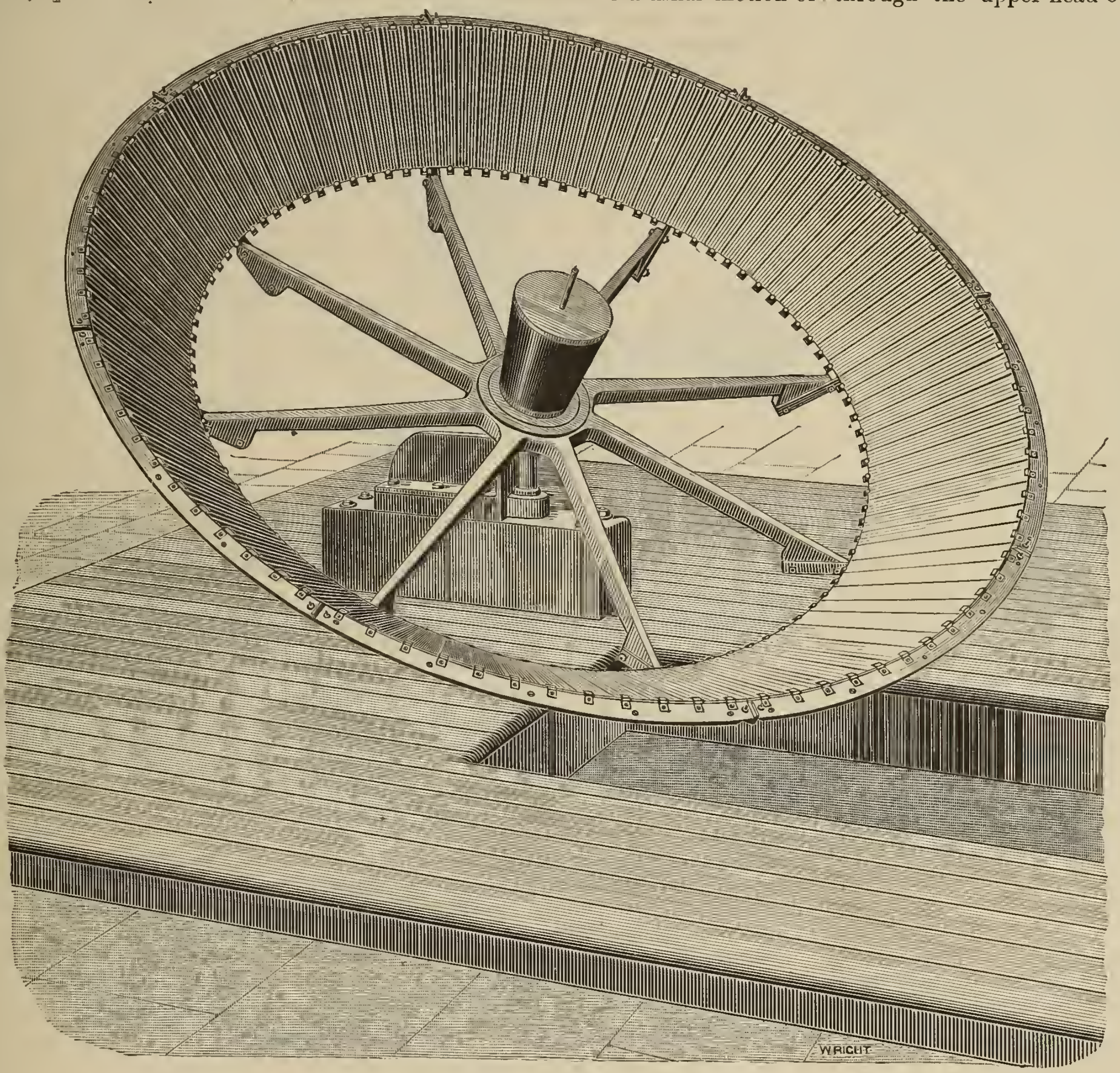
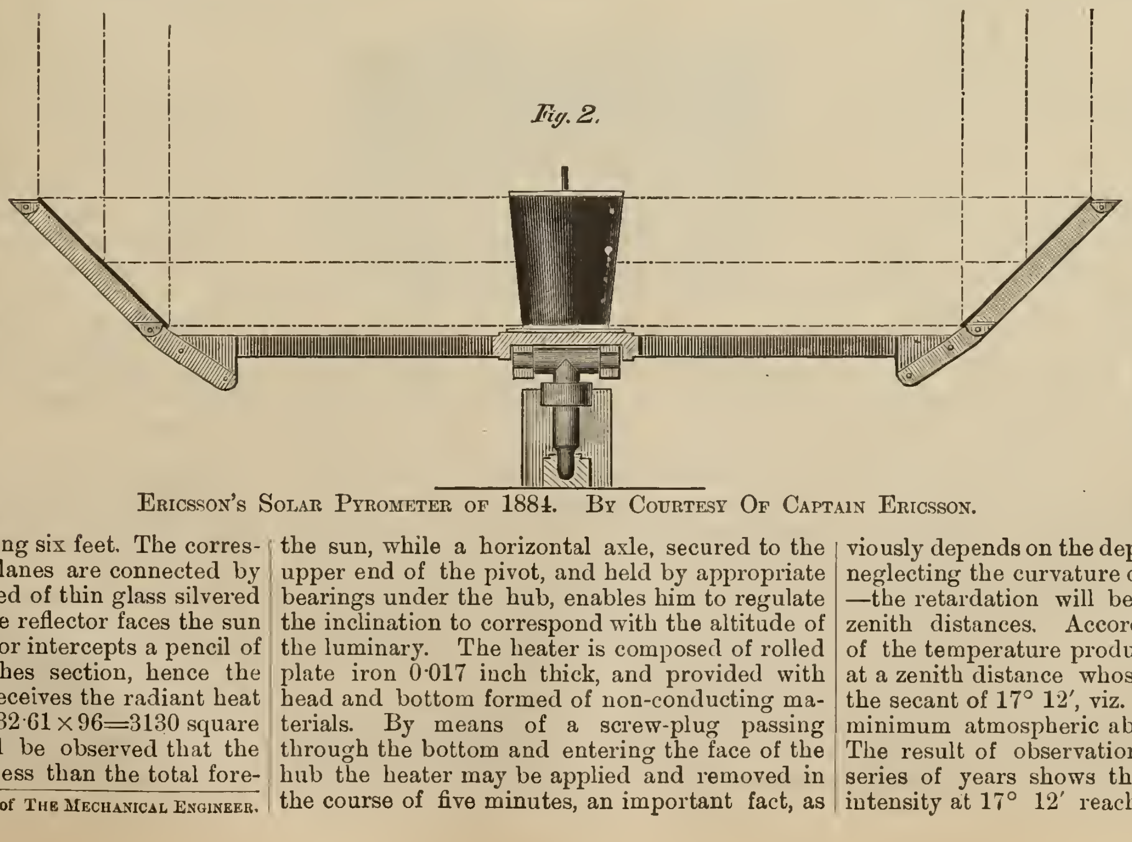


Fig. 2.



ERICSSON'S SOLAR PYROMETER OF 1884. BY COURTESY OF CAPTAIN ERICSSON.

The foregoing particulars, it will be found, furnish all necessary data for determining with absolute precision the *diffusion* of rays acting on the central vessel of the solar pyrometer. But the determination of temperature which uninterrupted solar radiation is capable of transmitting to the polygonal reflector calls for a correct knowledge of atmospheric absorption. Besides, an accurate estimate of the loss of radiant heat attending the reflection of the rays by the mirrors is indispensable. Let us consider these points separately.

Atmospheric Absorption.—The principal object of conducting the investigation during the summer solstice has been the facilities afforded for determining atmospheric absorption, the sun's zenith distance at noon being only 17° 12′ at New York. The retardation of the sun's rays in passing through a clear atmosphere obviously depends on the depth penetrated; hence—neglecting the curvature of the atmospheric limit—the retardation will be as the secants of the zenith distances. Accordingly, an observation of the temperature produced by solar radiation at a zenith distance whose secant is *twice* that of the secant of 17° 12′, viz. 61° 28′, determines the minimum atmospheric absorption at New York. The result of observations conducted during a series of years shows that the maximum solar intensity at 17° 12′ reaches 66°·2 F., while at a zenith distance of 61° 28′ it is 52°·5 F.; hence, minimum atmospheric absorption at New York, during the summer solstice, is 66°·2—52°·5= 13°·7 F., or $\frac{13·7}{66·2}$=0·207 of the sun's radiant energy where the rays enter the terrestrial atmosphere.

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* Republished on page 65, vol. 7, of THE MECHANICAL ENGINEER.

In order to determine the loss of energy attending the reflection of the rays by the diagonal mirrors, I have constructed a special apparatus, which, by means of a parallactic mechanism, faces the sun at right angles during observations. It consists principally of two small mirrors, manufactured of the same materials as the reflector, placed diagonally at right angles to each other; a thermometer being applied between the two, whose stem points towards the sun. The direct solar rays entering through perforations of an appropriate shade, and reflected by the inclined mirrors, act simultaneously on opposite sides of the bulb. The mean result of repeated trials, all differing but slightly, show that the energy of the direct solar rays acting on the polygonal reflector is reduced 0·235 before reaching the heater.

In accordance with the previous article, the investigation has been based on the assumption that, *the temperatures produced by radiant heat at given distances from its source are inversely as the diffusion of the rays at those distances. In other words, the temperature produced by solar radiation is as the density of the rays.*

It will be remembered that Sir Isaac Newton, in estimating the temperature to which the comet of 1680 was subjected when nearest to the sun, based his calculations on the result of his practical observations that the maximum temperature produced by solar radiation was one-third of that of boiling water. Modern research shows that the observer of 1680 underrated solar intensity only 5° for the latitude of London. The distance of the comet from the center of the sun being to the distance of the earth from the same as 6 to 1000, the author of the "Principia" asserted that the density of the rays was as 1000^2 to 6^2=28,000 to 1; hence the comet was subjected to a temperature of $28{,}000 \times \frac{180°}{3}$=1,680,000°, an intensity exactly "2000 times greater than that of red-hot iron" at a temperature of 840°. The distance of the comet from the solar surface being equal to one-third of the sun's radius, it will be seen that, in accordance with the Newtonian doctrine, the temperature to which it was subjected indicated a solar intensity of $\frac{4^2 \times 1{,}680{,}000}{3^2}$=2,986,000° F.

The writer has established the correctness of the assumption that "the temperature is as the density of the rays," by showing practically that the *diminution* of solar temperature (for corresponding zenith distances) when the earth is in aphelion corresponds with the increased diffusion of the rays consequent on increased distance from the sun. This practical demonstration, however, has been questioned on the insufficient ground that "the eccentricity of the earth's orbit is too small and the temperature produced by solar radiation too low" to furnish a safe basis for computations of solar temperature.

In order to meet the objection that the diffusion of the rays in aphelion do not differ sufficiently, the solar pyrometer has been so arranged that the density, *i. e*, the diffusion of the reflected rays can be changed from a ratio of 1 in 5040 to that of 1 in 10,241. This has been effected by employing heaters respectively 10 inches and 20 inches in diameter. With reference to the "low" solar temperature pointed out, it will be perceived that the adopted expedient of increasing the density of the rays without raising the temperature by *converging* radiation, removes the objection urged.

Agreeably to the dimensions already specified, the area of the 10 inch heater acted upon by the reflected solar rays is 331·65 square inches, the area of the 20-inch heater being 673·9 square inches. The section of the annular sunbeam whose direct rays act upon the polygonal reflector is 3130 square inches, as before stated.

Regarding the diffusion of the solar rays during the investigation, the following demonstration will be readily understood. The area of a sphere whose radius is equal to the earth's distance from the sun in aphelion being to the sun's area as $218·1^2$ to 1, while the reflector of the solar pyrometer intercepts a sunbeam of 3130 square inches section, it follows that the reflector will receive the radiant heat developed by $\frac{3130}{218·1^2}$ = 0 0658 square inch of the solar surface. Hence, as the 10-inch heater presents an area of 331·65 square inches, we establish the fact that the reflected solar rays, acting on the same, are *diffused* in the ratio of 331·65 to 0·0658, or $\frac{331·65}{0·0658}$ = 5040 to 1; the diffusion of the rays acting on the 20-inch heater being as 673·9 to 0·0658, or $\frac{673·9}{0\ 0658}$ = 10,241 to 1.

The atmospheric conditions having proved unfavorable during the investigation, maximum solar temperature was not recorded. Accordingly, the heaters of the solar pyrometer did not reach maximum temperature, the highest indication by the thermometer of the small heater being 336°·5, that of the large one being 200°·5 above the surrounding air. No compensation will, however, be introduced on account of deficient solar heat, the intention being to base the computation of solar temperature solely on the result of observations conducted at New York during the summer solstice of 1884. It will be noticed that the temperature of the large heater is proportionally higher than that of the small heater, a fact showing that the latter, owing to its higher temperature, loses more heat by radiation and convection than the former. Besides, the rate of cooling of heated bodies increases more rapidly than the augmentation of temperature.

The loss occasioned by the imperfect reflection of the mirrors, as before stated, is 0·235 of the energy transmitted by the direct solar rays acting on the polygonal reflector, hence the temperature which the solar rays are capable of imparting to the large heater will be 200°·5 × 1·235 = 247°·617; but the energy of the solar rays acting on the *reflector* is reduced 0·207 by atmospheric absorption, consequently the ultimate temperature which the sun's radiant energy is capable of imparting to the heater is 1·207 × 247°·617 = 298°·87 F. It is hardly necessary to observe that this temperature (developed by solar radiation diffused fully ten-thousandfold) must be regarded as an *actual* temperature, since a perfectly transparent atmosphere, and a reflector capable of transmitting the whole energy of the sun's rays to the heater, would produce the same.

The result of the experimental investigation carried out during the summer solstice of 1884 may be thus briefly stated. The diffusion of the solar rays acting on the 20-inch heater being in the ratio of 1 to 10,241, the temperature of the solar surface cannot be less than 298° 87 × 10,241 = 3,060,727° F. This underrated computation must be accepted unless it can be shown that the temperature produced by radiant heat is not inversely as the diffusion of the rays. Physicists who question the existence of such high solar temperature should bear in mind that, in consequence of the great attraction of the solar mass, hydrogen on the sun's surface raised to a temperature of 4000° C., will be nearly twice as heavy as hydrogen on the surface of the earth at ordinary atmospheric temperatures; and that, owing to the immense depth of the solar atmosphere, its density would be so enormous at the stated low temperature that the observed rapid movements within the solar envelope could not possibly take place. It scarcely needs demonstration to prove that extreme tenuity can alone account for the extraordinary velocities recorded by observers of solar phenomena. But *extreme tenuity* is incompatible with low temperature and the pressure produced by an atmospheric column probably exceeding 50,000 miles in height subjected to the sun's powerful attraction, diminished only one-fourth at the stated elevation. These facts warrant the conclusion that the high temperature established by our investigation is requisite to prevent undue density of the solar atmosphere.

It is not intended at present to discuss the necessity of tenuity with reference to the functions of the sun as a radiator; yet it will be proper to observe that on merely dynamical grounds the enormous density of the solar envelope which would result from low temperature, presents an unanswerable objection to the assumption of Pouillet, Vicaire, Sainte-Claire Deville, and other eminent *savants*, that the temperature of the solar surface does not reach 3000° C.—*J. Ericsson, in Nature.*

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AMERICAN AND ENGLISH STEAMSHIP MODELS.

A writer in the *Ironmonger*, an English trade publication, thus speaks of the relative values of English and American steamship models:

"Recent trials in practical service seem to show that the claims made for the type of flat-bottomed steamers are well founded, both as regards speed and fuel economy. The steamer *Finance*, of the United States and Brazil Steamship Company, arrived off the Highlands some weeks since, a few days ahead of time, having made the run from St. Thomas in five days. One of her officers, in commenting on this most satisfactory performance, said: 'We have come in two days ahead of our schedule time, and have made excellent speed all the trip, and done it with only 71 lbs. of steam. The speed of the *Finance* is owing, I think, to her model. She is nearly flat on the bottom, and has no keel except her two bilge keels, or rolling keels, as we call them. This gives her great carrying capacity as well as speed. Her bows have a fine entrance, but the body of the ship is carried well forward under the water-line, so that when she goes into a sea she rises like a duck, and does not stagger. I think that American-built ships have a greater carrying capacity, and develop more speed with less coal than any others in the world.

The swift steamship *America* is a much larger vessel than the *Finance*, yet the *America* only carries about 2,000 tons of cargo to the *Finance's* 3,166 tons. The *America* is, of course, the faster ship, but not enough faster to make up for the difference in carrying capacity. The *Finance* can make 14 knots an hour, and the *America* 18. The *Finance* burns from 28 to 30 tons of coal a day and the *America* 175. There is the ship *San Pablo*, a typical American ship. She has developed a speed of 16 knots an hour, with a consumption of 32 tons of coal. She carries a dead weight of cargo of 4,500 tons. She recently made the fastest passage on record between here and Gibraltar. She is now running between New Tacoma, on Puget Sound, and San Francisco. The round trip takes ten days. In thirty days she made three round trips and started on her fourth and has landed 12,500 tons of coal. In nine months she has cost only $26 for repairs in the engine room. She is built something on the model of the *Finance*, but has a keel. The *City of Rome* burns 320 tons of coal a day, and can only carry 1,000 tons of cargo. The great freight ship of the National line is the *England*, which carries 3,500 tons of cargo. She makes about 12 knots an hour, and can be pushed to 13. The *England* is 437 9 feet long, 42½ feet beam, and 35 feet depth of hold. The *Finance* is 300 feet long, 38·4 feet beam, and 23·6 feet depth of hold. I do not know the consumption of coal on the *England*, but will venture to say it is double that of the *Finance*. The *Finance* is not, of course, a fast ship, compared with the 'greyhounds of the sea,' but, as you see, attains a respectable speed, has great carrying capacity, and besides that, is a passenger ship. And look at the *San Pablo*, with a speed of 16 knots, a carrying capacity of 4,500 tons, and consumption of only 32 tons of coal. It is all in the model. I believe that a ship as large as the *Oregon* or *America*, and with much less engine power, built on the flat-bottom model, would beat their time badly, and have twice or three times their carrying capacity."—*The Ironmonger.*

◆

Persons out of Employment, who wish to turn an honest penny, can obtain club forms and go about seeking subscribers. We will send 50 copies of The Mechanical Engineer to any address, or addresses, for $50. The canvasser has thus a large margin of profit, with no risk but his time. In large cities, lists of 50 should be easily obtained by perseverance and energy. The money must come with the names, and no less than fifty will be accepted for $50.

◆

English Locomotive Engineers are fined, if they overrun the platforms at stations one car length.

HAND-WRITING.

A writer in *The Penman's Gazette*, speaking of faulty penmanship, says :

"'It is hard to teach an old dog new tricks.' Still it can be done—and in the case of indifferent writing, it ought to be done. The satisfaction of the result would amply repay the necessary labor. My rule would be, to select a first-class model—say a whole page of actual manuscript, written in regular and symmetrical hand—and copy it, slowly and minutely at first, examining every separate letter; then, more rapidly, looking at the general shapes of words; and finally, without the model, try to reproduce its style. This, kept up long enough, ought to remedy the most obstinate faults, and, at least, transform a slovenly hand into neat and regular penmanship. The experiment is worth trying."

As a rule, the handwriting of machinists and engineers is excellent, and, strange to say, better than the majority of business letters. This seems extravagant to those who do not know the facts, which are as we state. We have often had it in mind to photograph a page of our correspondents' penmanship, and may yet do so.

Our correspondence, as may be surmised, embraces letters from men in all stations of life—boiler makers, engineers, machinists, wood-workers, etc. These, from long handling of heavy tools, and from cramped positions of the fingers, would not be expected to make any approach to symmetrical writing; nevertheless, a great number write hands which are models of neatness and even elegance, while, in only a very few instances indeed, are the letters scarcely legible. We do not believe any trades can show better writers than those we represent.

◆

AMERICAN LABOR THE BEST IN THE WORLD.

A comparison has been instituted between the work of a European employee and one in the United States. It appears that employees of the cotton mills in England work up 2,914 pounds per annum, and those in Germany from 1,200 pounds to 1,500 pounds, while the operatives of the United States work up no less than 4,350 pounds. The amount of wool worked up in England by each operative averages 1,375 pounds; in the United States, 1,640 pounds; and in Germany, 1,000 pounds. In flax the average is 2,080 pounds for England and 715 pounds for Germany; in silk, 71 pounds for England, 87 pounds in the United States, and 59 pounds in Germany.

It will thus be seen that the operative in the United States works up 100 pounds of cotton to 67 pounds worked up by the English operative, and 27½ pounds in Germany; 100 pounds of wool against 77 pounds by the English operative, and 60 pounds by the German; 100 pounds of silk against 81½ pounds by the English, and 60 pounds by the German operative. It is consequently claimed that, as the American artisan furnishes more work in a given time than the foreigner, he is entitled to the higher wages he receives.—*London Times.*

◆

Doctor Johnson, so the story goes, was once flooding the passengers in a stage coach with his erudition on many topics. All listened in silence, overcome with the great man's learning. But one old tanner, not at all abashed, spoke up and said: "Sir, can you say anything entertaining about bend-leather?" Doctor Johnson was forced to admit that his education in this respect had been neglected, and he could not give any information on the subject.

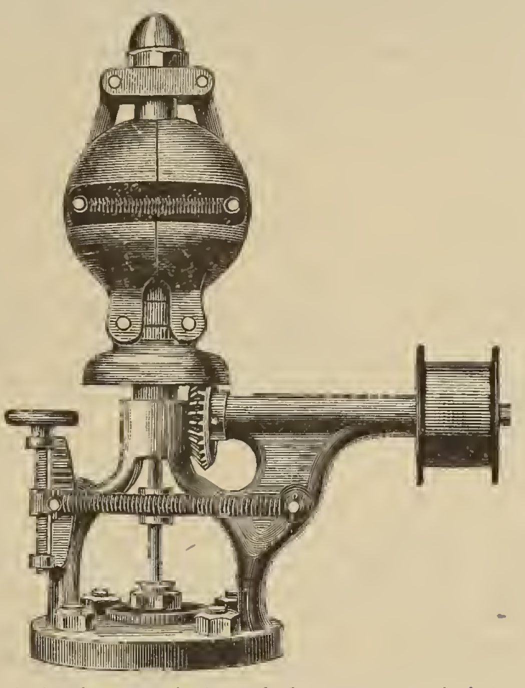
It does not require violent mental effort to see that this applies specially to those who pride themselves upon attainments in any branch they have studied, and would seem to indicate that others may be as well informed as ourselves upon topics they have given attention to. If a man has followed a certain trade all his life and still knows nothing of it, he is open to the charge of ignorance, but a man cannot be said to be ignorant upon subjects he has never given any attention to.

◆

The Electrical Exhibition held in Philadelphia is said to have been a financial success. The management state that all expenses have been fully covered and a surplus remains. In round numbers, the receipts amount to $100,000, of which $90,000 have been paid away in general expenses, leaving $10,000 profit.

NEW ENGLISH GOVERNOR.

The illustration represents a new governor, designed for fast running engines. The centrifugal action of the revolving weight is controlled by the tension of a pair of helical springs which are let into slots in the weights. The action and position of the weights are peculiar. Cast in one piece and afterwards separated, these weights are pivoted at their lower ends, and when closed they envelop the central spindle, appearing as a single ball, but when at work they fly outwards at the top under the centrifugal action, but are controlled by the springs. Each weight is connected by a link to a central cap-piece which slides upon the spindle, and carries the throttle valve.



A further regulation of the governor is introduced, in the shape of the helical spring, visible below the spindle of the driving pulley and bevel wheels. This spring is fixed at one end to the framing of the apparatus, and at the other end to a block in an oscillating link, the position of the block above or below the point of oscillation being decided by the hand-wheel and screw, passing through the spring block. The link is oscillated by the action of the governor, and according as the spring block is above or below the point of oscillation of the link, so does it tend to open or close the governor. When the link block is opposite the point of oscillation the action of the spring is neutral.—*The Mechanical World.*

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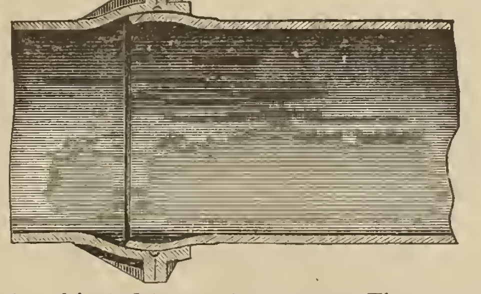
NEW MOVABLE JOINT FOR WATER PIPES.

A new form of water-tight, adjustable joint has been applied to water pipes in England, and found to be entirely satisfactory. These pipes are 35 inches diameter inside, and, therefore, the joint is subjected to great pressure. The engraving explains itself, but we may add that the gland, or follower is, of course, put on in halves. We find this in the *Engineer.*



◆

A Few Weeks Since the *American Machinist* asserted that there was a demand for luminous keyholes, and it urged inventors to supply them. It now appears, from the *N. Y. Sun*, that these fixtures have been on sale for a year past, near the *American Machinist's* office, to wit:

"A Fulton street paint dealer says that luminous keyholes, or keyhole trimmings, have been in the market for a year or more. The keyhole trimmings are made of glass, the back of which is covered with luminous paint. Not only young men of bibulous inclinations buy them, but also men with weak eyes. They shine brightly, and can be seen forty feet away."

Is this what our contemporary needs?

HE STILL PURSUES US!

Annually, for the past four years, we have received this communication through the mail:

"Would be pleased have your terms to insert an Adv. of a New Magazine devoted to Engineering & Mechanics, in your columns. Say 2 inch Space. I was informed the Mech. Engr. had a Special Column which it devoted to inserting a few lines of Advs. of any New & important work gratis.— Give charge for above space anyhow, also what it would be to insert Prospectus. Space ½ Col. of your Journal.— Would also be pleased to have copy of Mech. Engr. ***

Last year when this request came to hand we asked our prospecting friend when he meant to bring his paper out, for we began to have some doubts as to his sincerity. He made no reply, and we thought he was dead, but it seems that he still lives.

Dr. Arnold said:

"There is a tendency in things, under a certain amount of persecution, to rise into greater vigor, as fire burns more brightly under a slight sprinkling of water, but under a sufficient amount of persecution, their repression is as unavoidable as the extinction of the said fire by a sufficient amount of water"

This seems to fly right at our prospecting friend, and we wish he would publish his magazine first and ask us for advertising rates afterward.

◆

A UNIVERSAL TAP.

A firm in this city make a tap which cuts either a right or left-hand thread at will. We saw it in operation, and it is, in appearance, merely four chasers brought to a diamond edge in the center, the same as if a threading tool was moved sidewise. On these chasers the thread is cut the whole length. Between these chasers, equidistant, are four other pieces, called guides, which seem to have threads traced on them about 1-32d deep. The whole tap presents the appearance of a fluted reamer with a thread cut on the edges of the blades. With such a tool as this the operator cut a right and left-hand thread at will in pipe couplings, and the fits were very good. There was no overrunning or dragging of the thread anywhere. From a cursory examination it is not apparent to us why this tool acts as it does. It is used in a common drill machine, and is patented.

◆

EXIT THE BOILER-TUBE POOL.

Last winter a combination of capitalists and manufacturers was formed to work the iron tube market. By controlling production and establishing an artificial scarcity, these men hoped to make as much money as they thought proper, the consumers of their goods being the parties to pay it to them. In some circles, and portions of the country, this tube pool excited alarm, no one being able to foresee the extent of its operations. Manufacturers, who had boiler contracts on hand, were embarrassed, for they had not contemplated any change in prices, and, in a word, the tube pool was a nuisance.

Like the man in the deluge, we did not think there would be much of a shower, during the tube pool's term of existence, and events have proved that we were correct in our surmise. On February 23d we said :

"It is, of course, probable that during the time the pool may be in existence it can create a great deal of hard feeling, and cause much annoyance to boiler-makers, who cannot estimate with any certainty for the future as to prices; beyond this there seems to be no cause for serious alarm, for the fate of all pools, sooner or later in this country, is disintegration from the force of circumstances. Pools have been formed before now in this same commodity, but after a precarious existence went to pieces from internal dissension and want of good faith of the members. We do not believe it possible to harmonize all interests and conditions of manufacture so that each member shall be satisfied that he is getting his fair proportion of trade, or that he can make more by putting his affairs into the form of a joint stock concern instead of managing them himself."

After a "mute, inglorious reign" of about nine months the tube pool is defunct. Press dispatches of the 23d say :

"The National Wrought Iron Pipe Pool, which was formed here last December, was dissolved to-day because of a disagreement over the division of the profits. The Enterprise Iron Works of New York, which are owned by the pool, have been ordered to be sold and the proceeds divided among the members. A general cut in prices is now predicted.'

Sic semper tyrannis!

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Many Persons request that we furnish forms for clubs, as it is a saving in time to them, and is also more uniform in appearance. We have therefore printed such blanks, and will send them to all friends who may desire them.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

SOLID FACTS ABOUT STEAM AND WATER JOINTS

Editors Mechanical Engineer:

Often in practice it becomes necessary to stop leaks temporarily in large steam and water pipes until such time as repairs can be done properly or pipes renewed. When a leak occurs through corrosion, opening of the weld, or other causes, and it is not convenient to renew the defective section, the leak can be effectively and permanently stopped by the following procedure: Take a piece of thin sheet iron, about one-fourth larger than the defective place; curve it to the diameter of the pipe, put under it a piece of Jenkins' sheet packing, the size of the plate, and clamp it tightly round the pipe with an iron yoke. Jenkins' sheet packing has become a great favorite with engineers. It supplies a long-felt want, and it can be used for many purposes where rubber, asbestos, and other packings would not answer.

There are some old fogies who think nothing but a putty joint will answer. This is usually composed of two parts white lead and one part of dry red lead, well mixed to the consistency of thin putty; sometimes layers of wire gauze, or canvas, are put between the patch and the pipe. Another putty, once much used, is composed of four parts red lead in boiled oil and fine iron dust, three parts, or fine cast-iron borings. Most any one can make a tight joint with any packing, if the surfaces are smooth and come together fairly. The thinnest packing is the best and cheapest, being less liable to blow out. Ordinary rubber packing is rotted by oil and acids, which come in contact with it; also the joint bolts, holding the surfaces together, require screwing up occasionally, especially if the joint is subjected to frequent heating and cooling, whereas Jenkins' packing, after the joint is once made and hardened, will, for a long time, remain almost as solid as the metal itself.

When the pressure is off, and things are cool, experienced engineers make it a rule to examine all packed joints and take up the slack, if there is any, by tightening the bolts. This is the proper time to do the tightening, as everything is contracted in cooling off. But there are some who never trouble themselves about leaks until they occur.

If the leak to be stopped is in a cold-water pipe, it is best to heat the plate a little, place it over the packing, put on the yoke, and screw up immediately, while the plate is warm; the result will be a tight job every time. A leak in a water pipe can be as quickly and cheaply stopped in this way as by the old white lead and canvas *plaster* sewed with marlin. Moreover, if the water is used for drinking or culinary purposes, there is no white lead in it to spread disease. When the leak is at the junction of a T, or elbow, or in the fitting itself, the method described cannot be resorted to. Flanges should come together fairly, and never be pulled into line by screwing up the bolts, as it throws an enormous strain on one or two bolts, and is liable to break the flange. Sometimes, in order to bring the flange-faces true, it is necessary to cut crooked threads or slightly bend the pipe, but this should not be resorted to except in extreme cases. A template should be used to drill the bolt holes in the flanges by, so that when the flanges are in position if any two holes coincide the others will be right also. If the surfaces to be packed are badly warped, uneven, or corroded, it will be necessary to use a thick, soft, elastic packing, that will adapt itself to irregularities of surface. If the surface to be packed is very narrow it is sometimes difficult to prevent ordinary packing from blowing out. In such cases it is best to use a soft copper wire with ends brazed together; or else, cut a narrow groove around the face of the flange; the packing will be pressed into it and not blow out. Every separate pipe leading from the boiler should have a valve located in it, as near the shell as possible, with no packed joints between the boiler and valve, if avoidable. The stuffing-boxes and joints should be kept tight, so as to prevent the water of condensation dripping on the shell or masonry.

External corrosion, caused by dampness, is very rapid; boilers located under leaky roofs, water tanks, and in other damp places, have been found badly corroded on removing the masonry.

The days of hemp gaskets and hemp-packed pistons are past; fibrous packing of any kind will not be used long. Metallic packing is gradually taking its place on nearly all our large land and marine engines. An invention much needed is a cheap and simple self-packing arrangement for globe valve stems.

Many who design engines are not practical mechanics with broad experience; therefore they do not bestow sufficient thought and attention when designing, so as to render parts which require frequent readjustment and repairs easily accessible; consequently much expense is incurred and time wasted in making slight repairs, or even repacking unhandy joints. In the shop there are special appliances for setting up new work which are not among the facilities of an engine-room. If some machine designers, who are better artists than engineers, could receive a little practical training in the shop, or engine-room, or had to lie on their backs under some machine a few times, to tighten up a bolt with a crooked chisel and hammer, they would soon entertain different conceptions. Smoke Arch.

Beverly, Mass.

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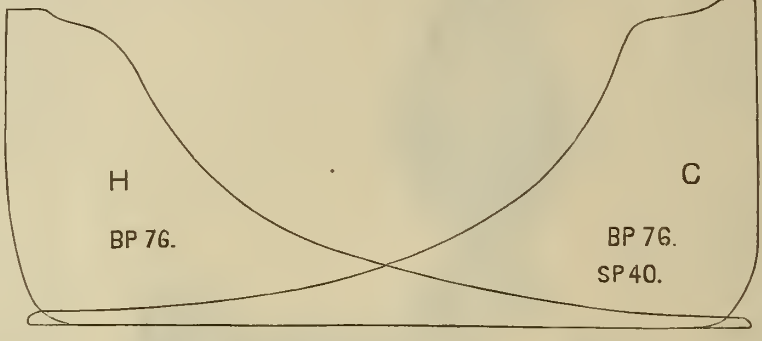
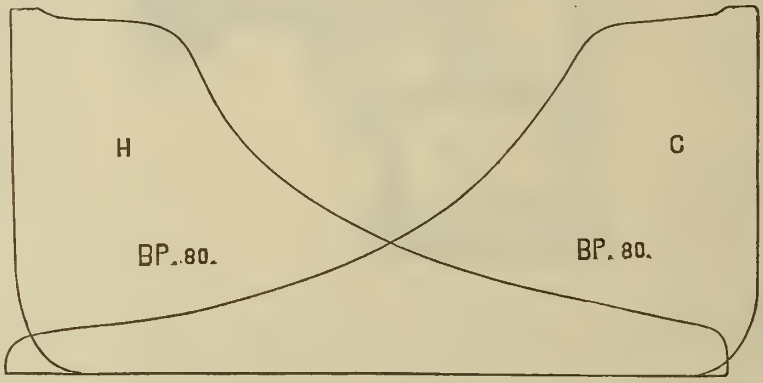
GOOD WORK FROM A HARRIS CORLISS ENGINE.

Editors Mechanical Engineer:

I send herewith some indicator cards taken from a Harris Corliss engine, 16″×36″, which has been running for five years, day and night; the engine was put in with the idea of making two hundred barrels of flour in 24 hours, which it has done with ease; but this season the proprietors increased the capacity of the mill to four hundred barrels, and last week they started the engine and the machinery. The engine was developing 40 horse-power to run the machinery, and on Oct. 21st the mill was put in operation and run at the rate of 300 barrels in 24 hours. The engine developed one hundred and six horse-power, which is pretty good, everything taken into consideration. The steam pipe is about thirty feet long and five inches internal diameter, with three elbows and a globe throttle in it. The opening in steam dome is only four inches, so you will see by the cards a slight deflection in the steam line from initial pressure to expansion curve. This would be obviated if the steam pipe were larger or the speed of the engine a little slower, but with the engine running 76 revs. under existing circumstances, a better card cannot be made.





This cylinder was put on and connected up by the engineer, who does not claim to be an expert, but one of the Western boys, and a solid association man. We have more of the same kind. They are the men who are in favor of a license law, which we will have soon, I hope.

Give us your opinion on the cards. Squeeze hard; we wont kick, for we want to know your opinion. I will bring this to a close and give some other brother a chance to get into the same issue! T. C. Logan.

Atchison, Kas.

[The cards are very good indeed, under the circumstances mentioned by our correspondent. Everything seems tight and in good working order. The compression is not extraordinary, and the valves are set A1. If we saw anything to object to we would not hesitate to state it. The data with these cards is as follows: No. 2 crank-end; boiler pressure, 80 lbs.; revs., 76; spring, 40. No. 7, steam, 76 lbs.; revs., 76; spring, 40.

Cards like these are much better, as examples of engineering ability, than those which look like a fish line snarled up, and which readers are requested to guess the origin of. Such cards are published in some papers, with the inference that they originated in a steam engine, when it appears by subsequent issues of said papers that they are mere charts, taken from the water end of a steam pump, on purpose to play tricks with. That is boy's foolishness, not worthy the attention of engineers.—Eds.].

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A PLEA FOR THE INDICATOR.

Editors Mechanical Engineer:

Oh, for the time when every engineer will want an indicator, know how to use it, and be allowed to apply it to his employer's engines—when indicators will become numerous and cheaper, and every engineer will have one. How long will it be? Just so long as every one who wishes can be an engineer; so long as all engineers are classed alike; so long as there is no general license law; so long as the faithful are classed with the unfaithful, uneducated with the educated, the diligent with the slothful. So long as employers do not hire any but tried engineers, and put confidence in them and their suggestions; so long as the employer knows more about the engines and machinery than the engineer. I call to mind a case where a large firm made some addition to the machinery of their plant. The engine they had would not do the additional work, so they came to the conclusion that the steam-pipe was too small and they put in a new one. All was of no avail. They then put in a new engine to do the extra work. After a short time the old engine failed to do the work it had been doing for years, and upon search they found the governor had become deranged. After adjusting the same everything worked well. Now I maintain that one engine would have done the work if properly attended to. If the indicator had been applied, the trouble could have been located and remedied at once, and saved time and money.

At another time I remember where an engine 8″×16″ was put in temporarily for experimental purposes. It was to run at a speed of 160 revolutions per minute. When started the engine could not be got near the speed wanted. The party putting the engine in said the steam-pipe was too small. This I did not believe. I maintained that the trouble was in the valve (a plain D valve). The foreman of one of the largest machine shops in this section of the State came with his indicator (as he was instructed) and took some cards; he then ordered the valve taken out and ¼″ taken off the steam-lap. After readjustment everything worked satisfactorily.

These are some of the reasons for asking how long it will be before indicators are considered an important part of the engine. Wm. A. Delcamp.

Shenandoah, Pa.

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ASKING FOR INFORMATION.

Editors Mechanical Engineer:

I can hardly call myself an engineer, unless there is such a thing as an engineer "in embryo;" but I am desirous of becoming a first-class marine engineer. To do that of course a mechanical education would be necessary. Now, what would you advise? Would not a course at some school like Cornell be advantageous? I have had a first-class school education, and so far as Greek, Latin, etc., are concerned, am all right; but I do not know what course to take as regards the other idea.

What chance is there of an engineer entering the navy, provided he is competent?

By answering this rather lengthy statement of two very short questions you will oblige one of your subscribers. J. C. C.

Olean, N. Y.

[Marine engineers, as a rule, are made aboard ship, and not in any school. A young man obtains a berth as an oiler, possibly as water-tender only, and from thence works his way up as best he can. Promotion depends a great deal upon circumstances. If some one of the corps leaves, all hands, if worthy, get a lift upward; it is seldom any one is put over the head of another, unless for good and sufficient reasons. This makes rather a long road, unless our supposititious young friend leaves himself, and gets a berth outside upon his own abilities. Experience makes the engineer, and there is only one way to get that. As our correspondent has already a good education he is well equipped for a start—if he leaves the Greek and Latin ashore. These are not very useful aboard ship unless, possibly, to talk to the firemen with when they clean the silver name plates with emery paper!

The Navy is always in need of engineers, and our correspondent will find it a good school—if he wishes to become a naval engineer.

The Revenue Marine is perhaps more desirable for him, and he can obtain all the information he requires by addressing the Secretary of the Treasury, Washington, D. C., making application for a position.—Eds.]

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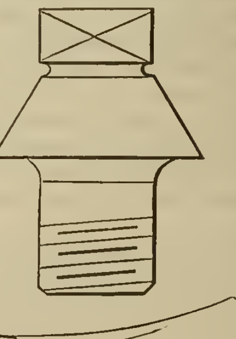
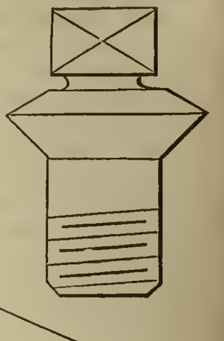
BOLT-PATCHES FOR BOILERS.

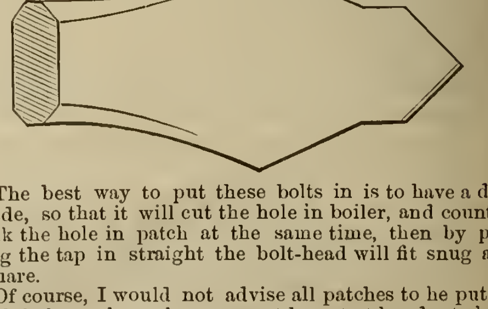
Editors Mechanical Engineer:

In regard to patching, there is no need for soft patches on any part of a boiler. By getting bolts made to fit countersunk hole in patch, the bad place may be cut out and the patch put on with these bolts, and caulked, and be as good, if not better, than if riveted on.

In fact, I have had to cut out rivets that had been put in patches, and put these bolts in, and they made a good job. The holes must be very fair and straight, so that the bolt-head will fit all around, snug, in the countersunk hole in the patch; the head must be caulked to the sheet after the square heads have been twisted off. The bolts ought to be made of best quality of iron.







The best way to put these bolts in is to have a drill made, so that it will cut the hole in boiler, and countersink the hole in patch at the same time, then by putting the tap in straight the bolt-head will fit snug and square.

Of course, I would not advise all patches to be put on with bolts, only such as cannot be got at handy, to hold on the rivets. For instance, the sides or crowns of fire-boxes, where stay-bolts and braces come in the way of holding on, it is better to put bolt-patches on, for rivets are of no use when not held up good and solid, and it is a bad practice to cut too many hand-holes in boilers. If there are braces on the defective piece, I take the crowfeet off and run the tap half through the holes, so I can get a start when the patch is up ; the bolts for the crowfeet should be a little different from the others, as shown in the first engraving.

The holes in patches should be countersunk enough to take the sharp edge off; the bolt-head will jam itself tight up, and can be caulked to sheet.

New York. A BOILER MAKER.

FROM SECRETARY G. G. MINOR.

Editors MECHANICAL ENGINEER:

The following is published for the information of members of the N. A. S. E.

Since the meeting of the National Convention at Baltimore, the following charters have been issued :

Syracuse, No. 2, N. Y., with 41 charter members.
W. H. Acker, Sec'ty, care Empire House.
Wichita, No. 3, Kansas, with 13 charter members.
Ed. C. Smith. Sec'ty, P. O. Box 259.
Zanesville, No. 6, Ohio, with 22 charter members.
James S. Douglass, Sec'ty, care Water Works.

Cincinnati, O. GEO. G. MINOR, Sec'ty.

CREEPING OF RAILS.

Mr. Johnson, of the Engineers' Club of St. Louis, said that on the St. Louis bridge the rails had been known to creep 260 feet in one year, and on the bridge approach 400 feet. This creeping varied with the amount of traffic. On the St. Louis bridge the rails crept in the direction of traffic. These rails were supported from their base. The reason given by Mr. Johnson for the creeping was that the rail, being held fast on the extended ties, is caused to measure its length across the bridge on its extended flange whenever a heavy weight passing over it causes a wave in the rail. This wave has been known to raise the rail between the two trucks of a car three-eighths of an inch, and the creeping has been measured, and at times has amounted to one-half to three-quarters of an inch. If the rail is supported at a place above its neutral axis, the creeping will be opposite in direction to the traffic. This Mr. Johnson demonstrated satisfactorily with a circular track of hickory. There must be some intermediate point, Mr. Johnson argued, at which the rail would have no desire to creep.—*St. Louis Globe-Democrat.*

A great deal of mystery is annually made over this matter, without much cause for it. According to our notion, *if* rails creep it is because they rise from their beds, and do not come down again in the same place. This, repeated many times, would, perhaps, cause some few rails to show evidence of movement.

"FIRST CLASS" AT SEA.

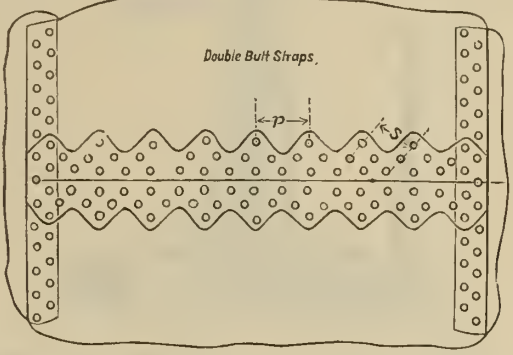
In some of the Liverpool lines a system prevails by which the Captain of the ship contracts for the feeding of the passengers. Naturally, he wishes to make what profit he can, and mistakingly thinks he can do it by skimping the cuisine. But, as a rule, the feeling is bad in a ship managed in this way. If a passenger inquires a little beforehand into the management of the line he proposes to travel by, he will probably find it easy enough to get eatable food at sea. In foreign steamers the food is much better than in most of the English ships. Thus in the great Messageries line not only is the cooking excellent, plain, and simple, but wine at table is provided free of extra charge. Of course, no two French or German ships are quite alike in respect of food; but the average character of it is very far above that of English ships. In some, however, there is a feature which would not accord with the habits of most Atlantic voyagers. There are only two "square meals" a day. * * The fact is that nine out of ten of the people who cross the Atlantic think more of the speed of the engines than of anything else. The foreign traveler, on the other hand, is seldom in a hurry, and thinks a good deal of his comfort.

On some of the Messageries steamers there are no cabins for more than two passengers each, and a whole cabin is to be secured by a single person at a very moderate extra fee. Some of the newer ships of the Peninsular and Oriental and Orient lines have single-berth cabins which, of course, are let at an advanced rate. In some of the foreign ships the Captain is really only the figure-head or ornament. The engineer is the real commander; and the Captain may devote his energies to looking after the bodily comfort of himself and his passengers. * *

But it is seldom, indeed, that the course of regular meals, bad as they may be, is interrupted on an English ship; whereas, in a French, but above all in an Italian steamer, if it is at all rough, no meals are served. The cook, perhaps, is ill; perhaps is frightened. The stewards dare not approach the galley, or if they reached it in safety could not possibly get back carrying a dish.—*The Spectator.*

THOM'S IMPROVED BOILER JOINT.

We illustrate below a new form of boiler joint invented by Mr. John Thom, England. The engraving shows the arrangement so clearly that very few words of explanation will suffice. The lines of rivets form zig-zags or vandykes, and the edges of the covering strip are cut to a corresponding contour, in order that they may not spring away from the plate when caulked. This disposition of the rivets permits of the minimum of reduction of the cross-section of the plate, the number of rivet holes in the outer row, where the plate encounters the maximum strain, being only one-half of that of the inner rows. The joint has a strength equal to about 90 per cent. of that of the solid plate, and by its use a saving of 15 per cent. of the weight of plates can be obtained with equal strength. It has been passed by the Board of Trade for some boilers now building.—*The Engineer.*



STEAM RAISING EXTRAORDINARY.

Much surprise and perplexity were felt by a stoker who had been cleaning out his boiler, that, although he had had his fire lit some time, the pressure gauge showed no signs of movement. The furnace plates did, however, shortly afterwards. They assumed a peculiar form of corrugation, not very pronounced, but distinctly perceptible. The man (probably absorbed in wonder at the unusual phenomenon) shortly afterwards fell over the mudhole cover, and thus stumbled on the cause, for, on making further examination, he discovered not only that the boiler had not been filled with water, but that neither the manhole nor mudhole cover had been put on. On these being fixed and the feed turned into the boiler, all seemed right until the water approached the level of the furnace crowns, when the furnace seams leaked so freely that operations had again to be suspended until the boiler-makers had been called in, a number of rivets renewed, and the "sprung" seams caulked. Fortunately the damage was confined to this, and as the cost of these repairs would have to be defrayed by the boiler insurance company, Bobby's employers did not suffer so much from their man's carelessness or "oversight" as they otherwise might have done. Possibly this may supply a clue as to the reason why so many steam users consider that any man who is strong enough to handle a shovel or rake, and who will work for very low wages, is competent to act as stoker for a steam boiler. We fear it is yet much too commonly held that the principal qualifications for a good stoker are "a strong arm and a thick head," and so long as this is the case and the cheapest labor procurable is considered adequate for boiler stoking, so long "accidents" from stupidity such as the above will continue to be recorded.—*Engineering Review* (*probably taken from some other paper without credit*).

THE *Deseret News* says that a person purchased some potatoes, and, while preparing them, discovered small, bright particles in the water. On examination of the contents of the pan, several large flakes of gold were found. The question that now agitates the minds of many is, where the potatoes were raised.

THE PANAMA CANAL IMPRACTICABLE.

Captain Bedford Pim, R. N., has just returned from the Isthmus of Panama. He views the canal now being cut through it as impracticable, for these reasons :

"As for the canal, all that I can say is that my original opinion of it (which I expressed in France and elsewhere), has not changed after careful examination. The plan of cutting the canal through, so as to have it on a level with the sea, seems to be a preposterous one, as it will be necessary to cut through hills hundreds of feet high, and where as much as eleven feet of water falls in a year. Had a system of locks been adopted the plan could have been carried out, and the canal might have been in operation at this date. But even if we admit the possibility of carrying the plans of M. de Lesseps to a successful issue, at the rate at which the work is now carried on it could certainly not be finished inside of twenty years, dating from to-day. That is a long while from the time set for the completion of the work.

"The carrying on of the work has been attended by the most reckless extravagance in the expenditure of money, and great want of foresight has been shown. No vessel can approach within three miles of the outlet of the canal into the Gulf of Panama, on account of shoals, and all passengers and supplies have to be towed in on scows at great expense. Three million francs have been spent in the construction of a hospital capable of accommodating 700 yellow fever patients. But the hospital is in the midst of the fever, and the sick men are not much better off there than outside. If they could bring some old hulks of vessels up to shore and load the patients on them, they could take them out to sea and give them pure air to breathe, which would cure many of them in no time. Now nearly all die ; 4,000 of the company's workmen have died already, and the death rate now is 109 per 1,000.

"But there is one fact which alone is fatal to the canal. It would be absolutely useless to sailing vessels coming from the Panama side. For eleven months out of the year there is an absolute calm extending 700 miles out to sea from the entrance to the canal, and in order to cross the Isthmus sailing vessels would have to be towed that distance, which is out of the question. Sailing vessels from that side would not use the canal, and the loss thus entailed would prevent its paying any dividends."

THE STEAM ENGINE THE BEST MOTOR.

In an elaborate paper upon "*The Efficiency of Fluid in Vapor Engines,*" published in *Van Nostrand's Magazine* for November, the authors—Messrs. H. L. Gantt and D. H. Maury, Jr., weigh the evidence for and against the various fluids, which have of late years been proposed as rivals of steam in doing the work of the world. We regret very much that we are not able to give this paper in our columns, but its length, for one thing, and its numerous tabulations of performance for another, unfit it for the pages of a newspaper. We make a few brief extracts which serve to indicate that steam has no rival, as yet, and that no other fluid than water is known which will give the same results commercially.

The various fluids experimented with were water, bi-sulphide of carbon, alcohol, ether, and chloroform, and the authors of the paper say :

"The vapor of alcohol gives us 1·4 per cent. more efficiency than steam, and requires a cylinder whose volume is only 0·853 of that of the steam cylinder to produce the same power. The disadvantages of alcohol are the high tension of the vapor, the great danger which arises from the ready inflammability of the hot liquid, and its cost.

"The use of ether would give us a greater gain in efficiency (2·11 per cent.), and would require a still smaller cylinder (0·535 of that of steam), but it is open to the same objections as alcohol, and in a more marked degree.

"The vapor of bi-sulphide of carbon gives a gain in efficiency of 3·71 per cent., and demands a cylinder 0·550 of that of steam. It, however, is not only open to all the objections that have been stated against alcohol and ether, but it has two which are peculiar to itself, viz., its intensely disagreeable odor, and its power of rapidly corroding iron which comes alternately into contact with it and with the air.

"The vapor of chloroform, which gives a gain of 3 per cent. efficiency, and requires a cylinder 0·761, the volume of that of steam, is not open to the objection of inflammability, but it has so high a cost that it is probably impossible that it can ever be used economically in competition with steam.

"All the apparent advantages of the non-aqueous vapors may be gained in the steam engine by an increase of initial pressure ; and, as the tendency of modern practice is in that direction, it seems certain that *none of the non-aqueous vapors will ever successfully compete with steam,'*

THE

Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain, comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-practice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may possibly have chanced on a similar one.

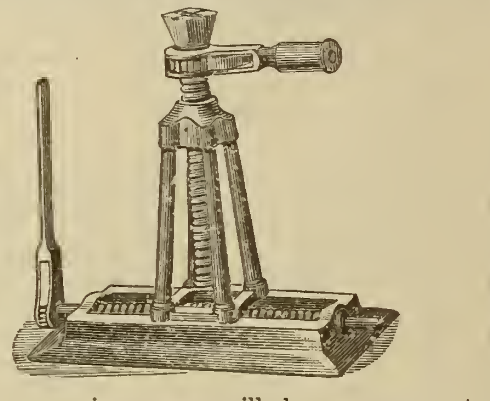
☞ *No matter will be entitled to payment unless the price is stated at the time.*

AN OPEN LETTER.

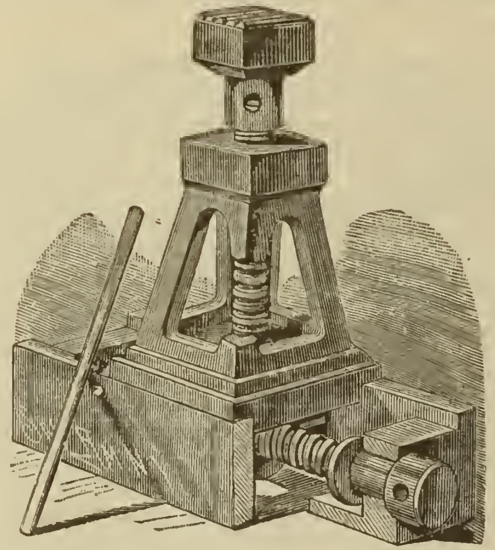
To the Hon. Commissioner of Patents:
Washington, D. C.

DEAR SIR:

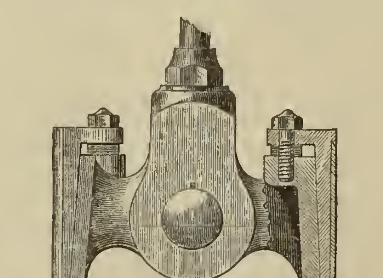
Permit me to call your attention to a few cases of recent issue from your office, which seem to myself and some others to whom they have been submitted, entirely at variance with the law governing the issue of patents. As printed, the statement is therein made that, in order to be entitled to a patent the inventor must have discovered something new and useful, and not previously known in the arts. This being the fact, how is it possible that a patent can be issued upon a device of this character, when it is not new, and has been previously known in the arts? In this special case it is known to me personally for as long back as I can remember. To be exact, covering a period of thirty-five years.



This engraving, as you will observe, represents a carrying-jack, and is now in use everywhere in the United States. It has a vertical screw which is turned by a lever, and this vertical screw is supported on a carriage moved by a horizontal screw, for the purpose of moving any load supported by the vertical screw. This is the machine spoken of in the previous paragraph as having been in use for thirty-five years, more or less.

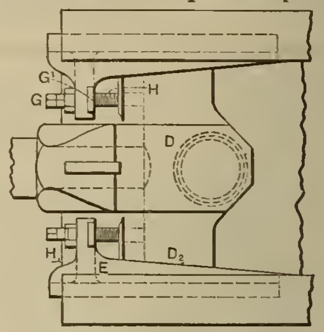


Here is an engraving of a machine, patented, which seems to all who have seen it, including one patent lawyer of experience, identical with the first example. As a practical engineer and machinist, I confess I see no shadow of variation between them in principle or in operation. Essentially and radically they are the same. Will you kindly tell the inventors of the United States, the patentees, capitalists, all and sundry who live by patented inventions, why this patent was issued?



Allow me to cite another instance. This engraving represents a crosshead for a steam-engine, which has adjustable gibs for taking up the wear. It has been in use on steam-engines of the New York Safety Steam-Power Company for fifteen years, possibly longer. In any case it is an old device, and is familiar to engineers as a nut and bolt. It is an obvious arrangement, which is not at all singular in its application.

In the subjoined engraving you will find an example of an adjustable gib for crossheads of steam engines lately patented. Please compare the two devices and see if there is any difference between them, other than that one of the gibs is flat on top while the other is of ogee form. Would this be sufficient to base a patent upon?



I might cite a great many instances more palpable in resemblance than these. I have them under my hand, but those shown are sufficient for this inquiry.

An inventor was recently accused of copying a certain valve gear, which is well known in this country and Europe. His defense was that his invention was not the same, but what he claimed as his invention was a fixed sector on which a block slides, which operated the valve motion. His device is to be seen in the Patent Gazette, and there are many persons extant who were familiar with steam engines before the inventor cited was born; for them it is difficult to understand how such a combination could be covered, for it is—*per se*—one of the oldest agents employed for the purpose named.

An answer is respectfully requested to these queries. It will be read by a large number of persons who are interested in patents and inventions. EGBERT P. WATSON.

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GREAT GUNS.

It is well known that in the matter of ordnance we are far behind other nations. Owing to the "policy" of those who authorize expenditures for this purpose, there is no money forthcoming wherewith to experiment, and all that has been done—judging from the report of the Chief of Ordnance—Gen. Benèt—is to potter with a cast-iron ten-inch gun lined with a steel bush 1″ thick. The report says, in one part: "This converted gun has shown great endurance and very considerable power of penetration. With a view of widening the field for competition as well as of simplifying the construction, the idea was entertained that if a steel lining inserted through the muzzle could be employed, both these ends would be fairly attained, and the cost of conversion be materially reduced. Accordingly, during the past year a 10-inch gun was converted on this plan, the tube—an annealed forging from open hearth steel—being furnished from the Midvale Steel Works. The work of conversion was done at the South Boston Foundry, and after its completion the gun was sent to Sandy Hook, New Jersey, and turned over for trial to the Board for testing rifled cannon. It has been fired 500 rounds, and still remains in good condition, and the Board has pronounced favorably upon this mode of conversion. Bids have therefore been invited this year for furnishing the materials for, and doing the work of converting 50 10-inch smooth-bore guns into 8-inch rifles, by lining, either with a coiled wrought-iron or a forged steel tube, and that plan of conversion will be adopted which presents the greater economy."

"Very considerable penetration" is a curious phrase. No mention is made of the charge employed, or other details given, and the reader's impression is, therefore, that Gen. Benèt himself has little faith in such guns. Alongside of the tremendous modern guns of England and Italy, this bastard 8″ rifle is a popgun, unworthy of attention.

It is one of the disadvantages of a republican form of government, that expenditures for the more efficient protection of the people hang upon the *ipse dixit* of those who know nothing of the subject they are given to consider. If a majority in Congress happen to vote the money, some "ex-

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We have used these engravings before in this volume, but for the special purpose of this inquiry we have ventured to use them again, for which we ask our readers' indulgence.—EDS.

periments" will be made to discover what is already well known, and what other nations have spent millions of dollars to find out.

We cannot even make the material for modern guns at present, for want of facilities, and with plenty of skill and knowledge were obliged to send abroad for it. Gen. Benèt says :

> "The difficulties in procuring steel from abroad, even for experimental guns, makes manifest without lengthy comment the necessity for home production. It is hoped that the very pressing needs of the department, and the difficulties under which it now labors in attempting to secure suitable materials for gun construction, may be relieved through the prompt and energetic action of Congress at its next session. The steel makers of this country will not undertake the production of steel on a scale adequate to our own wants, without the inducement of being fairly remunerated for their outlays, and the importance for immediate action on the part of Congress, for holding out such inducements by liberal appropriations, cannot be overestimated. The truth of this statement is apparent when it is considered that even after ample encouragement has been afforded, considerable time must elapse, say, two years or more, before the requisite plant can be designed, constructed, and set up, and the production of steel in masses of sufficient size and of suitable quality for gun construction can become a practical success. Then the manufacture and test of the experimental or typical guns will require at least two years more, even for the more moderate-sized calibers, before the manufacture of guns in quantity can be proceeded with. It was under a clear apprehension of these facts, and a deep conviction of the importance of saving time, that the department determined to procure, if practicable, the tubes, jackets, and trunnion hoops for the first experimental guns from abroad, hoping in that way to establish a starting-point in the manufacture of steel guns, and thus avoid, so far as possible, the delay that must hereafter inevitably arise when steel shall be procurable in this country, for want of some well-tested and definitely established types of gun construction as standards. Thus far its efforts in this direction have been attended with little success. Nevertheless, it will continue to persist in its purpose, believing that the importance of the object sought fully justifies such a policy. Types of guns of at least 8 and 10 inches caliber, should be fully established by the time that our steel makers are in a condition to furnish the steel required for such constructions, in order that there may be an immediate demand for their products. The steel forgings for the guns now under construction, which the department has been able to procure from American manufacturers—as the hoops, breech blocks, etc.—and whose production came within the capacity of casting plant, are of the very highest quality, and are an earnest of what excellence it may be expected will be attained here under larger facilities for manufacture."

Let us wait until some foreign complication threatens us, and then the back-country Solons, who dictate the present policy, will repent their fatuity.

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RULES FOR SAFETY VALVES.

As we have had inquiry for rules and proportions of safety valves, we give here those generally employed, and the authorities responsible for the proportions.

Rankine's rule for the dimensions of safety valves is :

> "*Multiply the number of pounds of water evaporated per hour by* 0·006; *the product is the area of the valve in square inches.*

The United States Board of Supervising Inspectors of Steam Vessels rule is, half an inch area per square foot of grate surface. The English Board of Trade, and Lloyd's Register, concur. The United States Board of Supv. Insp. also give these data for the construction of safety valves :

1. The distance from center of safety valve spindle, to center of fulcrum, should in no case exceed the diameter of the steam opening of the valve chamber.
2. The length of the lever should not exceed ten times the distance from center of valve, to center of fulcrum.
3. The bearings of lever in fulcrum should not exceed $\frac{3}{4}$ths of one inch.
4. If there are links between the lever and fulcrum, or between the valve and lever, said links should not exceed 4″ in length.
5. All the bearings must be in the same plane, not one above or below the other in any instance.

These are in accord with the best modern practice, and will not lead any one into error, respecting this important appendage.

◆

PERSONAL.

Mr. Frank B. Allen, Supv. and Gen. Agent of the Hartford Steam Boiler and Insp. Company, stopped just long enough in this office on the 27th instant to say "good-by," and that he was on his way to San Francisco to establish the company's business on the Pacific Coast. If any of our readers should encounter Mr. Allen in his struggles they will confer a favor by making it as easy for him as they can. Mr. Allen is an engineer "by birth," to know whom is a liberal education in such matters, and we have taken advantage of his absence to say just what we think of him.

◆

TO PROSPECTIVE SUBSCRIBERS.

The yearly contents of The Mechanical Engineer, if published in book form, would make an octavo volume of 1,240 pages, or about six books of ordinary size. Considering that the contents aforesaid cover all modern discoveries, theories, practice, and actual individual experience in managing engines and machinery of all kinds, it does not seem extravagantly expensive at $2 to an individual, and very much lower (by half in some cases) to a number of individuals. Add to the above that illustrations without number accompany the text, explaining by the pencil and the graver, so that the most untutored can understand the ideas presented, and we think we have an argument in our favor. Certainly, in no other form can so much be obtained for so little. We have not entirely shown how something can be obtained for nothing, but, as the next best thing, we have shown how solid value can be had for comparatively little.

The contents of The Mechanical Engineer include the practice of modern engineers everywhere, not only in our own country, but among all civilized peoples. It is an authentic record of the trades it represents, conducted by men who have formerly been actors in events similar to those chronicled. This experience, on the part of the conductors, is a guarantee of practical value which no other technical paper can present. The proof of the value of said experience is found in the steadily growing influence of The Mechanical Engineer everywhere in the country, during a period of great commercial depression.

These arguments in our favor are respectfully commended to the consideration of those who may be in ignorance of the paper, and its scope, and who see it for the first time. We are now sending out large numbers of sample copies, which will fall into the hands of new readers, and we take this method of outlining our policy to them.

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NOTHING VERY FUNNY.

Many of the daily papers are chuckling over the fact that steel rails are very low. Within the past thirty days they have been sold for $25.50 per ton, and some of our contemporaries seem to find in this an argument for abolishing duties, and making them still lower. The argument is that no manufacturer would sell goods at less than they cost to make, and that if steel rails can be sold now at $25.50 per ton, they could have been sold at said price any time within the past twelve months.

Such puerile opinions as these are hardly worth noticing, unless it be to make a point which, perhaps, more sensible readers and writers have overlooked, to wit: that the decreased price is partly borne by those least able to bear it—the actual makers of the rails, the men who cast and roll the ingots. Their wages have been reduced to a bare living; scarcely that in some instances. We do not see anything to make merry over in this. We observe that when wages are lower less goods are purchased all round.

We all suffer alike. In this country interests are mutual, and the butcher, the baker, and the candlestick maker are in one boat. If the ironworker has his pay cut down, all tradesmen feel the shrinkage as well. The loss is not confined to the men who are docked. It may be that free trade would change all this. We think it would. Not perhaps in the way that free-traders imagine, but in a way that every man on this continent would understand promptly. Instead of half a loaf we should have no bread at all, and what that means let essayists imagine—they could not describe it. We have held the opinion that when goods were scarce labor was in demand ; that when the markets were flushed all of us had to go and sit down awhile, but from the free-trader's point of view the more manufacturers there are to supply the market, the greater will be the demand for labor! This is political economy with a vengeance.

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The Result of the latest investigations by Prof. William A. Rogers, gives the length of the meter as 39·37027 inches.

THE PISTON-VALVES OF THE AMERICA, SS.

A paragraph in a daily paper stated recently that the English steamer *America,* whose fine performance this summer has excited so much interest, was to be hauled off for repairs and alterations, which will add materially to her speed. If this refers to changes in the valve gear, it will, doubtless, add to her speed by omitting the delays it has caused. A gentleman who came over in the *America* informs us that the piston-valves were constantly giving out, necessitating, in one case, five stoppages during one voyage, and in one instance extending over eight hours. Our informant states that there are packing rings in the piston-valves which are improperly made, in that the rings catch on the ports in traveling over them, with results that engineers and machinists understand.

We may remark here, that it is almost impossible to get any information in regard to English steamers and their performances; it is not to be had from the engineers, at any rate. The contrast in this respect, between English and American chief engineers, is very marked. From our own countrymen we have never received anything but courtesy, and an entire willingness to give all information, whether it is for or against them, but we have yet to get inside of the engine-room door of the first English steamer, while a request for information was, in the instance of the *Oregon* at least, uncivilly declined.

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SOMETHING ABOUT METALLURGY.—Number VII.

By Norman W. Wheeler.

The puddling furnaces most in use on the Atlantic slope are fired with anthracite coal burned with fan-blast pressure, and are double, having a working door upon each side, so that two puddlers can work at the furnace at the same time.

The general form of the furnace is much like the heating furnace to be seen at any forge, or blacksmith's shop, where they use a steam or tilt hammer. There is a fireplace at one end; the flame passes over a bridge wall into a reverberatory chamber with doors at the sides, wherein the puddling is carried on in a puddling hearth; a "neck" or narrow passage leading to the uptake, and usually a boiler set in brickwork over the furnace, under which the gases pass to the chimney. This has a damper at its top, worked by a chain leading to a place within easy reach of the puddler. The bottom plates are of cast iron $1\frac{1}{2}$ to 2 inches thick, and the basin to hold the charge is made up, bottom plates and wind boshes going across the furnace, with corner boshes so disposed as to make the bottom or basin, approach the octagonal form.

A wind bosh is a hollow casting, connected by pipes to the main blast-pipe, so that a part of the blast will go through the bosh to keep it cool. A water bosh is a hollow casting connected by water-pipes to a water-main with a considerable head, so that water is constantly flowing through the bosh to keep it cool.

The corner boshes of the basin are usually composed of wind boshes surmounted with water boshes, and the fire-plates and breast-plates under the doors are left bare—but cinder hardens or chills upon these plates, and affords partial protection from the heat. The door-frames are, in fact, water boshes. The working doors are lined with fire-brick, lying upon levers, for convenience of opening, and have stopper-holes notched in their lower edges to admit rabbles, and other tools, to the hearth. Tongs are slung by chains, to command the working doors, facilitate the lifting in of the charges and lifting out of the balls, and placing them in buggies, upon which they are drawn to the squeezer.

To prepare the furnace for work, rough walls of Champlain ore are built up against the boshes around all sides, except under the doors. Then the bottom plates are covered with slag from the hammer or squeezer, to the depth of about two inches. This squeezer-cinder consists of ordinary top-cinder—a complicated mixture of silicates of iron—and peroxide of iron, or scale. The fire is started and a strong blast put on, but the fire is kept thick at first, to give off a carbonizing flame and reduce the cinder to a pasty mass. If the flame be made strongly oxidizing at first, the cinder would be oxidized one or two degrees and become what the puddlers call "bull dog," which is too refractory to be softened so as to spread evenly over the plates. After the cinder has been softened and spread evenly over the plates, the blast is increased to give an oxidizing flame, which hardens the ball. Then a charge of 500 to 800 lbs. of scrap wrought-iron is put in the basin or hearth—the scrap from wire mills or washer factories being preferred. The blast is now made very strong, so that an excess of air comes through the fire, rendering the flame strongly oxidizing. When the scrap becomes hot it is separated into balls, loosely compacted. The damper is now raised to make a strong indraft at the stopper-holes, and a ball of scrap is held up in the indraft on a rabbling hook, so that the flame and air may permeate the mass and burn away the iron, the resulting oxide of iron falling upon the hearth. This burning of wrought-iron reinforces the natural heat of the furnace so much as to cause the fusion of this cinder nearly down to the bottom plates.

When the scrap is nearly burned and melted away, and what is left has become so compacted as to bar permeation of it by the flame, the temperature of the furnace falls, the bottom is rubbed down as evenly as possible, and the furnace left to chill.

This operation is repeated two or three times, to get a very refractory layer of bull-dog cinder about three inches thick, when the bottom is considered made and the furnace ready for a charge.

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THE PROFESSOR IN THE MACHINE SHOP.

Number 68.

The ultimate destiny of a good many of us who get our bread out of machine shops is to take charge of one, but how many of us are willing to fit ourselves for such work? I think, calling to mind all the men I have talked with, and all the confidences which have been made to me, that but few of us who entertain the ambition mentioned, have any idea as to what our duties should be. A goodly number feel that in order to take charge of a shop it is only necessary to "boss" the men around, and to some this is the end and object for which shops and foremen were created. I do not think persons with such views ever succeed. I am sure that, in our shop, any one who undertook to boss the people in it would soon experience a change of heart. In old times as I remember (I call old times about 1850), the foreman was a bigger man than the actual proprietors. Many a time have I known the foreman of that period tell the proprietors that certain things could not be done, merely because he did not take a notion to do them. His great strength—the old-time foreman's—consisted in being able to walk up and down the shop imposingly, and to speak severely to every one, except his favorites. But men of this stamp have gone out with the wooden rule, and good riddance of them.

The modern foreman is a very different man, and those who fill such places in the best shops are capable of much higher stations. What is a foreman but a deputy proprietor, the man who stands for him, whose money he handles and whose time (the same thing as money) he apportions? The foreman is the proprietor by deputy, and should, of course, be deferred to. It is not always that the right man gets into the right place, though, by any means, for I recall now that I had occasion to go to a large Eastern machine shop some years since, and the foreman was the man I had business with. I got over to the shop about half-past eight, for I wanted to give the foreman a chance to get the morning's work off his hands before I took up his time. The foreman had not come at half-past eight, but at nine o'clock he was in his office—smoking a very yellow cigar—where I found him after much search. This concern employed about 400 men, and I am pleased to know that our friend soon disappeared—with his yellow cigar.

I said the foreman was the deputy proprietor, and I guess this is so, for if the foreman cannot bring to naught all the proprietor's schemes, there is no man about the shop who can. How many ever think of what work is costing to produce? Very few. Not many foremen like to go up to laggards and say: "John, you are too long over that job. You are making time on it. You are spending $6 worth of work on a $3 job, and some one is losing money by it." Not many foremen like to do this, for fear that it will make them unpopular with the help; but as I look at it, a foreman is not hired for his popularity, but for his executive ability. True, one hinges upon the other, in a certain sense, for an unpopular foreman can be hindered by his help in a thousand ways, but if a shop has to be run on the personal magnetism business I know one man, or some men, who are going to lose money, and these are the parties who own the business.

The curse of every shop run on the personal magnetism plan is favoritism. How often have I seen and suffered by this! John Smith ran a big lathe, right behind the foreman's desk, and as I remember, that lathe was worth about $2 a day to the bosses. It used to be a byword in the shop as "a soft thing." John Smith was the foreman's "henchman"—deputy foreman—and he ran what speed and feed seemed good to him. To be just, John, in the main, meant to do right, but the foreman spoiled him by coddling him. Jack Bailey was another favorite; he ran a planer, and many a time have I seen him sitting fast asleep on a nail keg, in a summer afternoon, while his tool ran by the work six inches on each end, and took only one tooth feed. The "boring-mill fiend," as we used to call him, was another; let him alone for squaring up brasses, and taking a long time to do it! He would face the flanges, and let the tool run so long over them that it squealed, and the rays caused by the chattering shone like a little sun. When this happened he would look slyly around the shop, to see if any one observed it, shut one eye in a tremendously expressive way, and screw up on the cutter very moderately indeed. He used to say cast-iron was the best for boxes—brass was no good—"for you couldn't face the flanges with a boring bar without making chatters in them." What he really meant was that you couldn't loaf long enough over them. The foreman never saw any of these instances I have mentioned, but he was sharp enough in other cases of delinquency.

As I have previously remarked, few men in charge of works like to go to the help and point out that they are slow, or a long time at it. They compromise, and salve their consciences by laying such men off indefinitely, at the first chance. It seems to me, though, that if I were in charge of a shop where there were "sogers," that I would take a good opportunity and try to show such parties that they were only fooling themselves, and were the real sufferers. I think I would point out to them that trying to beat the boss by loafing and making a job last a long time, was the best invitation to be discharged that they could offer me. A man who habitually 'sogers" over his work is, of course, a nuisance, to be got rid of on the first occasion, but one who in good times, and with plenty of work on hand, deliberately seeks to delay it by not doing the best he can, is a fraud, and a very short-sighted one at that. He does not consider that his superiors can tell, without going near him, what he is about; that the very bend of his back, or the sound of his machine betrays him, and that there is little to choose, so far as principle is concerned, between him and the man who says: "Stand and deliver" in the highway.

Some shops run themselves, but how, and why? For the simple reason that the foreman is a man who understands human nature, and his business at the same time. He has, by gradual elimination, weeded the shop of all useless men; he has systematized the work so that each one knows what is expected of him, and does it without any coercion or bossing of any kind. Every man in such a shop runs his lathe, or his planer, precisely as if it was his own machine, and his own business, by which he earned his bread; as in truth it is. The casual observer coming in is struck with the earnestness and intentness of the men, and he carries away—if he is an old-time man—an impression in his mind that here is a new order of things which he has not yet learned.

The idea that a machinist is to undergo penal servitude, have his personal feelings abused, and his manliness outraged by some one in brief authority, merely because he is working for wages, and for hire, ought to be abolished in these days. Yet some shops are literally penal institutions. If a man takes service in them because he and his must have bread, he is outraged continually, and he stays only so long as he is compelled to. All shops are not like this, for I know of a great many, in various parts, where the foremen understand that dirt is loss, that want of proper conveniences is a loss, that abuse of any-one is a greater loss than all the rest combined—a loss of personal dignity and self-respect.

Let us be sure before we seek to take charge of shops, that we know what we intend to do, and then find the best means of doing it. It is not a berth to be envied by any means, for the prospective foreman must bear in mind that he is between two fires—the owners and the help, and that he must be sure he is right, in all cases, before he goes ahead. If he says a thing he must have reason for saying it, and if he makes an assertion, or a promise, by all means fulfill it. If he tries to serve two masters—the help on one side and the proprietors upon the other—he is sure to fail with both, and the only course to be pursued is a conscientious, straightforward, strictly honest, and sincere policy toward all.

Such a foreman as this is a priceless man.

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CONCERNING THERMAL LAWS.

Without a knowledge of thermal laws the engineer engaged in the construction of heat motors, whether they be the steam engine, the gas engine, or the hot-air engine, or engines depending upon the expansion and contraction under changes of temperature of fluids or of solids, will find himself groping in the dark; he will not even understand the value of his own experiments, and, therefore, will be unable to deduce laws from them; and if he make any progress at all, it will not guide him with certainty to further development, and it may be that he will waste time and money in the endeavor to obtain results which a knowledge of thermal science would have shown him were impossible. Furnished, however, with this knowledge, the engineer, starting with the mechanical equivalent of heat, knowing the utmost that is to be attained, and starting with the knowledge of the calorific effect of different fuels, is enabled to compare the results that he obtains with the maximum, and to ascertain how far the one falls short of the other. He sees, even at the present day, that the difference is deplorably large. He further sees, in the case of the steam engine, that which the pure scientist would not so readily appreciate, and that is, how a great part of this loss is due to the inability of materials to resist temperature and pressure beyond certain comparatively low limits; and that unless some hitherto unsuspected, and apparently impossible improvement in these respects should be made, the maximum of useful effect must be far below that which pure science would say was possible. Nevertheless, he knows that within practical limits great improvements can be made; he can draw up a debtor and creditor account. Furnished with such an account, the engineer is able to say, "I am debtor to the fuel for so many heat units; how do I discharge that debt? Usefully I have done so much work, converted that much heat into energy. Uselessly I have raised the air needed for combustion from the temperature of the atmosphere to that of the gases escaping by the chimney." He sets himself to consider whether some portion of the heat cannot be abstracted from these gases and be transmitted to the incoming air. As was first pointed out by Mr. Anderson, he will have to say a portion of the heat has been converted into energy in displacing the atmosphere, and that (so far as the gaseous products of the coal are concerned) must be put up with.

He will say, "I have allowed more air than was needed for combustion to pass through the fuel, and I did it to prevent another source of loss—the waste which occurs when the combustion is imperfect;" and he will begin to direct his attention to the use of gaseous or of liquid fuel, or of solid fuel reduced to fine dust, as in these conditions the supply may be made continuous and uniform, and the introduction of air may be easily regulated with the greatest nicety.

He will say, "I am obliged to put among my credits—loss of heat by convection and radiation, loss by carrying particles of water over with the steam, loss by condensation with the cylinder, loss by strangulation in valves and passages, loss by excessive friction or by leakage;" and he will steadily apply himself to the extinction or the diminution of all such causes of loss.

It is due to the guidance of such considerations as these that the scientific engineer has been enabled to bring down the consumption of fuel in marine engines to less than one-half of that which it was but a few years back. The daily consumption may have been even greater; but it arises from this: that the traveling public will have high speed, and at present the engineer has not seen how to obtain high speed without a large expenditure of power.—*Sir F. Bramwell.*

DWELLING HOUSES THAT ARE PALACES.

Modern dwelling-houses are palatial in all their appointments and belongings. A recent example in this city is the *Dakota*, which is described herewith :

The building is about 200 feet square and 10 stories high, the two upper stories being in the handsome mansard roof, which, with its peaks and gables, surmounted by ornate copper work cresting and finials, and relieved by dormer and oriel windows, gives the entire structure an air of lightness and elegance. The construction is of the most massive character, the brick and mason work being in some places four feet thick, and the partitions and flooring have iron beams and framing, filled in with concrete and fireproof material. * * *

From the ground floor four fine bronze staircases, the metal work beautifully wrought and the walls wainscoted in rare marbles and choice hard woods. There are four iron staircases and four elevators extending from the cellar to the kitchens and servants' quarters in the upper stories, separate from the rest of the house. There are electric bells to each elevator, and a complete system of electric communication throughout the house.

Opening from the lower court, and extending under the open ground in the rear of the building, is a large vault 150 feet long, 60 feet wide, and 18 feet deep. This will contain the steam-boilers, steam-engines, &c., for hoisting, pumping, &c., and the dynamos for supplying electric illumination. The vault will be roofed with iron beams and brick filling arches and made flush with the land in the rear of the building, 225 feet deep, which will be laid out as a garden.

The first floor contains the dining-rooms, which are finished in a perfect manner. In this case these words really mean something. The floors are of marble and inlaid. The base of the walls is of English quartered oak, carved by hand. The upper portions are finished in bronze bas-relief work, and the ceilings are also quartered oak, beautifully carved. The effect is that of an old English baronial hall, with the dingy massiveness brightened and freshened without losing its richness. The effect is heightened by a large Scotch brownstone engraved fireplace, which ornaments the center of the room. The business office has oral communication with every portion of the house, and the wants of the tenants can be attended to as quickly as can be done by human ingenuity and a perfectly arranged service.

The plumbing and hygienic arrangements are equal to anything of the kind in this country. On the top story are six tanks, holding 5,000 gallons of water each, supplied by steam-pumps having a daily capacity of 2,000,000 gallons; about 200 miles of pipe have been used in effecting circulation. The comfort and convenience of guests will be further insured by the accommodations of the dining-rooms, laundry, and barber's shop, run on the most improved plan, in connection with the building. It is the perfection of the apartment style of living, and guarantees to the tenants comforts which would require unlimited wealth to procure in a private residence. The wisest precautions have been taken to insure freedom from the ordinary cares of the household to the fortunate tenants. Coal and kindling wood are purchased by the manager in large quantities and sold to the tenants, who take in exchange for their money tickets, which are presented at the office, and the fuel is carried to their rooms in convenient quantities, thereby saving the user from any of the necessary troubles in buying and storage. This may seem like a small matter, but it is only one of the hundred plans taken to secure the comfort of the tenants.

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THE *Burgos*, a new English steamer with triple expansion engines, is said to carry 2,500 tons, dead weight cargo, on $8\frac{1}{2}$ tons coal per day at nine knots per hour.

ON THE DEVELOPMENT OF THE THEORY OF THE STEAM ENGINE AND ITS APPLICATION.

The theory of the steam engine, like every other scientific system, rests upon a foundation of facts ascertained by experiment, and of principles determined by the careful study of the laws relating to those facts, and controlling phenomena, properly classed together by that science. Like every other element entering into the composition of a scientific system, this theory has been developed subsequently to the establishment of its fundamental facts, and the history of progress in the art to which it relates shows that the art has led the science from the first. The theory of the steam engine includes all the phenomena and all the principles involved in the production of power, by means of the steam engine, from the heat-energy derived from the chemical combination of a combustible with the oxygen of the air acting as a supporter of the combustion. The complete theory therefore includes the theory of combustion ; the consideration of the methods of development and transfer, and of losses of heat in the steam boiler ; the examination of the methods of transfer of heat-energy from boiler to engine, and of waste of heat in this transfer, and, finally, the development of mechanical energy in the engine, and its application, beyond the engine, to the machinery of transmission, with an investigation of the nature and method of waste in this last transformation.

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Of all the heat sent forward by the steam boiler to the engine, a certain part, definite in amount and easily calculated when the power developed is known, is expended by transformation into mechanical energy; another part, equally definite and easily calculated, also, is expended as the necessarily occurring waste which must take place in all such transformations, at usual temperatures of reception and rejection of heat ; still another portion is lost by conduction and radiation to surrounding bodies ; and, finally, a part, often very large in comparison with even the first and principal of these quantities, is wasted by transfer, within the engine, from the induction to the eduction side, "from steam to exhaust," by a singular and interesting process, without conversion into useful effect. The science of thermodynamics only takes cognizance of the first, which is sometimes one of the smallest of these expenditures. The science of the general physics of heat takes cognizance of the others.

The science of the phenomena of the steam engine must, like every other branch of applied science, be considered as the product of two distinct processes of development ; the one is what may be called the experimental development of the subject, the other is the purely theoretical progress of the science. So far as the useful application of principles to the perfection of the machine is concerned, the latter has always, as is usually the case elsewhere, been in advance of the former in its deduction of general principles; while, as invariably, the former has kept far in advance, in the working out of practically useful results, and in the determination of the exact facts where questions of economic importance have arisen.—*Thurston.*

SOAP.

The accurate history of the manufacture of soap stretches back to the factories built at Marseilles, when there was an apparent recognition of the principle of saponification. Neither then nor until centuries later, however, was there any desire to understand what the principle was, and for many years every effort to wrest the secret from chemistry and make soap-boiling an art was fought by manufacturer and workman. Some facts about the manufacture of soap in England were recently given a *Times* reporter by a gentleman thoroughly conversant with the business. The art as carried on in this country employs similar materials in a like manner, the principal differences being that United States manufacturers have better machinery, make a greater variety of soap, and for commercial reasons use certain substances more largely than do the English. More soap is produced in England, however, than in any one country.

Olive oil formed the basis of soap before the art was introduced to England, and is used there in large quantities now. Three kinds of this oil come to market. The finest is salad oil; the second grade is obtained by greater pressure of the berries with boiling water, and the third by boiling the pulp remaining from the second grade. The third grade is used in soap manufacture. Tallow, obtained from English, Russian, South American, and Australian sheep, is largely used, after first being "rendered," or separated from the tissue with which it is connected. French manufacturers use lard. Palm oil is used more extensively in England than any other fatty substance. As it comes to the market the oil is a deep orange-red, and has to be bleached with chromic acid, or by some other process, before being used. Cocoanut oil is used extensively in the manufacture of mottled soap, and enormous quantities of it are also consumed in the factories in the north of England. Soap made from it leaves an unpleasant odor on the skin. Castor oil, which is also used as a soap material, is obtained from the East and West Indies, and also from the United States. Bone grease, horse fat, fish oils, "Yorkshire fat"—obtained from the greasy washings of fulling mills—and "kitchen stuff"—the product of kitchen waste—are also used in soap-making, as well as such vegetable oils as cotton seed, poppy, hemp seed, linseed, rapeseed, etc. The alkalies used in soap-making are soda and potash. Caustic soda is used in the making of hard soaps, and caustic potash in making soft soaps. The potash used in making soft soaps is largely exported to England from this country. Silicate of soda is one of the most common and successful alkaline adulterants used in soap-making. China clay or kaolin and sulphate of soda are also used in some of the cheaper soaps.

The apparatus employed in an ordinary soap factory is simple and not very expensive. It consists of a series of iron kettles set in frames of brickwork with fireplaces beneath, or steam-pipes running into the kettles from above, according to the method in which heat is to be applied; also tanks for preparing the lye, ladles, pumps, machines for molding or cutting the soap, etc. The lye-tanks are simply large vessels made of heavy wrought-iron plates, or of brick. In the preparation of the lye a layer of freshly-burned lime is placed on the bottom of the tank and a little water thrown upon it. Over this layer is then placed one of soda ash of equal quantity. Alternate layers of lime and ash follow until the tank is full. The contents of the tank are then flooded with water, which, after standing 15 or 16 hours, is drawn off from the bottom, strongly impregnated, of course, with the caustic. Successive flooding and drawing-off follow, until the filterings become too weak to be of any use. Caustic potash is prepared in the same way except that 80 parts of lime to each 100 of po ash is used.

Castile soap, which is made from olive oil, is the best known soap. The pure or white soap is made from pure olive oil and caustic soda. It is used in making liniments, plasters, etc., and in pills, and in this country to some extent as a toilet soap, and wherever a pure soap is desired. The mottled reddish castile soap has in it linseed, poppy and hempseed oils, as well as olive. In the manufacture of castile soap great care is used that the oil and lye be mixed in the proper proportions. For each 100 pounds of oil 54 pounds of lye, of 36° Baumé is required. The lye is first run into the pan, and when it begins to boil the oil is added. The boiling is kept up 18 or 20 hours, lye being added from time to time as evaporation alters the proportions given above. When the fatty matter in the pan is "killed" or neutralized, a large amount of water from the spent lye remains in the combination. To effect this separation, or "cut" the soap, common salt is thrown into the pan. Under the influence of the salt the soap separates from the lye and gathers in clots upon its surface. The mass is then allowed to cool and the lye drawn off at the bottom of the pan. Fresh lye, too strong to dissolve the soap, is then added to finish the coagulation or "close" the soap, and the whole is gently boiled. This lye may lose part of its causticity, indicating that the neutralization of the fatty matters is not absolutely perfect, and until that condition is reached the soap is not "finished." When the lye retains its causticity the saponification is known to be complete. The soap yields an odor resembling violets, and feels scaly when pressed between the fingers. Three pounds of olive oil will yield five pounds of the red castile soap known to commerce as Marseilles soap.

Mottled soaps are made by treating the soap, after being finished as described above, with lye, and not eliminating it entirely from the soap. The result is a deposit of mineral salts in the soap, which gives great variety of colors, varying from black and green to light red.

Yellow or resin soaps are very pleasant for washing the skin, and possess high detergent qualities. The resin is introduced after saponification is complete, and varies from one-third to one-fourth the weight of tallow usually used in this kind of soap. Cocoanut oil soap is more soluble in saline waters than any other soap. It is used largely on shipboard, and is known as "marine" soap. Its offensive odor is the only objectionable feature about it. The method of making this and most other hard soaps is similar to that employed in the manufacture of castile. What is known as the "cold process" in the manufacture of soaps has for its object the saving of time and money to the manufacturer. Tallow is melted at as low a temperature as possible and then saturated with cold lye. The mixing is performed by mechanical means instead of boiling. The process has been mainly employed in the making of the cheaper kinds of toilet soap in small quantities.

Until quite recently there was an excise duty on soap made in England, and any attempt to cheapen the article was resisted by the authorities and even made a criminal offense. Nothing was permitted to enter the soap except fats, oils, lyes and salt, there being a heavy duty on the latter. Excise officers were always on the premises during working hours, and locked up the pans when the factories closed at night. But with the abolition of the duty came various methods of cheapening soap, many of which are now in use. Among the substances used for this purpose are sulphate of soda, which gives soap an artificial hardness and makes it last longer; silicate of soda, or soluble glass, which is used more extensively than any other substance, and has high detergent properties of its own; potato flour, fullers' earth, and kaolin. Disinfecting soaps are intended, as the name implies, to disinfect and deodorize as well as cleanse. Chloride of soda is used as the disinfecting element.

Soft soaps, which are usually made and employed in this country in the rural districts for laundry work, are used largely in England for dressing woolen textile fabrics. Potash lye is used, and, unlike soda lye, remains in the soap. The fatty matters are animal and vegetable oils. The animal are chiefly whale, cod, seal, and tallow, and the vegetable olive, hempseed, linseed, etc. As in the manufacture of hard soaps, the alkali and fatty substances are boiled together, the aim in making soft soap being to effect a perfect combination of the two chemicals.

Toilet soaps constitute a separate branch of the soap boiler's business, and their manufacture is often carried on alone. It is also made largely by perfumers, who buy soap of boilers and remelt, perfume, and tint it. The coloring matters used include vermilion, red lead, ochre, and various matallic oxides. Essential oils or perfumes of various kinds are used for imparting the delicate odors to the soap. Among the curious toilet soaps made is "lettuce soap," in the preparation of which lard in which lettuce leaves have been boiled until they have parted with their color and juice is the principal article. Soft toilet soaps are made of potash lye and lard. Liquid soap, or "essence of soap," is made by mixing solutions of soap in warm alcohol and perfuming it. Transparent soaps are made of choice toilet soaps boiled in alcohol. —*N. Y. Times.*

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CRUCIBLE CAST STEEL.

By Mr. Henry Seebohm.

The converting furnaces in use in Sheffield vary in size, some holding as much as 30 tons of iron, and others not more than 15 tons. The iron gains slightly in weight by being converted into steel. The process occupies about three weeks, and a pair of pots may be used from 20 to 40 times before they are worn out and have to be replaced by new ones.

As in every other process connected with the manufacture of steel, in the process of conversion it has to run the gauntlet of many perils. Sometimes the pots crack; air is admitted to the furnace; the charcoal is burnt, and in bad cases, even the iron is oxidized. Bars which have thus missed conversion are technically said to be "aired;" and even when very slightly affected, may easily be discovered, in consequence of their having almost lost the tendency to become rusty. If the furnace be raised to too high a heat the surface of the bars will melt, and when they are drawn it will appear "glazed." There are even instances handed down by tradition in Sheffield of unskillful converters, who had heated the furnace under their care to such a degree that the whole mass of iron and charcoal had become fused together, and the end of the furnace had to be taken out to remove the contents.

During the process of conversion the outside of the bar of iron is turned into steel the first, and in a spring heat the center of the bar remains iron, though when the bar is broken the crystals of iron have lost their brilliancy; in technical language, the bar is said to be full of "sap," though the sap is "killed" and no longer looks "raw" or "stares."

In a country heat the sap is still more killed, and the crystals of steel on the edges have become more distinct.

In a single-shear heat the fracture shows more steel on the outside and less iron in the center, until in a double-shear heat the fracture shows about equal proportions of iron and steel. It is important that the transition from one to the other should be as gradual as possible. When the line of demarkation is violent or sudden, the process of conversion has been carried on too rapidly, and bars of blister steel so converted are said to be "flushed."

In a steel-through heat, as its name implies, all trace of iron in the fracture has been lost sight of, but the crystals of steel are small.

A short time longer in the furnace will make the steel a melting heat; the crystals will be large, and in exceptional cases their facets will reach across the bar.

The melting furnace consists of a row of oval melting holes large enough to contain two melting pots, one in front of the other, and deep enough to allow of sufficient coke to cover the lids. From each melting hole a flue leads in old-fashioned furnaces into a flat stack, each hole having a separate flue in the stack, but many furnaces are now made with short flues from each hole leading into a main flue, which ends in a single square chimney. The application of gas to the melting of steel has been successful, but for the highest qualities coke is principally used, as the control which the melter has over the temperature of each pot, which sometimes requires "keeping back" and sometimes "hurrying on," is supposed to be more absolute. There can be little doubt, however, that the adoption of gas-melting furnaces is only a question of time.

The furnace floor is on a level with the top of the melting holes; and the grate bars, as well as a flue leading into the chimney by which the draught may be controlled, are accessible from the cellar.

The pots in which the steel is melted are generally made in a room adjoining the melting furnace. They are composed of a mixture of Burton and Stannington clay, to which is sometimes added a proportion of Stonebridge clay, and if the pots are required to stand a great heat, of china clay from Devonshire. A small quantity of ground coke as well as of old pots ground is also added. Great care is taken that the clay be absolutely disintegrated and perfectly mixed together. This is accomplished by treading it in a trough, the pot-maker and his assistant kneading it with their bare feet. The pots are molded in an iron "flask" by means of a wooden "plug," and are slowly dried at the back of the stack; and the night before they are used gradually heated to a dull red heat, a process called annealing. Pot-making is a very important part of the manufacture of best cast steel. It is absolutely impossible to make good cast steel if the pots are defective. Each pot lasts a single day, and is used three times, containing severally about 50 lb., 44 lb., and 38 lb. of steel each round. The object of lessening the weight of each successive charge is to bring the surface of the molten metal to a different place in the pot, because the "flux" or scum which accumulates on the surface, has a chemical action on the silica of the pot, which is consequently decomposed for some depth just at that point, and the pot is reduced in thickness.

The bar steel is first carefully selected of the exact temper required, all flushed or aired bars are rejected, and after it has been broken up into small pieces and carefully weighed, it is conveyed to the pot, which has already been placed in the melting hole through an iron funnel called a charger. The lid is carefully adjusted, and the melting hole filled with coke.

The degree of heat to which the furnace is allowed to go is carefully regulated by the "puller-out," who is technically said to "work" the holes, and who has perfect control over them by means of the two flues, into either of which he can insert a firebrick if required; a brick in the melting hole flue lessens the heat by lessening the draught; one in the cellar flue increases the heat by increasing the draught. The head melter periodically inspects the pots and gives the final instructions to the puller-out, and decides the precise moment when the steel is dead melted, and the holes sufficiently burnt down to allow of its being "teemed" or poured into the mold with a fair chance of producing a sound ingot. When the "puller-out" has put on his "clothes," by which is meant a series of sacking wraps which envelop the arms and legs, and are soaked with water, to protect him from the heat, he raises the pot with a pair of "pulling-out tongs," and lifts it from the hole to the floor of the furnace.

The lid is instantly taken off with a pair of lid tongs, and the scum and flux is removed by a skimmer from the surface of the molten steel, which is then poured into a cast-iron mold formed of two halves tightly ringed and wedged together. The interior of the mold has been previously "reeked" or covered with a coat of coal-tar soot, to prevent the ingot from adhering to it.

The melting of the higher qualities of steel is a process requiring the greatest skill, and one of the principal reasons why the trade has become to such a remarkable extent localized in Sheffield, is the importance to this branch of the trade of being able to select, from a large class of more or less experienced workmen, the few exceptional men in whom sound judgment, technical skill, and steady habits are combined. The chances of accident in the melting of steel are many and various. Not only badly made pots, but badly annealed or badly worked pots, are sure to "run," and the steel to be deposited amongst the ashes, where it imbibes so much sulphur as to be practically of no value. Should a piece of coke accidentally find its way into the pot, the ingot will show a bright, sparkling fracture; technically speaking, it will be said to "stare," and under the hammer will prove "hot short" and crumble to pieces. If the steel be not long enough in the fire, it will teem fiery and produce a honeycombed ingot, and the same result will follow if it be too hot when it is poured. If it remain too long in the fire it will teem "dead," "the fracture of the ingot will look scorched," and though exceptionally sound, it will be brittle if hard, and wanting in tensile strength if mild. If the molten steel be chilled before it is poured into the mold, which may be detected by the stream skimming over as it is teemed, the fracture of the ingot will appear dull in color and full of small holes or honeycombs.

All ingots having a proportion of one per cent. or more of carbon, if properly melted will pipe; that is to say, the steel in the center of the ingot will settle down as it cools, leaving a hollow space in the middle at the top of the ingot to the depth of from 3 in. to 5 in. When the ingot has become cold it must be topped, that is to say, the hollow part must be broken off, until the ingot shows a sound fracture, and before this fracture has had time to rust, the ingots must be carefully examined; the ingots which are not properly melted must be rejected, and the exact percentage of carbon which each ingot contains must be marked upon it. An experienced eye can judge of the percentage of carbon contained in an ingot to a wonderful nicety by the appearance of the fracture. Between 1 per cent. of carbon and 1½ per cent. every tenth per cent. is well marked, and an experienced hand will detect a difference between, for example, 1·3 and 1·35 per cent.

A NEW ANESTHETIC.

Dr. C. S. Merrill lectured briefly on the nature and effects of the hydrochlorate of cocoaine. The doctor stated that the drug was prepared from the leaves of the cocoa-plant, and had been used to produce anesthesia of some parts for operative work, and that the first knowledge we had of its action as a local anesthetic for the eye, was from a paper by Dr. Kollar, of Vienna, read at the Heidelberg Congress of Ophthalmologists on the 15th of September, 1884.

The drug is a rare one, and at present very expensive, costing at the rate of $420 per ounce, or $6,720 per pound. No doubt, as the demand for it increases it will be manufactured in larger quantities, and become much cheaper. It is to be hoped that it will be produced in such quantities as to permit of experiments being made with it in other portions of the body, for we are justified in anticipating that it will render many of the general surgeon's operations painless.—*Albany Argus.*

◆

NONSENSE BY DR. JOHN G. JOHNSON.

Dr. John G. Johnson, having had six cases of poisoning from the eating of canned tomatoes, read a paper on the subject before the New York Medico-Legal Society. He concludes, after a careful review of the subject, that:

1. These were not cases of sickness from spoiled tomatoes.
2. They were cases of corrosive poisoning from muriate of zinc and muriate of tin.
3. This poisonous amalgam must be abandoned.
4. Exemplary damages, "at the discretion of the jury," will be sustained by the courts for this reckless tampering with human life in using a dangerous means when a safe one could be used.
5. The canners have only themselves to thank for the present panic in their business, for they have persisted in the use of this dangerous amalgam, knowing it was dangerous.

As it happens, muriate of zinc and muriate of tin are not amalgams, but fluids used as fluxes in soldering. It is more than doubtful if these, used as they are, have any injurious effect. The quantity of muriate of zinc used in soldering a can would not exceed, at most, a salt-spoonful; as it is very dilute, it is difficult to see how it can be an active poison, even if the whole was put into the can, and one person eat the contents thereof.

◆

TORPEDOES.

There has of late years grown up the idea that torpedoes alone will constitute a sufficient defense for this country. Congressmen make long speeches in favor of torpedoes, and refuse to vote an appropriation for forts and guns. Even some professional soldiers have been carried away with the defense of our harbors by means of submarine mines alone. The very uncanniness of the torpedo, and the general ignorance of the masses of the true nature of submarine mines, has invested them with a species of awe and admiration.

Submarine mines can in no case replace guns, especially as their own security depends upon guns. Guns and passive obstructions may constitute an effective defense, but submarine mines alone—never. It must be distinctly borne in mind that a submarine mine has but one life, and, having been once exploded in action, it cannot be replaced; while the activity of the guns is limited only by the supply of ammunition.

Submarine mines, more than any other weapon, call for experience, skill, training, and the closest attention on the part of those operating them. From the very nature of things they must be operated by "the few," while guns can be fought by "the multitude," and without very great training. It is a well-established principle that all engines-of-war should be as little complicated as possible, and as free as possible from delicate parts; therefore, the main defense should never be left to submarine mines, which any one of a number of unforeseen accidents may render useless, and which can be operated by only a few men whom it would be difficult to replace in time of action.—*Captain Edward Maguire, U. S. A.*

◆

By Subscribing Now you get 14 months for $2.

Chippings and Filings.

An Instantaneous Remedy for convulsive hiccough is granulated sugar moistened with cider vinegar, in portions of a few grains to a teaspoonful—so says the *Therapeutic Gazette.*

◆

Wood in France is sold for a third of a cent a pound. It is worth as much as corn in Kansas by the pound. So when the Kansas man burns corn, he is no more profligate than the Frenchman who burns fagots.

◆

Detrick & Harvey, Baltimore, Md., will proceed at once to erect a machine shop, 100 × 60 feet, two stories high. It will be equipped with the best machinery, and it is expected to be ready for starting up next winter.

◆

Where Wicks are used for feeding oil to bearings, a tube filled with horse-hairs should make a superior vehicle; this for the reason that the capillarity of the tubular hair facilitates the transmission of oil. All hairs are tubular.

◆

Some One employed on the *Railway Gazette* appears to have brought over a number of alleged technical jokes from England, in a gripsack. Better throw them away! We have too many native jokes of this character now in service.

◆

Many Persons request that we furnish forms for clubs, as it is a saving in time to them, and is also more uniform in appearance. We have therefore printed such blanks, and will send them to all friends who may desire them.

◆

Haverford College, located a few miles from Philadelphia, has established a department of engineering, under Prof. James Beatty, Jr., embracing the mechanical, civil and sanitary branches. A fully equipped machine shop has just been completed.

◆

A Singular Case of a vessel sunk by her own anchor is that of the steamer *Berbice* at Antigua. She anchored in shoal water, and when the tide ran out rested on her anchor. The bottom of the ship was more tender than the bottom of the sea, and the anchor went through and sunk the ship in fifteen feet of water.

◆

Persons Who Use Tracing Paper in any quantity, can make it very cheaply by immersing best tissue paper in a bath composed of turpentine and bleached beeswax. A piece of beeswax about an inch in diameter, dissolved in half a pint of turpentine, is said to give good results. The paper should dry two or three days before use.

◆

A Fly-Wheel weighing only 125 pounds burst in a Boston wood-yard, with these results: One piece went 400 yards, and tore a cottage all up, smashing through feather beds, breaking wagons, knocking plaster and lath in all directions, etc., etc. If the wheel had weighed 250 lbs. it would have razed the city of Boston to the ground, at this rate!

◆

The Waiver Of Protest of a note dispenses with the necessity, not only of actual protest, but of the steps necessary to be taken before a legal protest can be made; it is, therefore, a waiver of demand of payment from the maker, and of notice of non-payment to the indorser who waives the protest, according to the decision of the Supreme Court of Pennsylvania.

◆

It Is Reported that Van Rysselberghe, in Belgium, has solved the problem of transmitting a telegraphic and a telephonic message along the same wire at the same time. A trial of this has been made at the Antwerp Universal Exhibition, where concerts held in important towns in Belgium were heard, the transmission being made with ordinary instruments along ordinary telegraph lines and with earth returns.

◆

There Is Something Strange, says the *Toronto Globe,* about the cost of electric lighting. In Toronto the cost is 62 cents per light per night. In Winnipeg the cost is $1.25, which is said to be accounted for by the fact that coal is dear. In Rochester the cost is 40 cents a night. This is accounted for by the fact that the dynamos are run by water power. But how is it accounted for, that in Ottawa where water power is also used, the cost is only 22 cents a light?

◆

An Extraordinary Performance is quoted by a correspondent of the *Railway Age.* He says: "On September 20, 1884, a Brooks engine, 25 tons, 42-inch drive wheel, 14 × 18 cylinder, engineer Jno. W. Else, ran 11 6-10 miles in 11 minutes and 35 seconds, from Pocatello to Rossfork, pulling pay car and one coach."

This occurred on the Union Pac. R. R., and the time given requires the engine to make 462 revolutions per minute, and nearly 1,400 feet piston speed per minute.

◆

Press Dispatches say that Charles Kellogg, of Buffalo, has closed a contract with a New York syndicate to furnish 50,000 tons of steel pipe, to be of 36, 40 and 48 inches diameter. The delivery is to begin within six months, and the contract is to be filled within two years. The pipes will be manufactured by a new process, for which application for patents, both American and foreign, has been made. The total amount of the contract is $4,000,000.

"Steel" is a very elastic word now-a-days.

◆

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◆

This Is The Opinion of the chief engineer of a steamer out of San Francisco, who modestly hides his name:

> "I take The Mechanical Engineer, and have since the first number. From what I can understand from my newsdealer, it is eagerly sought after. So it should be, as it has done a power of good to engineers; of that I am sure. May it retain the old staff, and keep on with the good, good work.
>
> "I could say something of boilers, but will wait for a short while."

By all means let us hear about boilers.

◆

This Statement comes from a foreign contemporary:

> "There is not to be found on a single railway in France or Germany, a locomotive which pleases English eyes, the construction of which can be defended on any sound mechanical basis, unless it has been designed by an Englishman or a Scotchman."

This being the case, we suppose the reason why our contemporary publishes so many engravings of French and German locomotives, is merely to show them in all their hideous deformity. They are rather slab-sided, and no mistake.

◆

It Is Sometimes asked what students of technical schools do with their education. This transcript from the records of the Worcester Free Institute shows:

Partners in business firms, 23; superintendents, 16; chief engineers, 3; division engineers, 5; assistant engineers, 16; civil engineers, 20; draughtsmen, 49; mechanical engineers, 10; machinists, 13; foremen, 8; teachers, 17; chemists, 12; advanced students, 4; designers, 5; others, mostly engaged in manufactures, 45.—246. Deceased 9. Total, 255.

◆

A Form of Western Humor, which we deprecate, is gaining ground among our milling contemporaries. This is in attributing the most exaggerated erotic sentiments, in poetical form, to Clifford Hall, Esq., of the *Modern Miller,* and Albert Hoppin, Esq., of the *Millwright and Engineer.* Neither of these gentlemen are guilty of Swinburnizing, and it must most awfully shock them when they read the verses in question; particularly Mr. Hall, who is a mild, inoffensive gentleman, with a reputation to maintain. We would reprint some of these effusions if we thought the type would stand on their feet.

◆

Says Mr. C. J. H. Woodbury, of Boston:

"The records of duplicate inventions indicate the parallelism of the human mind. No invention of moment can be developed to a position of any importance, but that some one will make declaration of earlier schemes possessing its salient points. The honors and the acquisitions borne upon Professor Alex. Graham Bell, stimulated to a phenomenal degree the memories of the inventors of abandoned, still-born telephones."

Will Mr. Woodbury say what it indicates when patents are issued for devices which are, and have been, in daily use for years?

◆

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◆

An English Steel Firm says: "If you imagine that you can buy real best crucible cast-steel, from high-class Swedish iron, for tools at less than £50 per ton, you are very much mistaken. You can pay as much more as you like, up to 1s. 6d. per lb., and still get full value for your money."

◆

The Travels of native Indian explorers, their stratagems and their disguises, their hazards and sufferings, their frequent hair-breadth escapes, are teeming with excitement. One of them describes a portion of his track at the back of Mount Everest, as carried for a third of a mile along the face of a precipice at a height of 1,500 feet above the Bhotia-kosi River, upon iron pegs let into the face of the rock; the path being formed by bars of iron and slabs of stone stretching from peg to peg, in no place more than 18 inches, and often not more than nine inches wide. These paths are constantly used by men carrying burthens.—*Nature.*

◆

Vice Admiral Close, of the British navy, has offered a singular explanation about the loss of the gunboat *Wasp* recently off the Irish coast. There exists, it seems, a form of defective sight known as "moon blindness," persons afflicted with which are unable to perceive a light shining in darkness. It is easy to see the consequences of this infirmity in the navigating officer of a ship. Admiral Close says he nearly lost the man-of-war *Trident* once from this cause, only discovering in the nick of time that his navigating officer was unable to see the light of a lighthouse half a mile distant. If "moon blindness" is an established fact in medical science, the sooner provision for detecting it is made, the better.

◆

Following The Application of any boiler-purger or other substance for loosening scale or deposit upon the shell, heads, or flues of a steam boiler, special care and attention should be given to cleaning out the boiler with a prompt removal of such loose fragments as may have become detached and fallen down. These particles, if not removed, are often swept about by the various currents within the boiler, and collecting in a conglomerate mass upon some part of the fire surface, prevent access of water to that particular part, and thereby it is overheated and is bulged or bagged as it is sometimes called—often inflicting a dangerous injury to the boiler and requiring a considerable outlay for new sheets, a patch, or perhaps other expensive repairs.—*The Locomotive.*

◆

When A Leather Belt has been slightly injured by rain, or by being wet in any other manner, it should be dried as much as possible, and laps that may have started can be fastened by a little cement, the composition of which, as follows, is furnished us by the Page Belting Co.: Equal proportions of good glue and Prussian gelatine dissolved in water, and cooked in a tin vessel set into a larger one containing water. Do not allow the vessel containing the cement to set quite on the bottom. It should be cooked until it is quite thick and ropy; it can then be worked into the places where the laps are started, by means of a knife. The belt should then be hammered until dry, and a few pegs may be used, which can be obtained from any local shoemaker.

A man might be equal to making pegs with a jack-knife, if the "local shoemaker" was not handy. The quotation is from the *Mechanical News.*—Eds.

◆

Periodically some one revives the old argument against the practice of belting from the periphery of the fly-wheel of an engine; that by so doing it gives the work "a leverage over the engine," and involves a consequent loss of power. We haven't found any one who could explain what became of the power that was said to be lost. Until this can be elucidated we shall continue in the delusion that to make one wheel answer for both fly wheel and pulley is a saving of expense and an equalization of the application of the power of the engine. Will some one of the believers to the contrary figure out the difference in leverage between one pound moving through a space of two feet per minute, and two pounds moving through a space of one foot in the same length of time?—*Millwright and Engineer.*

◆

A Gentleman in the West wished to move a house across the track of the Missouri Pacific R. R., and he selected the night-time, when few or no trains were likely to run. To guard against accidents he bribed the flagman at the crossing with a bottle of whisky to go down the road 100 yards. This person looked into the bottle too long, and when he had fallen into the ditch, and the house was square across the track, up comes a special express and walks right through the house. As it happened, there were six boarders, beside the family, in it, and all these people went flying through the air in a very indecorous manner. After the accident, everything was "explained," and as no one was killed, or seriously hurt, it was considered to be what might happen in any family, under the circumstances. The house-mover, however, was greatly exercised over the loss of his rollers!

◆

A Scotch Professor said recently, to the students of naval architecture in Glasgow, as follows:

> "Whatever may be the character of your daily work, whether you are employed as engineers, draughtsmen, or mechanics, never rest satisfied till you know the meaning of all that you do and why you do it. Do not be content with merely learning methods of setting off work and performing calculations, or with copying processes you may have seen others employ. The man who merely does as he sees others do, without very well comprehending why they do it, and who works strictly by rule and line, looking to custom as the supreme authority, will never improve or advance himself, nor be of much real use in such times as these; nor will he find much interest in his work.
>
> "'Custom, which all mankind to slavery brings,
> That dull excuse for doing silly things.'"

This seems to be good sound sense for all latitudes and longitudes.

◆

The Elephant And The Boiler Tubes. I once asked an India road officer, says *Vanity Fair*, what was the cleverest act he ever knew an elephant to perform, and he said, once, when unloading some boiler tubes from a ship, it was an elephant's task to carry them, by means of his trunk, from one part of the wharf to another. The tubes had been oiled to prevent them from rusting; and, when the elephant took one up, it slipped. He tried it again with the same result, and at last seemed to comprehend what the reason was, for he soon afterwards pushed the tube with his foot to where there was a heap of sand, and then rolled the tube backward and forward. The sand adhered to the tube, and the elephant then carried it with ease. He did the same to the remainder, without aid or suggestion from his mahout.

◆

This Surprising Event occurred in England, but it happens here also, with alleged "engineers," or persons so called:

> "A few mornings ago the proprietor of an establishment found his engine man engaged in withdrawing the fire from under his boiler—an externally fired one. The engine, a short time previously, had slackened speed and finally come to rest. When the fact of the engine being under speed was communicated to the attendant, he had begun stoking all the harder to get the steam up, but without any effect. [It would seem, from what follows, that there was a most decided effect.—Eds. M. E.] A strong smell of burning was shortly afterwards perceived, when it turned out that all the water in the boiler had been evaporated, and the boiler bottom was red hot along its whole length. Some timber resting on the top of the boiler was charred, and some waste set on fire, and this, with the burning of the india-rubber manhole-cover joint, had caused the strong smell of burning, which led to the discovery of the cause of the engine stopping for want of steam.—*The Mechanical World.*

Clever chaps, these!

◆

Some Very Fine Machine Tools are exhibited at the fair of the American Institute, notably those by F. B. Miles & Co., Philadelphia. Among them are a large radial drill, a crank planer, and a car-wheel borer. We shall not attempt to describe these tools, as a mere reiteration of details gives but little idea of capacity, and none whatever of appearance and workmanship; which latter, in a machine tool, after design, is the one thing needful. The car-wheel borer is a marvel of convenience and rapidity of execution. It will surprise many machinists—as it did us—to be told that car-wheels, to the number of 100 in ten hours, can be bored in this machine regularly, and without extraordinary exertion. A record exists of 170 car-wheels bored in ten hours on this machine. This is rapid work, from our standpoint. A car-wheel hub—if our memory serves us—is 8″ deep by 4″ diameter. The time mentioned includes taking the wheels from the floor and putting them back on it. The same builder also shows a slotting machine which has, among other things, a very simple let-off motion, to clear the point of the tool from the work on the back stroke. Conveniences for adjusting the work, or handling it, render this a most valuable machine of its class.

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◆

REDUCTION IN RATES FOR 1885.

In common with many other publishers, at this season, we have been in the habit of giving the last four issues of the current volume gratuitously to all new subscribers, and we herewith announce that we will do the same this year. We will furnish this paper from the current issue until Jan. 1st, 1886, to all new subscribers who may send in their names prior to Jan. 1st, 1885, and we hope that the number who will take advantage of these terms will be large. This offer will not extend beyond the period named, and we shall not be bound by it for any favors arriving after Jan. 1st.

Also, we announce, as a concession to old subscribers, that we will send two copies of this paper for $3.50, or $1.75 each. If our constituents, who have so long encouraged our efforts, can see their way to obtaining a friend to join them, they can save a trifle by so doing.

We have also reduced our club rates in accordance with the times. Realizing that many are out of work, and that those who are employed have been cut down, we have cut ourselves down as well.

Our club rates for 1885 will be as follows:

Five	copies	to any	address	each	$1.60
Ten	"	"	"	each	1.40
Fifteen	"	"	"	each	1.30
Thirty	"	"	"	each	1.20
Fifty	"	"	"	each	1.00

☞ Where lists of 12 names are sent, the rate for 10 names will apply, not that for 15 names. In no case will lower rates be accepted than those given, unless in the rate for 30 names, where 28 will be accepted. On the 50 rate the full number must be sent and no lower rate than $1 will be taken for any number of names.

These rates, it will be observed, are a material reduction from last year all through, and we hope to be favored with a response to them in such increased ratio as to, at least, cover the reduction. Those who feel that they are willing to aid us in our enterprise to the extent of soliciting their friends to come in, can merely send the names with the money, being particular to have the addresses distinctly written and correct.

Brief Advertisements.

Twenty-five cents a line for each insertion under this head.

PATTERN LETTERS FOR MOULDERS, Brand Letters, &c. Vanderburgh, Wells & Co., cor. Fulton and Dutch Streets, New York. Send for price list and catalogue.

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THE MECHANICAL ENGINEER.

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Enlarged 1883.

New York, November 29, 1884.

Single Copies, 8 Cents.
$2.00 per Annum.

COMPOSITE CRANK-SHAFT FOR MARINE ENGINES.

By the Risdon Iron Works, San Francisco, Cal.

In recent issues we have given several illustrations of crank-shafts for marine engines, and through the courtesy of a chief engineer on the Pacific coast, who forbids us to use his name, we are able to publish another illustration of a compound crank-shaft which has been giving good satisfaction. Our correspondent says :

"Being an amateur in mechanical drawing, and wishing to draw your attention to what I would call a good thing, I send this sketch of a crank-shaft that will doubtless interest a great many of your readers. And I wish to show how very easily it can be replaced, should it break in the crank-pins or the middle section.

"The engines the shaft is in are those of the coasting Steamship *Eureka*, and are vertical, direct-acting compound 21" and 42" by 34" stroke, making 80 revolutions per minute, built by the Risdon Iron Works, of San Francisco. The crank-shaft has given perfect satisfaction; and there has never been a sign of a loose bolt since the engines have been running, about two years.

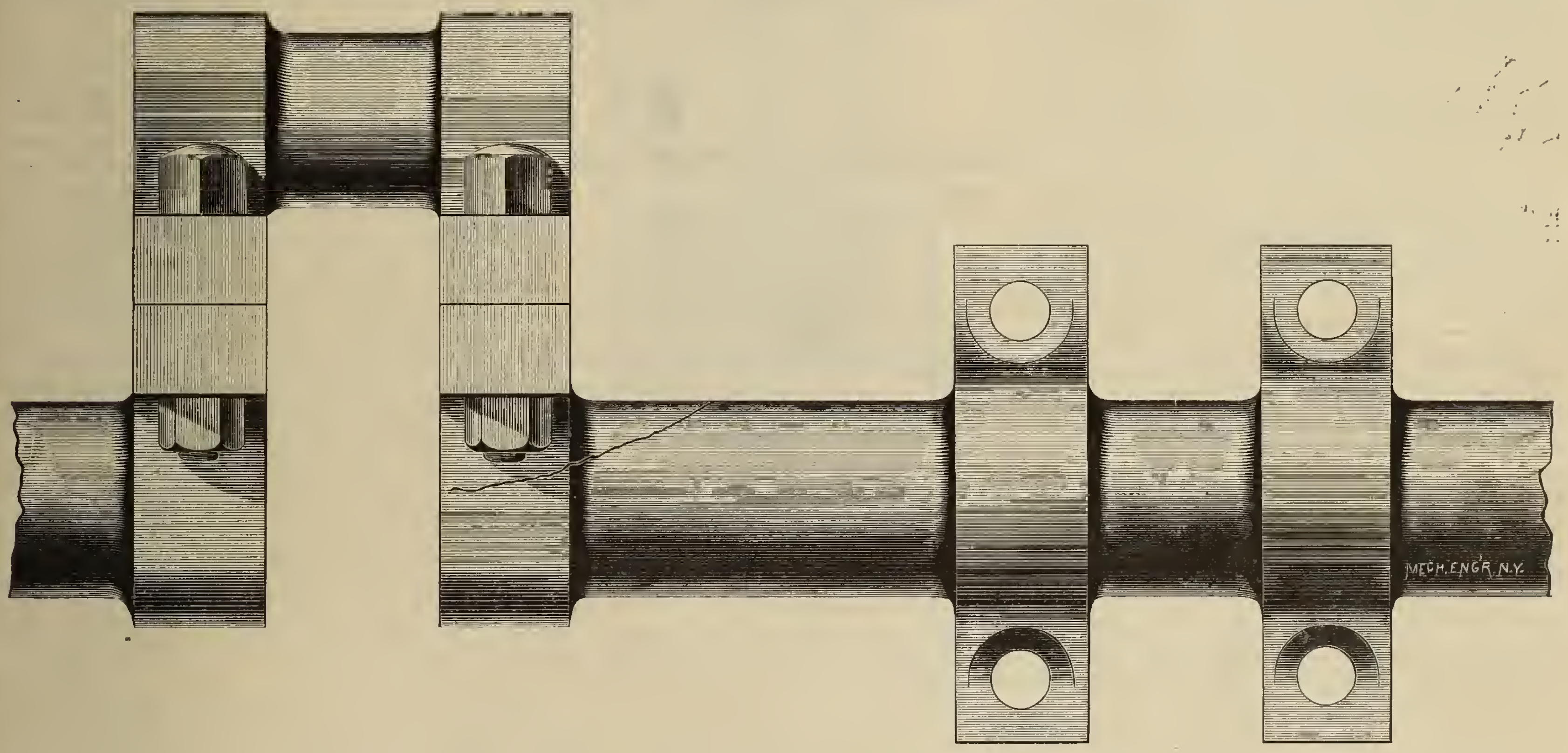
"Unfortunately we had the middle section break about two months ago, as shown by crack. We had a duplicate on board, for we make long trips sometimes, and it behooves us to carry all the spare machinery that would likely be needed on a long voyage. The whole crank-shaft, for that matter, would take up but very little room on shipboard, if disconnected.

"You will doubtless wonder why it broke in the place that it did. It never would have but for a flaw that showed itself across the face of the crank. We anticipated it and were not surprised when it happened. Having a duplicate part on board, we disconnected the details that needed it, took out the old shaft, and replaced it with the new one in 5 hours. It could have been done in much less time if we had it to do over again. The new shaft worked splendidly and has never caused a moment's uneasiness since it was put in.

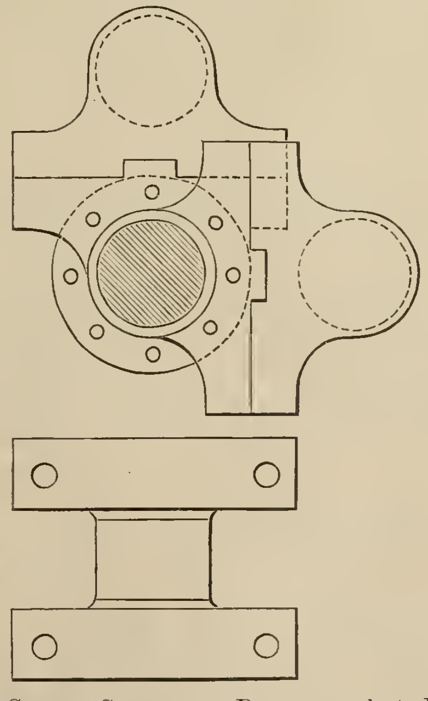
"I don't put myself before you as a draughtsman, because I am nothing but a young engineer, struggling along, trying to learn all I can that will benefit me in my calling. By sending this sketch it helps me as well as others, for we learn more by interchanges of this kind than in any other way. The drawing is to 1½" scale, and I could not see it very well, as it was made in a dark room, and at sea too.

"I have merely shown the crank-shaft, for the after-end contains the thrust-bearing, one eccentric, and the worm-gear for turning engine by hand."

We thank our correspondent, in our own behalf, for his attention, and are sure that the brethren everywhere will appreciate his good-will. The apology for the drawing is quite unnecessary ; the engraver has made a picture of the main shaft, but the details are exactly as drawn by our correspondent, being merely reduced in size.


MECH.ENGR N.Y.

Composite Crank-Shaft of the Steamship Eureka.



Mr. J. L. Bogert, of The Flushing Iron Works, Flushing, L. I., sends us two large and beautiful photographs of his lathes. These tools are well known to those who have used them as machines of precision. We would rather run one of them for four dollars per day than poorer lathes for two dollars !

We Are Under Obligation to Mr. John Erwood, of Chicago, Ill., for a complimentary card to the third annual ball of Chicago Association of Stationary Engineers No. 1, which takes place on the 25th instant. Our ball days are over, but we can join with the brothers in spirit, and they will please accept our thanks for their kind remembrance.

Bridgeport, Conn., Engineers, are organizing an association under the auspices of the *National Association*. Some twenty names, comprising the leading engineers of Bridgeport, have been entered, and a charter will soon be applied for.

A Series of experiments have been made by a German Government Commission, showing how largely the presence of coal dust in mines contributes to the violence of an explosion. The experiments had been made above ground, in a wooden gallery. The initial disturbance was affected by firing a shot with 1-4 lb. of gunpowder. The result was startling and marvellous. With 20 metres of the floor covered thinly with coal mine dust. and ten metres of the gallery next to the shot filled with a mixture of one firedamp and twenty air, the flame shot out 185 ft. to 190 ft. with a noise like the bursting of a magazine.

The Magazine Of Art, for December, is a special number full of interest to all art lovers. For those who take an interest in fine engravings, accompanied by intelligent art criticisms, and information concerning painters, ancient and modern, this journal is of special value. It is published by Cassell & Co., Limited, New York, at $3.50 per annum.

It Seems Scarcely Possible, but Prof. Huxley says that the weight of the human skin is ten pounds and a half.

A WELL-KNOWN ENGINEER CANED—AND DESERVEDLY.

It is not always safe to cane engineers, but we are pleased to record one instance where the recipient deserved it.

George M. Barker, of Nashville, Tenn., treasurer of the N. A. of S. E., received from Minneapolis Association No. 2, of Minnesota, on the 6th of November, a present of an elegant gold-mounted ebony cane. It is very heavy, and the head is 2 inches in diameter by 3 inches long, solid gold, very elaborately wrought, and chased by hand-work. On the top is engraved :

G. M. Barker, M.E., from Minneapolis Association No. 2, Minneapolis, 1884.

The point of the cane is silver-mounted and tipped with a steel button ; the whole forms a most elegant and useful present. As a specimen of fine workmanship it would be difficult to duplicate. Accompanying it was the following letter :

G. M. Barker, Treasurer N. A of. S. E.

Dear Sir and Brother : Please accept this small present from the officers and members of the Minneapolis Association of Stationary Engineers, as a token of appreciation of services at the National Convention of stationary engineers at Baltimore, Md., September 15, 1884. Fraternally yours,

Signed,
E. S. Getchell, Pres.
W. McMillan, Sec.

This is a good way to cane engineers.

FACTS ABOUT FILES.

Steel for files is made of special length in the bar, so that the blanks can be cut without waste. These blanks are then forged, ground, annealed, and cut. When cut they are hardened, being heated in molten lead for this latter purpose. After being hardened, they are assembled before an inspector, the good, bad, and indifferent together, just as they come from the hardener. The inspector has a piece of steel, hardened to saw-temper, called a prover, and he draws this over every file from point to heel. He judges by the "feel" of the prover, the hang of it, whether the file is hard enough or whether there are soft spots in it. Then he rings the file, balancing it on his finger, and striking it lightly with a piece of flat steel. If it gives out a clear sonorous note, is flat, without wind or crook, and "proves" all right, it is a good file, and is put up with the firm's name on it. If it does not ring, it is a "dummy;" the stamp is ground off of it, and it is sold (by some concerns) as second quality. This is the file sold on sidewalks for 10c, and without a name on the tang.

When you buy a file observe these points: That it is straight, and true on the faces; that is, not twisting. See that it is thick for its length whatever that may be, thin files are apt to be re-cut files, and as such are liable to be fire-cracked from the second hardening they have undergone. Moreover, if the new file is not thick it cannot be re-cut; there is not stock enough in it to re-grind. Some filemakers skin the weight of their steel as close as possible, as files are sold by the dozen and not by weight.

◆

The Hyatt Filter Company, Newark, N. J., will have a large plant on exhibition at the New Orleans Exposition, which will furnish 60,000 gallons of Mississippi water, per hour, chemically pure. This will be a great achievement.

◆

E. P. Allis & Co., Milwaukee, Wis., are building for their exhibit at the Cotton Centennial Exposition at New Orleans a miniature roller-mill plant of great beauty. The mill is three stories in height, and open on the sides, showing the machinery complete in action. The engine which drives the mill is a perfect model in miniature of the Corliss engines made by the firm. It is complete, in all parts, and will run as perfectly as large engines. The same is also true of all the rest of the machinery comprising the plant. The workmanship is of the finest, and the finish is very beautiful. This exhibit is handsome, and cannot fail to attract attention.—*Industrial World.*

◆

Prof. W. Matthieu Williams, of England, in his recent series of exhaustive articles on "The Chemistry of Cooking," republished in this country in the *Popular Science Monthly*, says: "A great many fallacies are perpetuated, not only by ignorant people, but by eminent chemists and physiologists, by assuming that the tables of chemical composition of food represent the practical nutritive value. These analyses are usually of food in the raw state—the facility of assimilation is unheeded, as this depends upon the original condition of the food and all the chemical changes involved in the process of cooking. For instance, in 'whole wheat' flour bread, analyses of millers' bran are quoted to sustain the assumption that such entire flour, or bread, is more nutritious than any other, but this assertion is not justified without making it clear that the ordinary rejected portions of the grain are as easily digested and assimilated.—*American Miller.*

We diffidently assert that we found this out many years ago. When laboring with dyspepsia and "physicians were in vain," we cured ourselves of dyspepsia, pure and simple (not indigestion) by studying and observing the process of assimilation. The freaks and vagaries of the human stomach are beyond all set rules and formulæ, and there is no trite saying which is truer than "What is one man's meat is another man's poison." Case in point: after trying everything else we lived the whole of one winter, nearly, on buckwheat cakes and strong black coffee, and throve upon it.—Eds. M. E.

RESPECTING FLAWED SHAFTS.

An English inspector cites some instances of flawed shafts in a recent number of the London *Engineer*, and gives an example, which we copy:

"A compound beam engine, with cylinders 28 in. and 32 in. diameter, with a stroke 2 ft. 6 in. and 5 ft., has been running for eight years with a flawed shaft, as shown by Figs. 1 and 2. There is a bad weld. A considerable number of pieces have come out of the shaft at A B, and there is a spiral crack besides from C to D, out of which oil exudes by simply barring the wheel, without blocking the cranks. This would be considered quite sufficient to condemn the crank by many people; but Mr. Longridge shows that it had a factor of safety of 8.2 to begin with; so that, even if its strength was reduced one half by flaws, it would still have an ample margin of safety."

A number of other examples are also given, the weight of evidence going to show that many shafts are condemned too hastily. We have remarked instances ourselves, where crank-pins have continued to drive machinery when they (the crank-pins) had but a small fraction of their original area left, as shown by the removal of them and actual fracture of the parts; but this does not seem to be an argument for the retention of damaged details. Renewal of such parts is reduced to the simple question of insurance. If we retain them we simply risk total breakage, with all its attendant and possible damages, against the cost of a new detail. In some cases this risk may be thousands of dollars' actual outlay for renewal of the plant, not to mention the incalculable loss made by stopping, if the engine is in a factory, possibly in a busy season. The labor question alone—loss of pay to the help—is a serious one, taking thousands of dollars out of their pockets and those of neighboring merchants. All this hangs upon a defective portion of an engine. There does not seem to be any question as to the course to be pursued.

FIG. 1

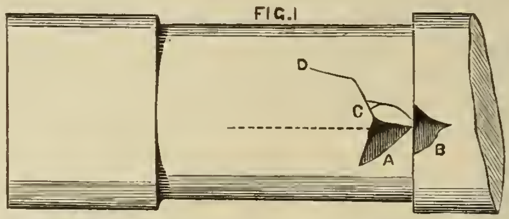
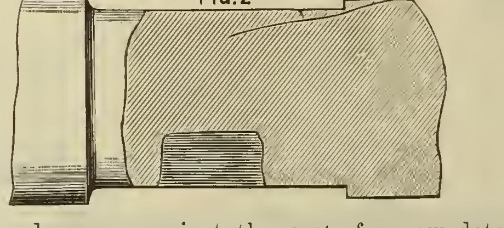


FIG. 2



◆

M. Fouchs describes in *La Nature* a curious acoustic experiment. Having closed his ears so as to completely exclude all sounds, and then having conducted, by means of an acoustic tube, the voice of a speaker into his own mouth, he found that the quality was entirely changed so that it ceased to be recognizable.

This may be curious, but its exact value to the world remains undiscovered.—Eds. M. E.

◆

President Johnson, of the Edison Electric Light Co., recently told a *Sun* reporter that a young man desirous of becoming an electrical engineer should do this: "The only thing for him to do is to go to work in the basement of some company, where he will learn to string wires on the poles first. Then he will learn to connect the wires with the dynamos, to set up the dynamos, to make them over in the machine shop, and while he is doing that he will be getting lectures on the subject of electricity which he won't forget, because they are practical instructions. The lectures and fancy experiments of a college wouldn't leave much greater impression upon him than a dream.

"If the young man is already a telegraph operator so much the better. Mr. Edison was a train boy before he became an operator. Mr. Charles Bachelor came from England, as a mechanic, to set up some silk machines. My first experience as an electrical engineer was in sweeping out a telegraph office. We do not know of any other way to become an electrical engineer than to pass through the operating departments of some of the great companies."

REMOVING PAINT FROM IRON-WORK.

It is necessary in repainting iron-work to remove the old coats which have been put on; to do this by scraping requires a great deal of labor, and Mr. A. J. Bishop, M. M. of the Cleveland and Indianapolis R. R., recommends the use of a wash which he has found effective. He says:

"In making tests to obtain proportions and results of different strengths of potash and lime, I obtained the following: 1 pound lime, 4 pounds potash, and 6 quarts water. I am satisfied that this proportion is about right. These tests were made with crushed potash.

"The average time required to remove paint from two pairs of drivers has been, for two men, seven hours, while the time for scraping would reach three and four days for same work. The paint has been removed from a tank by two men in seven hours, and other parts of a locomotive in a proportionate length of time, while with heat for burning same, or scraping cold, the time is beyond comparison.

"There are some objections to potash, as it may injure the hands or clothes of the user, but to avoid this I have made use of hemp packing fastened to a stick, two and a half or three feet in length. This gives the workman plenty of distance from his work, and he does not injure himself or his clothes, and also gives him a good swab or brush with which to apply the potash.

"Another objection is the surplus of potash which may be left to remain upon the work, which, if not thoroughly removed, is injurious to the durability of the paint when repainted; but this can be avoided by extreme care being taken to remove the potash."

By going over the surface with diluted acid all the potash will be killed.—Eds.

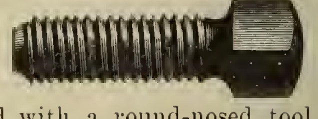
◆

When Scale is thick and hard, the proper examination of the parts beneath it is impossible until it has been entirely removed. Indeed, if it were not removed the boiler would become unworkable. Scale, therefore, being so great a foe, has to be periodically chipped away with hammer and chisel, and the process of chipping is so severe that it tends greatly to wear out the boiler. The cost of chipping is in itself a heavy item, and it should be borne in mind that a factory boiler must, during the process, perhaps every six or eight weeks, be put out of work for several days at a time. Scale will stop the feed-pipe, which supplies water to the boiler; or, hardening over the fusible plug in the furnace-crown, which is intended to melt and give warning when the water is dangerously low, will nullify this precaution, and it has thus caused both collapse and explosion.

Carbonate of lime is deposited as a pulverulent body, and under some conditions (chiefly neglect on the part of the engineer in charge) will form a hard scale, but by proper attention a great deal of it may be got rid of by blowing down, or emptying the boiler to the extent of a few inches, day by day, by the scum-cock, while it floats near the surface, or by the blow-off cock when it has settled at the bottom. If, however, this floury deposit is allowed to accumulate and thicken the water, it will produce priming.—*G. S. King.*

SET-SCREWS.

Set screws, being liable to severe strain in setting them down on the work, should always be turned with a round-nosed tool under the head, as shown in this engraving, never to a square shoulder.



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Mr. George Wylie, of Harlem, N. Y., has just finished a working model of the regulation U. S. field-piece, made entirely by hand, valued at $150.00, which he presented to Co. "D," 12th Regt., N. Y. S. M., to decorate its quarters.

◆

Do It At Once.—It was the advice of one who accomplished an incredible amount of literary work, to do whatever is to be done and take the hours of reflection and recreation after business, and never before it. When a regiment is under march, the rear is thrown into confusion if the front does not move steadily and without interruption. It is the same thing with business. If that which is the first in hand is not steadily and regularly despatched, other things accumulate behind, till affairs begin to press all at once, and no human brain can bear the confusion.

THE INTERCHANGEABLE SYSTEM OF CONSTRUCTING FIRE-ARMS.

It is generally believed that Americans, notably Whitney and Hall, were the originators of the above plan, but it appears from a communication to the *Journal of the Franklin Institute*, by F. H. Storer, of the Bussey Institution, that the interchangeable system was, to some extent, known in Russia in the last century. The communication says: * * * * *

"I would submit, that as a mere matter of historic fact, and solely as concerns the question of priority, it may possibly be open to doubt whether the statement can be made to harmonize with the following remark of Professor Erman, who, traveling in Siberia in 1828, wrote as follows: 'Leo Sobakin (born in 1742) was a serf in the Government of Tver. He early displayed great mechanical ingenuity and was sent to England to study. On his return to Russia he was appointed superintendent of the machinery at Ije. Of the apparatus erected or brought into use under his direction, much was undoubtedly invented by himself, and was quite original. It conduced much, for example, to the perfection of the fire-arms made at Ije that every piece was made there according to a model, and if it did not exactly fit or correspond with that model was rejected by the overseer. The system of shaping the several parts by simple pressure was also carried to a great extent. All the pieces of the same denomination in Russian arms are consequently so perfectly equal or alike, that the experiment has often been successfully made of taking to pieces a large number of muskets, and then, from the promiscuous heaps of similar parts, to put them all together again.'"

Without seeking to question this quotation, may we not say that American inventors and machinists made the system commercially possible? There is a vast difference between presenting, or originating a scheme, and realizing it practically.

◆

In Response to an item concerning letter files, in our last issue, *The Mechanical News* says:

"We believe it best to file letters in the old-fashioned way, but shortcomings may be attributed to it that it does not deserve, principally, perhaps, through the failure to train an office-boy properly. This attaché should play the chief part in filing the letters of a house. All the assistance he should receive is the folding of the letter, writing at the top, name, date of receipt and reply, and placing it in a package secured by an elastic band. At the end of a week, perhaps, they should be collected by the office-boy and placed in a special case among the last installments for the current month, arranged arbitrarily in alphabetical divisions. If it be desirable to keep the letters of the various departments separate, this may be done by simply putting another paper band about them, indicating the department, and leaving them in the general package."

We are using a file which looks like an accordeon; there is no difficulty in finding things in it, but, unless it is held in a special way, it throws everything out on the floor; moreover, it is only half made, soon developing weakness which results in total collapse thereafter. There may be ship-shape, well-made letter files in the market, but we have never seen one, and we earnestly trust that no inventor will seek to make a fortune out of such a trifling thing. The method named by our contemporary is good—for those who like it and have phenomenal office boys. The average being of this race in New York would be half an hour finding each letter; our experience with creatures of this class has been melancholy; we shudder at the recollection of it!

◆

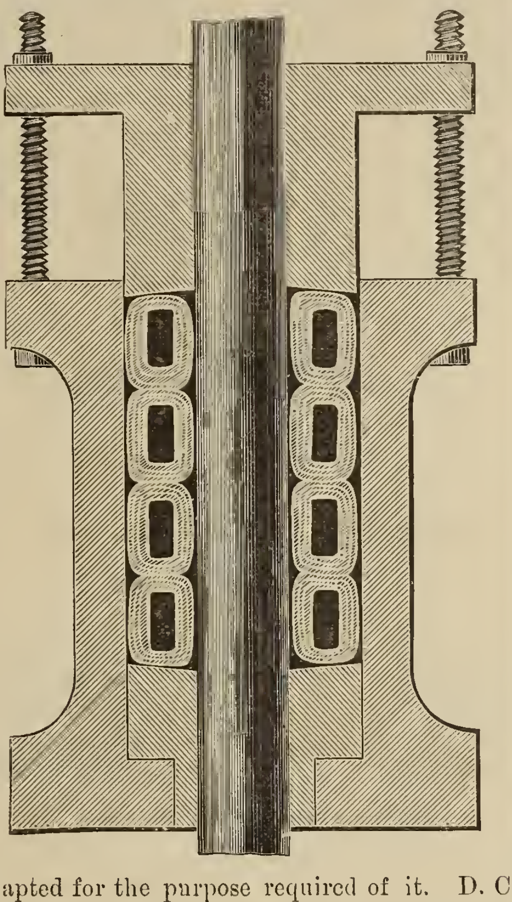
Joseph M. Wade thus indicates the cause of the decadence of many scientific societies in this country. The greatest curse comes from selfish members. Some trade papers have a member of their staff join for what they can get out of the Association, and no more. Money is furnished to treat the members, if necessary, and as scientists are not suspicious, this thing will continue for a time. Then, again, some members who are voted in without thinking, prove like firebrands thrown into a tinder-box. There was one positive case where a person gained membership to a microscopical society, for the sole purpose of annoying another member. This man was a queer compound of deception, treachery, and untruthfulness, which were all indicated distinctly in his countenance, and yet he had no difficulty in securing membership. Is there any wonder that many scientific societies have a sickly birth, a miserable existence, and almost an unnoticed death?

◆

The Amount Of Coal used for steam-engines in England is estimated at nearly 19,000,000 tons annually. Here is a fine chance to find what the saving of one quarter of one per cent of its cost would amount to—if we only knew the cost.

THE EUREKA STEAM AND WATER PACKING.

The engraving shows a new form of packing for rods that are under steam and water pressure. As will be seen, this packing consists of a gasket having a gum core which, when introduced to the stuffing-box, is flat, or oblong in section. This greatly facilitates the work of packing for one thing, and tends to the durability of the packing itself. As it wears away under friction, the screwing up of the gland tends to square the gasket, and bring it into closer contact with the body of the rod. It is claimed that this feature tends greatly to economy of time and material. The Eureka packing is made in sizes from 1-4th of an inch upward, and is well adapted for the purpose required of it. D. C. Beane, 80 Cortlandt St., N. Y., is the general Eastern agent, and will give prices on application.



◆

We Figure It in this way: It is a poor issue of The Mechanical Engineer that does not contain one dollar's worth of information. With twenty-six issues that would make twenty-six dollars received for two dollars expended, approaching the profits realized in Hebrew clothing stores.

◆

A Correspondent of a contemporary asks when the exhaust valve should open and close, and he is answered thus:

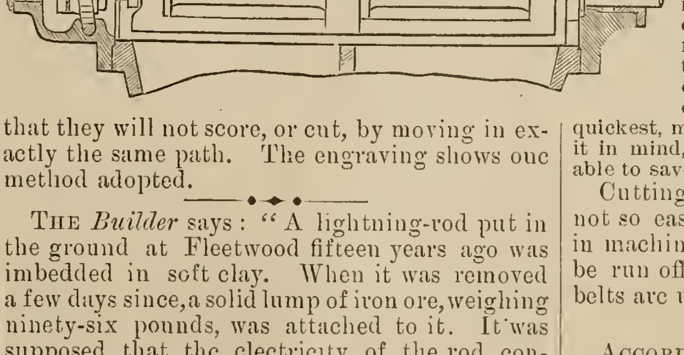
"On general principles, we should say open the exhaust when the piston is about 3", and close it when from 3" to 4" of end of stroke."

He must be sorry he said anything when he reads that.

◆

"WRINKLE" IN CORLISS VALVES.

An idea recently patented in England is to give Corliss valves a slight endwise motion, so that they will not score, or cut, by moving in exactly the same path. The engraving shows one method adopted.



◆

The *Builder* says: "A lightning-rod put in the ground at Fleetwood fifteen years ago was imbedded in soft clay. When it was removed a few days since, a solid lump of iron ore, weighing ninety-six pounds, was attached to it. It was supposed that the electricity of the rod converted the soft clay into iron ore."

This is better than the philosophers' stone, but it strikes us as a wild solution.

GOOD WORK BY LOCOMOTIVE ENGINEERS.

Engineers Anson C. Fisher, of Utica, and M. Collard, of Albany, have a record to be proud of in their handling of Locomotive No. 567, on the Central Road. It is run by a double crew that alternates every other day in drawing the first Atlantic express east, and the accommodation (No. 39) west, between Syracuse and Albany—300 miles daily—148 miles each way, and four miles in yards getting to and from the trains. Timekeeper Alexander Thompson, of Albany, has forwarded to Engineer Fisher the report of the number of miles run each month within 19 months, 142,008, without a dollar being expended for repairs upon the engine beyond the work that is usual by roundhouse men and engineers. No. 567 came out of the shop March 5, 1883, and continued running until October 15, 1884, when she was taken in again for a general overhauling.—*Utica Herald.*

Engine No. 165, on the Philadelphia and Reading R. R., has run three years without being off her wheels or costing anything for repairs. Her mileage in that time is 130,000, but this includes only the distance between depots, not that traveled in going to and from the round-house. Moreover, the work done by the engine is exceptionally heavy, it driving a train of four cars at very high speed between this city and Philadelphia. It is frequently driven over sixty miles an hour.—Eds. M. E.

◆

Respecting Crooked Indicator Cards: A genius handed us one not long since with a request to say what caused the errors in it. We replied, indifferently, that the motion seemed to be taken from the leg of a yellow dog. At this he was wroth and said "we didn't know anything about indicator cards." "It may be so," we answered meekly, "but we know just enough not to make any guesses on unauthenticated scrawls."

It is good to know this sometimes.

◆

A Correspondent in a southern city propounds the old question of the long handle or short handle screw-driver, why he can do more work with the former than with the latter. We answer because on the former he uses both hands and on the latter one hand. If this is not the correct answer we give it up.

◆

In common with other publishers we receive notices from postmasters when subscribers' addresses are changed. We sometimes receive such notices in regard to persons whose names are not on our books, and we surmise that some friend sends them their paper regularly. We cannot be responsible in such cases for the continuous delivery of the paper.

◆

When machinists and engineers purchase books at the rate they now do, it does not seem as though they thought the world was coming to an end presently! It is a straw, but it shows the tenor of opinion; when a man thinks he will soon be out of a job he does not stock his house full of books. We have sold more books in the past fortnight than in four weeks previously.

◆

To A Mechanic this sounds rather curious. We find it in an exchange:

"A lady who has been in mills a good deal and appreciates the importance of knowing what to do in case of accident, says: 'If you ever chance to be near machinery in which a man is being carried round and round, awaiting a horrible death, do not stand paralyzed with fright, do not run for some one else, do not run to stop the large wheel. All this consumes precious time, and something must be done at once. Cut the belt immediately. It is the quickest, most effective way of relief, and if you bear it in mind, there may come a time when you will be able to save a life.'"

Cutting a belt in motion—slow or fast—is not so easily done. If a man is carried round in machinery, and the belt which drives it can be run off, that is the thing to do. But large belts are not easy to run off, even.

◆

According To Parties engaged in catching porpoises, this fish will live from five to seven days out of the water. One fish is worth about $30.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

HINTS UPON FEED-PUMPS.

Editors Mechanical Engineer :

The plunger-pump is one of the oldest devices for boiler feeding. It is simple, and not liable to go back on one when most needed, but like all other things devised by man it requires to be taken care of, for frequently it is the most neglected piece of machinery connected with the engine-room.

It is not good practice to locate the pump between the boiler and heater, for, in this case, it has to work water at a temperature at, or near, 212° F., and, to use an engineer's expression, it is apt to kick or stop working. This is caused by the water vaporizing in the pump-barrel, which destroys the vacuum. The same is liable to occur if the pump has to lift hot water even for a short distance, unless the pump is lower than the source of the hot water.

Suction-pipes leading under brick floors, or in the ground anywhere, should be of lead, brass, or copper, as iron pipes are soon rendered leaky by corrosion.

A cubic foot of pure, fresh water, at a temperature of 62° F., weighs 62·321 lbs. avoirdupois; consequently a uniform column of water one inch square at the base and one foot high will weigh 1·144 of 62·321=·433 lb.; and a column 33·96 ft. in height will weigh 33·96 times ·433, or 14·70 lbs. per square inch, which is the weight or pressure of the atmosphere on every square inch at the level of the sea. From this data any one will readily understand why water cannot be raised by the pressure of one atmosphere (suction, so called) much over 26 or 28 ft., and it requires a first-class pump to do that.

Practically there is no such thing as suction. To illustrate this, suppose we have a single acting plunger-pump situated 15 feet above the water to be raised! As the plunger descends it will displace or discharge a certain amount of water or air, from the pump cylinder, equal to the area of the plunger multiplied by its stroke. As the plunger ascends again, a partial vacuum is formed under the plunger, and the water is driven, up the suction-pipe (so called) into the pump cylinder by the pressure of the atmosphere acting on the surface of the water in the vessel from which it is taken. In this case, as the pump is fifteen feet above the water, the vacuum, by gauge, due to the column of water in the suction-pipe would be 13·26 inches; consequently 6·49 lbs. of the total pressure of the atmosphere above absolute vacuum would be expended in raising the water into the pump barrel, not taking into account the friction of water in suction-pipe. Therefore the load on the plunger during the up-stroke is 6·49 lbs. per square inch of its sectional area, or, in other words, is equal to the weight in pounds of a uniform column of water, which equals in height the vertical length of the suction-pipe multiplied by area of pump-plunger. The resistance to the downward stroke is computed by multiplying the area of plunger in square inches by the boiler pressure per square inch; to which we add 25 per cent. for friction in pipes and heater, and vertical length of feed-pipe.

If all the conditions were known it would be a very simple matter to compute the necessary size of pumps for a given boiler, but in most cases it is a matter of conjecture, or experiment, which must be determined by actual practice. One engine may require from 20 to 40 per cent. more water, per hour, per horse-power than another; one boiler will generate dryer steam than another, and some attendants carry the water different from others, all of which have an influence on economy. Even an unprotected pipe, or a leaky joint contribute to diminish the efficiency of every pound of water pumped into a steam boiler.

Beverly, Mass. Smoke Arch.

◆

ABUSES IN THE PATENT SYSTEM.

Editors Mechanical Engineer :

I congratulate you upon your "Open letter to Commissioner of Patents," on page 274 of current volume, and I hope you will keep it up.

I think that adjustable gib you published is one recently patented by Mr. Corliss, of Providence, R. I. [It is.—Eds. M. E.[I saw the sketch in New York, and told the party I had used the same thing for 15 years, and sent him a sketch of the device when I reached home, and yet it is now, 1884, just discovered (?). New (?). And not previously known to the arts (?).

The carrying-jack was invented by our old friend, John Powers, Tenth Street and Avenue D, N. Y., just about 35 years ago. I remember it distinctly. The new form of movable joint water-pipe, page 271, (said to be invented in England), was used a long time since at Jersey City, by Ward, and more, exactly like cut, in this city during the past ten years.

'Rah! for novelty!

Reform is much needed in the Patent Office, and the press should go for them. Chief Engineer.

Department of Public Works.

[The only way to reform the Patent Office, and abuses in it, is for those interested to kick, and kick hard. The Commissioner is merely an agent of the people, and must do the will of the people. There is no question but that the business is carried on in a fashion that would not be tolerated in any mercantile house in the country, but there is no reason why it should be.

We wish all interested in the matter to write us, stating their views; we will publish them, and the Commissioner of Patents will see them. In this way complaints will get to his hands directly. Correspondents must state facts of their own knowledge; we do not wish second-hand evidence. The present correspondent is a man of wide experience and a prominent public officer. His name is withheld by request.—Eds.]

◆

ELASTIC JOINTS FOR WATER-PIPES.

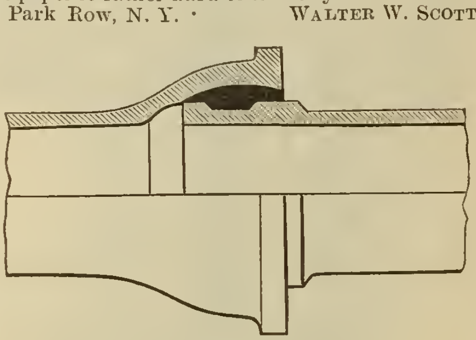
Editors Mechanical Engineer :

In "Trautwine's Pocket Book of Engineering Formulæ" you will find a movable joint for water-pipes substantially the same as the one you have reproduced from the London *Engineer* as an English device, only the American one is better and cheaper to make, as the follower is dispensed with. If I recollect rightly it was used in laying a main across the Schuylkill, the pipes being joined on a float which was advanced as the work progressed, the joined pipes being paid out astern, rope fashion, and allowed to sink to the bottom of the river.

In view of recent events your "Open Letter" to the Com. of Patents, in the last issue, is just what is wanted.

The Mechanical Engineer is getting better and brighter every issue. I wish you good luck and hope you will continue as you have begun, for a genuine trade paper is rather hard to find anywhere.

34 Park Row, N. Y. Walter W. Scott.



[We append a diagram of the movable joint referred to. It is called John F. Ward's Flexible Joint, Small pipes are laid, as Mr. Scott states, but larger ones require more care. Pipes with these joints have been laid in 40 feet of water successfully. The male ends of the pipes are turned true and lead is then poured in around them and calked. That is all there is of it.—Eds.]

◆

TROUBLE IN A BLOW-OFF PIPE.

Editors Mechanical Engineer.

As I see by your paper that you answer questions both for the skilled and the unskilled mechanic. I would like your advice.

I have charge of a return tubular boiler, which is 15 ft. long and 3 ft. diam. with twenty-six 3 in. tubes. My trouble is with the blow-off pipe filling up with scale of a grayish white color; and as hard as the iron itself.

I had to cut the blow-off pipe out and put in a new one a year ago, which is now filing up again. I blow off every morning before I start the fire, also right after dinner. Do you think a larger blow-off pipe would help, or not? The one I have is 1 1-2 in. The one I took out was filled up so that it was only 1-2 in. inside. I have run the boiler for three years, and the scale on the sheets is only about 1-32 of an inch thick, with scarcely any on the tubes, except on the back end, which has some that I take to be mud settlings, as I use brook water.

Please answer, and oblige a reader who is trying to learn something.

Port Chester, N. Y. B. F. Hunt.

[The blow-pipe is rather small, 2" would be better, but even this will be filled in time, with the hard water our correspondent uses. His boiler is in very good condition, and the management of it is also good, as shown by his report. We do not know of any remedy for the difficulty; which is not a serious one, the blow-pipe being inexpensive to replace. If the pipe can be taken off and filled with crude petroleum and left to stand from Saturday night until Monday morning, he can knock the scale out of it easily and avoid getting a new pipe.—Eds.]

◆

KEEPING HOT BRIGHT WORK CLEAN.

Editors Mechanical Engineer :

Could you or your many readers give me, through the columns of your valuable paper, a recipe for polishing (or removing) tarnish from hot iron bright work, such as cylinder heads, and at same time leave a bright finish? I have tried different compounds, but have not found the right article. W. P. S,

Aurora, Ills.

[Bright work about an engine becomes tarnished from oil baked on it. It is wiped off with waste which is more or less greasy; this leaves a thin film of oil on which soon burns as hard as varnish. The only thing to do is to cut this varnish off with strong lye, or caustic soda, and not allow it to form again. Finished surfaces can only be kept bright by constant attention. Tripoli, applied wet and rubbed off as soon as dry, answers well. A small, stiff brush should be kept to get in about the angles of nuts, etc., at the bottom.—Eds.]

◆

New Subscribers, prior to Jan. 1st, receive The Mechanical Engineer 14 months for $2.

HOW TO BECOME A FIRST CLASS STATIONARY ENGINEER.

Editors Mechanical Engineer :

Will you kindly advise me, through The Mechanical Engineer, as to the best course to pursue to become a first-class stationary engineer? and oblige,

Dexter, Ont. H. J. Lewis.

[All that is necessary to become a first-class stationary engineer is to read, master the principles involved and—get experience. On the last "hangs all the law and the prophets." Without it no man can be an engineer. To get it he must devote his life to his calling, and the longer he practices, and the closer the observation he gives to it, the better man he is.—Eds.]

◆

NO REMEDY THAT WE KNOW OF.

Editors Mechanical Engineer :

Referring to you for advice, if you know of anything that will prevent gas, from acid, from eating up the bright work of an engine in a chemical works, you would oblige me very much by publishing it.

Boston, Mass. A Reader.

[The only thing that we know of is to keep the bright work well oiled when possible.—Eds.]

◆

THE SMALL DRILLING MACHINE.

Editors Mechanical Engineer :

G. E. A., who inquired for the small drilling machine in your issue of the 1st instant, can obtain it from Frasse & Co., 62 Chatham Street, N. Y.

New York. George Wylie.

◆

PERSONAL.

The accession of Mr. J. F. Holloway, Cleveland, Ohio, to the Presidency of the *Am. Soc. of Mechanical Engineers* is an honor which is well deserved. Mr. Holloway is a practical engineer in the fullest sense of the term, as all Western engineers know; he brings to his office professional ability, personal integrity, and and an earnest intention to advance the interests of all that amounts to enthusiasm. Mr. President Holloway will please receive "the assurance of our distinguished consideration."

◆

MORE BOOKS.

Our readers will perceive that we have added a great many more books to our list. All of these are standard, useful works, well worth their prices. Our book trade is increasing far beyond our expectation, and we have devoted valuable advertizing space to it for a short time, being fully satisfied that it is for the interest of our readers and ourselves to do so.

Chippings and Filings.

One Of The Oldest manufacturing concerns in this country is the Lowell Machine Shop, at Lowell, Mass. It has a paid-up capital of $900,000, and has been in existence forty years. It employs 700 men.

◆

"In Times like These," says *The Northwestern Lumberman*, "the man who conducts his business as nearly as possible on a cash basis will have no cause to regret it."

He won't, unless the cash all comes from him.

◆

The *Hartford Courant* says :

"From the pipes of the Cheney Building's elevator 64 young perch were taken, and 58 were removed from the pipes connected with the Charter Oak Building elevator. The presence of fish in these pipes is accounted for by the scarcity of water in the reservoir."

Wouldn't it be nearer the truth to say that the strainers needed attention?

◆

A Writer in *The New York Times* says :

"We have seen in Michigan, 30 years ago, copper sticking like a huge spire out of the rock, and this bent over and curled, where the Indians, years on years before, had worked until they had beaten off fragments of it. The method of working was primitive. The savage built fires around the crude copper rock, until it was at a red heat. He then poured on water, and the rock was broken, setting the copper free."

◆

There are about a hundred workingmen now employed in New York City alone in cutting diamonds, and their wages average about $25 a week. The expert who decides how a stone shall be cut does not always perform the actual labor of cutting, but simply directs the lapidary how to cut so as to bring out the utmost brilliancy of the stone. It happens sometimes that the first cutting produces a comparatively dull stone; a skillful cutter takes the same stone, and, although reducing it in size, increases its brilliancy. Sometimes a part of the stone may be so hard that it cannot be polished. It is not always the hardest stones that are most brilliant.

Charles L. Clark, chief engineer of the Edison Electric Light Company in East Newark, and Robert Hewitt, Jr., have jointly invented an instrument to record the variations of a thermometer, barometer, steam or water pressure, or heat or cold, at any distance, through the medium of electricity. The system has been put to severe and highly successful tests. It also includes the use of the hydro-barometer, indicating and recording the height of water in tanks and reservoirs.

◆

The Test Of Glue, says the *Tischler Zeitung*, is to carefully weigh a piece and suspend it in water, at a temperature not exceeding 50° F. during 24 hours. The coloring matter is precipitated and the glue swells in consequence of the absorption of water. On removing the glue from the water the increase in weight will be found to be in proportion to the quality. The weight of the coloring matter can also be ascertained by weighing the glue a second time after it has been thoroughly dried.

◆

An ingenious machine is thus described by the *Railway Official Gazette* (Eng.):

"Most of our readers have probably seen at the Health Exhibition certain red chests, which seem likely to serve a useful purpose. If you want a postcard you have but to drop a penny into an aperture, and forthwith a drawer opens and you find one card and no more. You shut the drawer and may go on repeating the operation, until a notice becomes exposed that the drawer is empty. Should you think to take a mean advantage and put in only a halfpenny instead of a penny, the drawer remains closed, and your coin is returned through another opening at the bottom of the box. The same result would happen if you should put a shilling in; but a two-shilling piece being of the same weight as a penny, it is hardly advisable to try it, because no change is given. There is a second aperture for the reception of two-penny pieces, and a corresponding drawer which will give in exchange a sheet of note-paper and a stamped envelope."

◆

Here Speaks A Man to whom the lapse of years has not brought wisdom! He writes to the *Millstone* as follows:

"The improvements in milling should have vastly improved the quality of our flour, but such is not the case. Our flour to-day is rough and dry, and void of life, and has no longer that sweet taste that characterized the bread of thirty years ago. It is more unpalatable now in six hours after baking, than it then was in six days. What is the cause?"

We will tell him—it is the thirty years. Put that period on the average boy's palate, and, to the man, things in general are not so good as they were. Too much shag tobacco, too many beers, too much alleged pie—leaving whisky out—blunt the fine sensibilities of the palate, and men think the fault is in the substance. Things taste just as good to the children of this day as they did to the children of thirty years ago.

◆

The *Johnstown Tribune* says:

"At the open-hearth steel works of the Cambria Iron Co. the experiment is now being made of casting steel tires for locomotive and car wheels by running the metal directly from the furnaces into cast-iron molds, and ready, when cooled, to be fitted and shrunk on. This process, if successful, will dispense with the ordinary process of casting in sand molds, and will not only greatly facilitate operations, but also lessen the expense."

Steel tires are not cast in form in any event, but are made from ingots resembling a hat-body, or conical in shape. After this they are forged, punched, and rolled to size. Vickers & Co. made *cast* cast-steel tires some years ago, but soon abandoned them, for obvious reasons. If the Johnstown people can run open-hearth steel into a chill, and have it sound, they can do a big thing—something no one else has done yet.

◆

One Ton (2,000 pounds avoirdupois) of gold or silver contains 29,163 troy ounces, and, therefore, the value of a ton of pure gold is $602,799.21; and a ton of silver, $37,704.84.

A cubic foot of pure gold weighs 1,218.75 pounds avoirdupois; a cubic foot of pure silver weighs 655.25 pounds avoirdupois.

One million dollars gold coin weighs 3,685.8 pounds avoirdupois; $1,000,000 silver coin weighs 58,929.9 pounds avoirdupois.

If there is one per cent of gold or silver in one ton of ore, it contains 291.63 ounces troy of either of these metals.

The average fineness of Colorado gold is 781 in 1,000, and the natural alloy: gold, 781; silver, 209; copper, 10; total 1,000.

The calculations at the mint are made on the basis that 43 ounces of standard gold, 900 fine (coin), are worth $800, and 11 ounces of silver, 900 fine (coin), are worth $12.80.—*A Floater.*

◆

People speak about their eyes being fatigued, meaning that the retina, or seeing portion of the brain, is fatigued; but such is not the case, as the retina hardly ever gets tired. The fatigue is in the inner and outer muscles attached to the eye-ball and the muscle of accommodation which surround the lens of the eye. When a near object is to be looked at, this muscle relaxes and allows the lens to thicken, increasing its refractive power. The inner and outer muscle are used in keeping the eye on the object to be looked at, the inner one being especially used when a near object is to be seen. It is in the three muscles mentioned that fatigue is felt. Relief is secured temporarily by closing the eyes, or gazing at distant objects.

The usual indication of strain is a redness of the rim of the eyelid, betokening a congested state of the inner surface, accompanied with some pain.—*Medical Journal.*

◆

The Metric System is still agitated in certain quarters, and the desirability of its adoption by American mechanics seriously considered. Upon this subject Mr. Coleman Sellers says:

"Carefully as I have considered this subject of weights and measures during the time I have been from home, I am the more confirmed in my opposition to the enforced adoption of the metric system of France in my own country, and firmly believe that those countries that have adopted it are at a disadvantage, as compared to even the most imperfect of our systems. America has entered on the line of simplification of its metrology, and that is the direction that should be followed—not by any means giving up what is good, but by making what has been found to be practical, better and simpler.

"One has not to be long in England to find out how firmly are the seemingly complicated systems of weights and measures of that country fixed with the people. They weigh by the stone, and compute by the sterling currency as rapidly, or more so, as we do with our dollars and cents, and that because their unit is larger. The English shopkeeper knows nothing about decimals, and says, if you ask him, that he has never learned what they are. England has lately made legal the admirable standard manufactured by Sir Joseph Whitworth, and the chance of her adopting the metric system is not in the most remote degree possible."

◆

The Blow From A Swordfish is tremendous. The fish itself is from eight to twelve feet long, about eighteen inches in diameter, round-bodied, and very active. An instance of its strength is appended. The *Themis*, a three-masted schooner, sailed from Mobile, August 4th, of this year, and when five days out sprung a leak. Upon search being made the horn of a swordfish was found driven through the bottom.

On further examination it was found that the blade had penetrated the copper sheathing, then the outer planking of the hull, 4 inches in thickness; next a vacant space of 9 inches between the outer and inner timbers, or "ceiling," and lastly 4½ inches more of solid wood constituting the ceiling, altogether nearly 9 inches of plank and copper, with 11 inches of vacant space, including the 2 inches of the end broken off. How much of the sword remained outside has not yet been ascertained. The blow was struck from below, in a direction nearly vertical, and some idea of its amazing force may be found from the figures above given. The point of impact was a little forward of the mizzen-mast, about three feet from the keel, on the starboard side. The swordfish is the natural enemy of the whale, and probably mistook the ship's bottom for a foe.

◆

SLIGHTLY PERPLEXING.

On Oct. 14th one of the boilers in what is known as John Du Bois' "little mill," at Du Bois, Pa., exploded while under a pressure of ninety pounds of steam. The *Courier* gives the following particulars of the accident: "The engineer, Mr. Daniel Gilbert, was standing in the rear of the engine at the moment the explosion took place. He immediately shut down the engine and crept on hands and knees to the door. Having presence of mind about him, he tried to gain his way to the safety-valve and raise it, but the heat being so great he was forced to retreat. Seeing the front part of the furnace was blown down and the mill on fire, he quickly ran out around the mill, came in at the other side of the boiler-house where the pump stood attached to the hose, and commenced playing on the fire, which in a very few moments was under control. Mr. Gilbert, the engineer, told us the boiler had been in use twenty-six years and had been thrown away three or four times, and that in his opinion it was quite unsafe."

This is confusing, in that we cannot see why any one should need to raise a safety-valve after the boiler had burst! It's a wonder a boiler twenty-six years old, "thrown away three or four times," bursts! but a greater wonder that a man holds his life so cheap as to run it.

◆

CONCERNING COFFEE.

Let us say a word upon that great friend of man—coffee. How few there are who know what it is! Not the black, acrid decoction commonly known as such, but the fragrant stimulant which never reacts. Coffee is the only stimulant known to science which does not exact more than it bestows.

Alcohol is a notorious robber in this respect, but coffee is like charity—"it is not puffed up, it vaunteth not itself;" but it is a steadfast friend to the weak and enervated. But it must be genuine coffee, properly made, to have this effect. Not the bastard substance, so called, put up in paper packages or tin cans, and already ground and already worthless. It must be the genuine bean, recently roasted, and ground just before it is made, and then brewed.

The only way to make coffee so as to obtain its full strength and aroma is to filter boiling water through it—the French process, so called, but it is no more French than German, for all Continental peoples have used it for years. Aside from obtaining coffee in its entirety, this plan has the merit of quickness, for it takes only a few minutes, say three or four, to obtain the best cup of coffee which can be had. It also needs no clarifying or settling—the process itself does that; and those who have only drunk coffee which has been boiled for an indefinite period, and allowed to stand an hour or two after that, have a new sensation in store. Filtered coffee requires a special apparatus, for convenience, though it can be made in an ordinary pot by the aid of a flannel bag. The pots can be had in all house-furnishing stores, and are known as French coffee-pots.

One other word as to the brands of coffee: The coffee-bean is grown in various parts of the world, but it is not of equal excellence; it varies greatly with the locality in which it is raised; certain districts, even in the best countries, producing specially fine grades. "Rio coffee," shipped from Rio Janeiro, has a strong "twang" to it which some persons like. Maracaibo, also a South American coffee, has a rank flavor. Jamaica coffee is good, but lacking in strength. The best of all—to be brief—is Java coffee, and the two best Java brands are Plantation Ceylon and Old Government "Padang;" this latter the name of the district in which it is grown. These marks bring the highest prices of any that come to open market. As for Arabian Mocha the largest importers say it does not exist in this country—except in the catalogues of dealers. We regret to say for the coffee-lover at large that "Ceylon" and "Padang" cannot be had, except at certain places in large cities, for not every one knows of them, and there is but little demand. The "smart" groceryman always has everything, and no matter what customers inquire for, it is handed out to them—from the same box that all other goods are taken out of. Good Java coffee can be had, however, if the consumer will take the trouble to roast it himself. Most provincial grocerymen buy their coffees from city houses; these jobbers have had the coffee on hand a greater or less length of time, and the grocerymen kept it a little longer still. The result is that good coffee, as a rule, cannot be had freshly roasted outside of large cities. It pays, however, to take a little trouble to obtain it, and those who do so will find the process we have mentioned superior to the old one of boiling. This not only extracts the woody flavor of the beverage, but also dissipates the aroma.

The Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-pratice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may have possibly chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

ENGINEERING BLUNDERS.

When American engineers do not make as good designs, or machines, as foreign engineers require them to, they receive more or less advice and remonstrance. Sometimes this is friendly and mildly argumentative; at other times it is dictatorial, as from the throne of the universe. In any event it crushes American engineers, and leaves them in such condition that they are unfit either to design or to construct.

This is not for the public weal, and we hope that in future, when we make cruisers, or rashly attempt compound engines and boilers, that our shortcomings will be dealt with in a spirit of Christian charity and forgiveness.

"My son," said the paternal crab, in Æsop, "why do you walk sidewise, or backward, to reach your goal? Why do you not turn your face to the point you are aiming for, and go straight forward?" The son replied: "My father! when I see you refrain from walking backward I will do likewise."

There is consolation in the paragraph appended, and it applies so happily to the criticisms passed upon American mechanical engineering by foreign journals that we append it.

The *Pall Mall Gazette* (London) says in a letter from Chatham:

"The exposé of the defects in her Majesty's ship *Agamemnon*, quoted in *Pall Mall Gazette* from *Truth*, has given rise to an unusual amount of controversy in naval circles here. Unquestionably the salient features of the moot question raised by the publication of the paragraph are in substance incontrovertible. I have it on the very best of authority that from the first very grave doubts existed in the minds of the officials in this dock yard as to the sailing capabilities of the vessel, which, it will be remembered, was built here and sent to Devonport to fit. The glaring defects in the *Agamemnon* are unfortunately not confined to that vessel, for it has been, it now appears, generally known among the chief officials here that the *Ajax*, sister ship to the *Agamemnon*, is not one whit superior to the *Agamemnon*. The *Ajax* was built at Pembroke, and is now here for fitting. At her trial trip, which took place some 12 months since, her steering apparatus was found to be very defective; so much so that a collision was only just avoided. The cause of this unsatisfactory state of affairs in the navigation of these two immense and costly war vessels is attributed by the naval experts here to the faulty construction of the 'sheer' or longitudinal curve or bend of the hulls, which, being out of proportion to the other 'lines,' counteracts the effects of the rudder when the vessel is 'under way,' and causes her to 'heel by the bow,' as one of the Admiralty officers expressed it, when the head of the vessel is put about. The bulbous and disproportionate shape of the hull acts in the same manner as would be produced by forcing an unevenly formed wedge through the water, the action of a 'head sea,' or tidal stream producing an erratic course. Another blunder in the design of the 'fitments' of those vessels is the inefficiency of the hydraulic and automatic gear. The delay in sending the *Ajax* to sea is authenthically stated to be owing to having to fit duplicate hydraulic gear for working the turrets and guns."

Thus, it appears that blunders in engineering are not confined to any race, or section, but may occur to all.

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OF INTEREST TO INVENTORS.

At the last meeting of the *Am. Soc. of Mechanical Engineers* Mr. Oberlin Smith introduced a very interesting and important subject, to wit: the delays in transacting business in the Patent Office, and the injury incurred thereby to all and sundry. Much discussion ensued, resulting in the appended resolution:

"*Resolved*, That in furtherance of the views of the Society on the important subject of protection by patents, as expressed in the discussion thereon during the present session, the President be, and is hereby requested to embody said views in a memorial to Congress, to be prepared by him and such other members, if any, as he may request to co-operate with him therein; which memorial shall be duly forwarded to Congress on or before the date of its assembling next month; that said memorial shall recite briefly the importance of the interests involved, the fact that the patent system is based upon a recognition of the rights of the inventor to the value of his work; that the fees were merely to cover the cost of conducting the same; that already some $3,000,000 have been collected from inventors in excess of such cost, and that the reason of the diversion of this large sum from its legitimate purpose, the work of the Patent Office, through the resulting inadequacy of its clerical force, is and has long been greatly in arrear; and, finally, as an inevitable consequence, inventors are subjected to unreasonable and in many cases disastrous delays in obtaining the protection to which they are justly entitled, and for which they are charged; that said memorial shall be so presented as, if possible, to secure for it favorable and early consideration.

"Further, that to the same end, the President shall cause to be prepared a suitable power of petition embodying substantially the same arguments, and shall cause a copy thereof to be forwarded to every member of the Society, with the request that, if approved, each member will sign the same, and will procure other signatures thereto, and will thereupon promptly transmit to his member of Congress, or Senators, with his personal request that the measures advocated in the memorial may have his support and advocacy."

We sincerely hope that benefit will accrue from this, as it is certainly much needed.

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MECHANICS' DEBATING SOCIETIES.

Debating societies in general are objects of ridicule to all small wits everywhere, and endless jokes are made upon the subjects discussed. In many cases this is deserved, for the interests of to-day are neglected, while the character of Cæsar's wife, and similar weighty matters, are thoroughly overhauled.

Ignoring all such silliness, and devoting the attention of members to topics that will improve and instruct, there is no reason why a society for debate should not have great advantages. Mechanics, particularly, can derive benefit from such associations if they restrict membership to representatives of trades. Engineers are doing this, and have done it for some years past, but we do not observe, or know, of any similar assemblies among members of other trades.

If, now, to the avowed object of open discussion of mechanical and philosophical subjects, there be added a modest reading-room, the nucleus or beginning of a most useful association will be formed. Periodicals would be furnished for it by most publishers, *provided* the said publishers were satisfied that the association was what it purported to be; that is, composed of working mechanics who were unable to pay for all papers in their line. Individual teachers, or other professional men, would undoubtedly give occasional short lectures upon subjects germane to the association, and in this way encourage the members to go on with their good work.

The first question which arises when such schemes as we have briefly outlined above are proposed, is the expense, but this need not be an obstacle. For the room, most church societies would be willing to permit the use of the basement for the purpose once a week. If no such building is convenient, in some localities, members could undoubtedly obtain the use of vacant rooms for a very small sum. It is unnecessary for us to go into details as to methods and management, our purpose being only a general hint to those desirous of improvement as to one channel for it.

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"CONFIDENCE" IN BUSINESS.

As a business qualification confidence is an eminently essential factor to success, even swindlers who possess it standing upon the same footing as honest men. It seems only necessary in this city to walk into a business office with a plausible story, and plenty of cheek, to establish a credit on sight. This has been done time and again, the latest case being that of a person who represented that he was getting up a "Guide" to the Cotton Exposition, to be held in New Orleans during the winter. In pursuance of his scheme he went to business houses of all classes and deposited bogus "notes," as collateral for an established credit. Some of these notes were for over $10,000, and such concerns as the American Bank Note Company and the Century Company, accepted them without question, for they immediately went to work upon the orders, permitting the swindler to draw cash against them. This he did without loss of time. This confidence-man visited printing-houses and paper-dealers, and to all of them gave his notes, only one concern—after they had sent out a lot of paper—having the ordinary prudence to question the value of the notes. So soon as this was done the fraudulent character of the transactions was seen.

We are not writing a homily upon rogues and their doings, but we confess to some astonishment that leading New York business houses should part with their property upon the strength of a piece of paper, handed to them by a stranger. True, the paper bore the resemblance of an honest commercial document, and had the names of reputable persons as indorsers, but it is only ordinary common-sense to ascertain whether strangers have any right to negotiate valuable names.

NOT AT ALL DIFFICULT.

We find the following going the rounds of the press, and venture to correct a statement near the close. The preceding writer refers to cutting threads by a special process:

> "It is difficult on the best of planers to plane a piece with exact paralleled surfaces, if those surfaces are wide enough to be tested with straight-edge and end measure pieces combined; the elevating screws at each end of the head rarely agree. Possibly this lack of uniformity in the two screws at each end of the cross-head is the reason why the planer cannot be made to do work both ways, with roughing and finishing cut, the two ends of the cross-head on both sides of the planer not working together. If the production of exact screws can aid in this improvement and add at least thirty per cent. to the work of the planer, it will be a point of much value gained."

No careful workman relies on the elevating screws for raising or lowering the cross-head, to plane a job parallel. He measures from the table up, and gets the cross-head exactly true with it, and then he planes parallel every time. On some "make-shift" jobs we have had to remove the screws entirely, and hold the cross-head in place with clamps.

NEW INDICATOR ARTICLES.

The indicator series in our last volume by William Barnet Le Van have had wide popularity, and in the book form are selling rapidly. In accordance with many requests Mr. Le Van has taken up the matter where he left off, and will give our readers concise rules and advice on more advanced problems, or studies, in the use of the indicator. These articles will run well into the next year, and will be fully illustrated.

The current hand-book, "*The Steam-Engine Indicator and its Use,*" has been handed to impartial professional engineers of high standing, with a request to point out errors of fact in it. None were pointed out affecting the value of the work.

SHORT SUMMARY OF THE SITUATION.

We have been at some pains to obtain the sense of the business community in this and other sections, and we contemplated publishing the letters *verbatim*, but some manufacturers are unwilling to be put on record in this manner, although freely expressing their views privately. We have also personally interviewed prominent business men, and our agents have done the same. The result is that those whom we have addressed feel that the prevailing dullness in trade has no connection with political matters, and that the future, immediate or remote, will not be affected injuriously by any change that has occurred politically. Those interviewed were of all political parties.

AN INSTALLMENT.

It is perhaps not improper in us to call attention to our appearance at this time. Our new dress—new type throughout—and handsome engravings combine to make this a very fine issue.

Our support, both present and prospective, has been, and is such as to warrant renewed effort and outlay on our part to show that we appreciate it. It is needless to say that we have never made a promise or prediction in our paper that was not strictly carried out, and our present improvement is only an earnest of more to follow. This is one installment in advance.

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AT A RECENT BOILER EXPLOSION in Scotland it was shown that the boiler was without a safety valve, the same having been removed, and the hole plugged up. The jury returned a verdict of "not proven," as to carelessness on the part of the engineer.

SOMETHING ABOUT METALLURGY, NUMBER 8.

By NORMAN W. WHEELER.

When the puddling hearth is brought to the condition indicated in the last issue, and the fire cleaned, it is ready to receive a charge of pig-iron. All the cracks and leaks about the bottom will have been stopped with chilled cinder, even to the tapping-holes in the breast-plates.

Previous to charging the pig-iron, a barrowful of squeezer-cinder, and a shovelful or two of powdered ore are thrown upon the hearth, and the "fix" or ore walls about and upon the boshes repaired where they had become imperfect. Then the pig is put upon the hearth, the working doors and stopper-holes closed, and the blast turned on. When the iron is melted the damper and blast-gate are adjusted to make a slight plus-pressure in the furnace, so that all the leaks shall be outward rather than inward, and the flame made oxidizing, so that it will take C from the carbonized iron, and go off chiefly as CO_2.

The charge is now constantly stirred about with hooked iron bars—rabbles—put through the stopper-holes, and soon may be observed a great and sudden increase in the temperature of the charge itself, which appears much hotter than the walls and roof of the furnace. This increase of temperature is caused by the burning of the silicon contained in the iron, with the O of the squeezer-cinder and that of the fix-ore, and also with the free O in the flame.

In a short time the charge begins to boil, and as each bubble of gas escapes from the surface a small blue flame shoots up, which is characteristic of the burning of CO to CO_2, and indicates the gasification of the C absorbed by the iron in the blast-furnace, which now escapes as CO and is burned to CO_2 in the oxidizing flame.

The attention is next challenged by the appearance of exceedingly bright points upon the surface of the charge, which rapidly increase in number and size. These points are particles of decarbonized iron, which are rapidly oxidized in the flame, but give up their O again to the remaining C in the charge, when they are carried under by the rabbling, which has been continuous since the iron was melted.

The boiling grows more and more active until the charge appears like a seething mass of froth, carrying lumps of shining matter, which are accretions of iron particles, in much the same condition that they were at one stage of reduction in the blast-furnace. When the combustibles of the charge have burned away it shrinks to nearly its original level, because no gas is then being generated within it; that is, the iron "falls."

The skillful puddler keeps the iron sponge afloat in the slag as long as possible, and when it begins to fall, gathers the sponge into balls of convenient size, and draws off the greater part of the cinder through the tapping-holes. He then closes the stopper-holes, makes sure that the fire is thick enough, and adjusts the damper and blast-gate to produce a flame as hot and as little oxidizing as possible, to give the final welding heat to the balls, when then taken to the squeezer or hammer for welding up, and from there they go to the roughing rolls to be rolled into muck bar.

When you next visit a rolling-mill, watch for these things I have told you about, and keep a sharp lookout for other facts, and you will be surprised to see how well the new facts will fit in amongst the old ones, the mere skeletons of which you have gathered from these talks.

THE END.

BOOK NOTICES.

THE ELECTRICIAN'S POCKETBOOK. The English edition of Hospitalier's "*Formulaire Practipue de Electricien,*" translated, with additions. By Gordon Wigan, M. A. New York, Cassell & Co., Limited.

This work is a concise expression of modern electrical science up to the present time, and contains rules, clear descriptions, and engravings, for the practical operator in all lines where electricity is used. Although some of the calculations are couched in forms with which many persons are unacquainted, there yet remains a vast amount of information which can be made useful in the engine room and elsewhere. It is not possible to give any idea of the contents of the work, other than a mere enumeration of chapter heads or a portion of the index, and we must therefore content ourselves with this brief announcement. The cost of the work is $2, and will be forwarded by mail at that price.

THE PROFESSOR IN THE MACHINE-SHOP.

NUMBER 69.

Now, as to hiring men, there is a word or two to be said. How often is it not the case that a machinist asking work is treated very much as though he were a beggar asking alms? In too many places it is just so, though some persons will not like me to say this. I have never been rudely treated anywhere I went, but I have been in counting rooms when machinists came in and asked for a job, and I have seen the proprietors take no more notice of them than if they were beggars—not so much, perhaps, for a beggar would be attended to at once, while the machinist was merely looked at and left to wait. This does not seem quite fair. A man who is out of work has no time to throw away, and, surely, the few minutes needed to transact business with him could be readily spared, and the man permitted to seek elsewhere. Most proprietors of shops are gentlemen, in every sense of the word, and would not allow themselves to speak rudely to a man seeking work, but there are others who rose from the shop themselves, who try to forget it. They think it is business-like, and the correct thing to shout at a man as if he was half a mile off, or else to roar at him as soon as he gets inside the door—"We don't want no more help!"

Old Roberts was one of the latter class, and he got nicely "met up" with, as they say down South. Roberts has a shop in a town of about 100,000 inhabitants, and one day a shabby old chap came slowly into the office. He had no more than entered before Old Roberts threw down his pen in a rage and fairly screamed at him:

"What the —— do you want? Can't you see the notice on the wall, in the alleyway, 'No help wanted'? You better go and learn to read."

The shabby old man looked familiar to me, and in a moment I saw that Old Roberts had "put his foot in it," for the stranger was an inventor who was constantly taking out patents and building machinery. All he said was, very quietly, "Excuse me, sir, I seem to have got into the wrong shop"—and out he went. Old Roberts smelled something, and asked me if I knew the man, and who he was.

"Yes," said I, "I do, and you are the boss blockhead. Roberts, you are too rough! There's no sense in treating any one in that way, and this time you have kicked yourself off of your feet," and I told him, who the man was.

"How can I tell who is who?" said Old Roberts; "that man who came in was like an old beggar, and I supposed he was one out of a thousand who bother the life out of me, asking for jobs after I have put up a notice that I don't want any help."

"Well, now, don't say too much about old beggars," said I, looking at Old Roberts' greasy coat. "A man's coat is neither here nor there, and you have just seen that it is not a very safe criterion to go by. It is no wrong for a man to ask for a job; you asked for them high and low when you were in want of work, and you didn't care if there were notices in letters ten feet long put up all over the place. You said to yourself, 'That don't mean me; that means bums, and the notice is only put up to frighten them off; maybe they want a first-class man'—and you went in and tried your luck in spite of notices. Tell you what you do, Roberts, treat every one civilly and you will make no errors. It is the cheapest thing going. Next time you come over to Bungtown I am going to roar at you as soon as you get inside the door:

"*What the —— do you want? we don't want no help; can't you see the notice on the wall in the alleyway? You had better go and learn to read.*

"That would sound fine, wouldn't it?" Old Roberts said nothing, but I think I made an impression on him that will do him no harm.

In our own shop we do not have a great many applications for jobs; we are out of the way, for one thing, of the noble army of men who are always out of work, and escape by that reason, but once in a while, say twice a week, a man comes along and wants a job. If he is a decent-looking, respectable man I get into conversation with him, but if he is dirty and smells of gin I simply tell him that we are not hiring men at present, and that settles it. I have found this to be satisfactory all round, and I never make any mistakes on the score of appearances. It is always safest to keep your mouth shut until you know who the visitor is.

This reminds me of a curious incident which occurred only last week, and it shows how many-sided human nature is. I will repeat it *verbatim:*

Jake and I were in the office, when the door opened and a man about fifty, of ordinary appearance, came in. He said nothing, but, looking sourly around, threw some papers off of a chair and brought it over to my desk. He banged the chair down on the floor pretty hard, and said: "Is this Mr. Moulton?"

"Yes, sir," said I, "it is;" and waited for him to begin his business. He seemed in no hurry about it, but leisurely surveyed the office and all its belongings, finally ending by staring hard at Jake. He lost his time here, for Jake can look a hole through chilled iron when he feels like it, and that is when he is mad. Our curious visitor at last said in a harsh peremptory voice:

"Who makes your castings?"

"Well," said I, "Flask & Cope make them now, at Slagtown."

"Are they good castings; let's see some of them. What do you pay for them?"

All this was said in a tone of voice and with a manner which suggested that the man was laboring under some strong excitement, or else had a screw loose somewhere; and not being used to it I began to get rather riled. As for Jake he walked around and switched his tail, so to speak, as a cat does when it is preparing to spring. Without making any move to show the castings to our dictatorial friend I said: "Who are you, sir, where do you come from, and what is your name?"

"My name is —— and I come from ——." (This is an occurrence of recent date so I omit names.)

"What is your business? Our castings are entirely satisfactory, in quality and price, and we don't care to make any change. If you will let us know how we can serve you we will consider the matter."

To this the man made no reply for a moment, but directly, looking at me with an indescribable glance—insolence, cunning, rapacity, and fury all combined—he said, "I suppose you think I came in here to get your work?"

This rather startled me, and I honestly thought for an instant that the man was an escaped lunatic from somewhere, and I began to brace myself. Jake too was on his guard and came and stood behind the man's chair.

At his remark I got up and spoke with more decision. "My friend!" said I, "if you will say what you came in here for and have done with it we shall be obliged to you. We want to close this interview at once."

"What for?" said the man, coolly.

"Well," said I, "your manner is so peculiar that we don't understand it. We are not used to being bullied in our own office, and it rather riles us, especially as we don't yet comprehend what it is all about. We don't want irritable strangers to walk in, slap chairs down with a bang, and demand details of our business. What do you want of us?"

"Me irritable!" said the man; "you're the ones that's irritable. I am cool enough," and he laughed like a steam whistle.

I got up and stood before the man and said, "Will you close this interview at once?" He slapped his hand down on the desk and said with a violence that was incredible:

"I have told you, for the tenth time, that I came in here to suggest a plan whereby you could make ten dollars or so, by going in with me."

"This is the first time (after twenty minutes) that you have mentioned anything, but," said I, "you cannot suggest any plan whereby, if we made $1000, we would have anything to do with you."

"Why not?"

"*Will* you please retire, and at once," said I. The man got up slowly and said, 'Well, of all the curious folks I ever saw, you are the beat. This is a new experience to me, but I don't bear any malice.' And he finally disappeared through the door.

"I thought Guiteau was hung," said Jake as he finally left.

Now the letter of the above conversation is nearly perfect, but the spirit of it, the indescribable rage and fury, the cold scorn, the sarcasm, the violent gestures and insulting bearing generally, surpass anything I ever saw outside of a lunatic asylum. I have been down in the forecastle where drunken deck-hands and coal-passers were having a racket, I have had one or two firemen in my time, when I followed the water, cut up very rough, but none of them equaled this man who came in on business and in cold blood (!) to propose a transaction for mutual benefit.

Truly: "'Tis a mad world, my masters."

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ENGINEER VERNON.

The engineer who has charge of the locomotive round-house in Bordentown, N. J., looks as if he might be close to 60 years of age, and yet, beyond question, he is the oldest railroad engineer in the United States, if not in the world. In 1831 Baldwin placed a little wheezy machine on the Newcastle road, a line about sixteen miles in length, connecting Newcastle, Del., with a little point known as Frenchtown, on the Chesapeake, a few miles below Elkton, Md. It was a ramshackle affair, capable of little more speed than a runaway cow. It was in use only a short time, but during that period was managed by George Vernon, who now superintends the round-house in Bordentown.

In 1832 several locomotives were brought from England and placed on the Newcastle and Camden and Amboy lines. They were known as "Johnny Bulls," and the first one used on the Camden and Amboy road was on exhibition in Philadelphia in 1876. Vernon ran one of those locomotives for a year or two, and then was engaged by the Camden and Amboy Company, in whose service, including that of the Pennsylvania road, he has remained without interruption until now—a period of more than half a century. His age lacks only a few months of 78 years. For thirty years or more Vernon was head engineer of the Camden and Amboy roads. He hired and discharged engineers, and the most experienced and valued veterans of the throttle were trained under his eye.

"Rum is the bane of a railroad engineer," he said, "and I have seen it wreck many a bright young man. The clear head, the cool nerve, and the instant perception of the right thing to do in a crisis, must belong to the railroad engineer, or he can never become a first-class man. When he clouds his brain with alcohol his usefulness is gone, and his employment by a railway company is a constant invitation to disaster and death. I have been a strictly temperate man for more than forty years."

Railroading was far different when Vernon was young from what it is to-day. Old Mr. Stevens, who may be called the father of the Camden and Amboy Railroad, believed that the engineer should not be hemmed in and hindered by the modern cab.

"When it was cold we had to wear our overcoats," said Vernon, recalling these times; "we often ran a mile a minute, and you can understand that with the thermometer below the freezing point we raised a wind like a tornado, and we felt it too. Many a time I have crouched behind the boiler, and peeped over the top, while we plunged into the driving snow, or sleet, or rain. After a time we were allowed to rig up a sort of rude curtain, which fluttered like a sprit-sail around our heads; but Mr. Stevens would not allow us to put a glass in front, and we had to keep our face to the opening cut in the canvas, and take the hailstones or rain-drops as they shot in like bullets."

Such an extraordinary term of service as that of Mr. Vernon has been marked by many remarkable incidents. Before telegraphs were known he frequently carried the President's message a part of the distance between New York and Philadelphia, and was often engaged to take the news of lottery drawings from one of those cities to the other. On such occasions Vernon was in demand, for he had the reputation of knowing how to get all the speed out of a locomotive of which it was capable. Vernon was always remembered by the lottery men, who never failed to reward him for his running. He sometimes ran only his engine, and sometimes drew several cars after him. He has carried Presidents, Cabinet officers, statesmen, generals, and the great men of other countries; he has drawn millions of passengers, and journeyed hundreds of thousands of miles, and yet he never had an accident, there never was a person killed on his train, and he never received a scratch himself. When the Pennsylvania Company leased the lines in New Jersey a dozen years ago, they gave Vernon his present easy berth.

As an appendix to the account of Vernon, it should be said that Abner Huston, or Pop Huston, as he is generally called, began as a fireman on the Camden and Amboy Railroad in 1836. He became an engineer two years later, and in 1840 he went to Havana, having charge of a locomotive sent out by William Norris, of the Bush Hill Locomotive Works. Huston, therefore, ran the first four-wheeled connected locomotive in Cuba. He remained several months, or until the engine was accepted, when he returned, and after a somewhat varied railroad experience assumed charge of a shifting or drilling locomotive in the Pennsylvania road's yards in Camden, where he is still working, having been in continuous service about forty-eight years.—*N. Y. Sun.*

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"FOR THIS TIME ONLY."

The views which we have expressed from time to time in this paper as to mathematics and their connection with engineering have excited some discussion, and elicited the views of others. The subject has had sufficient attention, no doubt, but we cannot forbear quoting from a recent lecture of Prof. Kennedy, of the University College, London. This gentleman's opinion coincides so closely with our own utterances that it would almost seem as though he had read them; which idea, let us say, we do not entertain for a moment. We quote from the London *Engineer*:

"An interesting lecture on 'The Science and Practice of Engineering' was delivered by Professor Kennedy—University College, London—on the 24th October, the occasion being the inauguration of the Crewe Scientific Society. Mr. F. W. Webb presided.

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"Prof. Kennedy said: 'How far and how often could an engineer arrive at definitely valuable results by calculation? To what extent could calculated results be taken to represent actual facts, and trusted in design and construction? These questions concern all in different degrees, and on their answer depended to a great extent their method of work. It happened to be his good fortune to be at the head of a laboratory where they had special facilities for making inquiries into this very matter, directly and indirectly. He was, therefore, all the more ready to take that opportunity to speak about it. In the first place, he said that an engineer could never expect to arrive at valuable or trustworthy results by means of calculations taken from books, calculations which he did not understand, "rules," so called, from pocket books, etc. Pocket books, were very well to remind them of formal facts which they forgot or did not carry in mind, and to give by tables the results of long calculations. This was their legitimate and important function. But directly it came to taking up a formula which one did not understand, a's and b's and c's, putting in values and calculating results merely by rule of thumb (as far as one's self is concerned), the result was worth absolutely nothing, and few, if any, sensible men would trust such a result. In his mind, that definitely put an end to the idea of certain mechanical engineers about universal engineering dimensions all ready calculated. There was plenty of engineering work to be done without actual formulæ— the object of so much dread and scorn—done well, and done scientifically. From his point of view it was a great advantage to a man if he could follow the reasoning, physical or mathematical, on which other parts of engineering work, and especially design, depended. Fortunately for most of them, there was for the most part no necessity that a man should be a great mathematician in order to be a fairly competent engineer. He had had the pleasure of knowing personally some of the greatest mathematicians of our time. *With one exception, not one of them would make his mark as an engineer, even if he confined himself to the scientific side of his work.* He had also the pleasure of knowing some of our greatest, most original, and longest-headed engineers, and, so far as his knowledge went, hardly one of them had such aptitude for mathematics as would place him in even the second or third rank of mathematicians, if he devoted himself to that most fascinating subject. But all the same, there were engineers in plenty—not as many as could be wished—who had succeeded in grasping thoroughly the science, mathematical and physical, of their profession, without having lost the peculiar bent of mind which specially adapted them to be engineers.

* * * * * *

"'It happened in many cases that engineering problems were terribly complex, both mathematically and physically. Even to state them in any exact form was very difficult. So they contented themselves with an approximate representation of them by some theory, or formula. The science of an engineer was not only shown by his knowledge of the best working theory, formulated or unformulated (very often the latter), but by the accuracy of his estimation of the extent to which his theory probably represented the actual case; of the extent to which he might trust his assumption, and of the points in which the actual results would probably differ most from those given by the approximate theory.

"'He had used the expression "unformulated theory." He had known men who had wonderful physical insight with very little mathematical knowledge. The process of reasoning by which they arrived at results they had difficulty in putting into words; probably for want of familiarity with scientific terminology. But they had wonderfully accurate and correct notions as to where a given piece of machinery would give way; how best it ought to be strengthened, and so on. Of course, such knowledge was dangerous, because it was mainly based upon experience, and that within a certain limited range. It was, therefore, apt to give extraordinary results when applied outside that range. In itself it was to be respected, and within certain limits trusted. But the man possessed of this talent ought, if he had a right knowledge of himself, to be the first to mistrust his own judgment applied to matters beyond the range of his own experience. Then must step in some one who could give reason for the faith that was in him, who was capable of tackling a new problem, of seeing through it, and getting at its real meaning. But even here, results did not always presuppose actual formulæ. *He rather insisted on this idea, because he would not like them to think that they were altogether shut out from the scientific side of their work by being bad mathematicians.* Within certain limits, no doubt, the better capacity one had for mathematical reasoning, the better would one be able to work at the science of engineering. But he should like them to believe that a little mathematics, if only it be sound and accurate as far as it went, might go a long way. Also that much mathematics misapplied might only go too short a way.'"

The italics are ours. The omissions noted are not conflicting statements, but momentary discussions not relevant to the principal subject.

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We Will Say Again, in another place, that all new Subscribers who send in their names before January first, 1885, are entitled to receive The Mechanical Engineer for fourteen months. We hope ten thousand will do this!

CONFUSING TEXT-BOOKS.

It is claimed by authorities in geometric science that their conclusions are based on definitions easily understood, and on self-evident axioms and postulates, but any one of ordinary common-sense, who will trust to his own judgment and not be overawed by the weight of authority, will find by examination that their premises are often in direct opposition to their conclusions.

An angle, for instance, is defined by Euclid (see Playfair's translation) as "the inclination between two straight lines which meet and are not in the same straight line;" by Legendre as "the quantity, whether greater or less, by which two straight lines which meet depart from each other as to their positions," and by Davies as "the space, or the divergence, between two straight lines produced to intersection;" and from these widely different definitions, as a relation between two straight lines which *are not* in the same straight line, they each deduce the same elementary proposition, that the lines *are* in the same straight line when the angle is 180 degrees.

From these definitions it will therefore follow that the inclination, or the departure, or the space, or the divergence, between two lines is twice as great when they are portions of the same straight line as when they are perpendicular, or at an angle of 90 degrees.

This absurd conclusion, that the angle between two straight lines comes into existence only when they are produced to intersection, has been the source of countless blunders and much useless waste of money, especially on railway surveys, on which it is necessary to calculate the sign and magnitude of each tangential deflection on the alignment.

In proof of this might be cited a circular issued by the chief engineer of an important transcontinental road, instructing his assistant engineers to produce always to intersection tangent lines from the extremities of each circular arc; nor is this in any way a singular instance of supermathematical stupidity. In a work, for instance, on the elements of plane surveying and navigation, by the late Mr. Davies, Professor of Mathematics in the United States Military Academy of West Point, after defining an angle as the portion of a plane between two straight lines which meet at a common point, he gives four elaborate rules for determining the angle between two straight lines from their bearings, and adds, in a note, that "the above principles are determined under the supposition that the two courses are both run from the same angular point, hence, if it is required to apply them to two courses run in the ordinary way, as we go around the field, the bearing of one of them must be reversed before the calculation is made."

In application of these rules it is then stated that, when the bearings of two courses are N. 39 W. and S. 48 W., the angle between them is 93 degrees when measured from the same angular point, and 87 degrees as "we go around the field." The same confusion of ideas exists as to the natures of other trigonometric quantities.—*Van Nostrand's Magazine.*

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LIGHTING CHANNELS BY ELECTRICITY.

An immense electric light has been erected at Hell Gate, near this city. This locality is a narrow tortuous channel, abounding in difficult eddies, and through which the tide rushes like a mill-race. Hell Gate is the only approach to this city for large vessels from the North, and thousands of sailing-vessels and large passenger steamers use it constantly. It was thought that the electric light would be a great advantage to pilots, but they say it is the reverse.

A *Sun* reporter interviewed them, and thus states the pilots' objections:

"'Pilots never liked lights around there, even when in dwelling-houses. Lights are useful for ranging, but any attempt to substitute them for the light of day will probably fail, as it has hitherto. Pilots who have been through since this light was turned on say that they cannot tell where the shore is or how far away.'

"'It is like looking from a light room into the darkness without,' said Pilot Stilwell. 'You cannot see anything ahead of you when you are blinded by that light. The chief difficulty is in tacking through the Gate with a sailing-vessel. It is impossible to tell how far the shore is from the vessel, or, what is worse, how far away a coming ship is. The new light seems to increase the danger of collisions. The light as seen from Flushing Bay seems to be not half a mile away. It upsets all our calculations about distances.'

"'If we could have the lights every quarter mile along the shore to the Brothers Islands,' said another pilot, 'it might be all right. The shadows are too strong. The light seems to fail suddenly. That is, it illumins a small space beautifully, but outside of that space navigation is rendered more dangerous than before. Even the electric lights on the Brooklyn Bridge bother us. No light is needed there when the night is reasonably dark. We do need some sort of ranges when there is thick or foggy weather. In a fog the light does not show as well as an old-style whale-oil lamp. On a clear, dark night it can be seen beyond Eaton's Neck, say thirty-five miles away. The supposition was that the light would enable us to see the land-marks around Hell, Gate distinctly. It has had the opposite effect.'

"The experiments with the electric light are made on the supposition that it will penetrate fogs more effectively than the ordinary oil light. The opinions of experts differ on this point. Experiments made by Gen. J. C. Duane and Lieut. John Millis, of the Lighthouse Board on Staten Island, show that the electric light is ten times more powerful than the best oil light, and that the cost of a unit of electric light is rather less than that of a unit of oil light. The French Government has extensively adopted the electric light. In English lighthouses it is yet in experimental use. Some steamships have adopted the light with apparent success. Mark Twain, in his 'History of the Mississippi River Steamboat Service,' says that the electric light has worked a revolution. There is an electric light at Port Said, at the entrance of the Suez Canal, where it forms a marked contrast to the first lighthouse ever erected in the world, which was a tower with a wood fire on top of it, located at Alexandria.

"The experiments by the English lighthouse authorities at South Foreland have been carried on extensively with oil, gas, and electricity. It was recently determined that an electric light so powerful that the naked eye could scarcely endure it three miles away on a clear night was not so good as a much smaller gas light when there was a dense fog.

"When Mr. Thomas A. Edison was asked about electricity in lighthouses, he said there was no difficulty except with the arc light. He says the arc light has no red or yellow rays in it, and the white rays are all absorbed by the fog. The common gas-light looks blood-red through a fog, so does an incandescent electric light. He believes that powerful incandescent lights will be eventually found to be the best for lighthouses or any light that must be used in thick weather.',

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THE THEORY OF THE STEAM-ENGINE.

It is proposed here to follow the history of the experimental development of the principles controlling the efficiency of the engine, and modifying the conclusions derived by the application of the science of heat transformation, after first tracing the progress of the development of that science. The gradual formation of the pure theory of the steam-engine will be traced, and the limitation of that theory will naturally come up for consideration afterward.

The germ of a science of the steam-engine may be found in the work of Sadi Carnot, published just sixty years ago. Although familiar with the then doubted mechanical theory of heat, he was not sufficiently well convinced of its correctness, apparently, to make it the basis of his work, but assumed, throughout his "*Reflexions sur la Puissance Motrice du Feu,*" the theory of substantial caloric. Nevertheless, in his development of the theory of heat engines, he enunciated some essential principles, and thus laid the foundation for the theory of the steam-engine which was given correct form, in all its details, as soon as the dynamical theory was taken for its foundation principle. Carnot asserts that "the motive-power of heat is independent of the means taken to develop it; its amount is determined, simply, by the temperature of the bodies between which the heat is transferred. Whenever there exists a difference of temperature, there may be a development of power. The maximum amount of power obtainable by the use of steam is the maximum obtainable by any means whatever. High-pressure engines derive their advantage over low-pressure engines simply from their power of making useful a greater range of temperature." He made use of the device known as the "Carnot Cycle," exhibiting the successive expansions and compressions of the working fluid in heat engines, in the process of change of volume and temperature, while following the series of changes which gives the means of transformation of heat into power with final restoration of the fluid to its initial condition, showing that such a complete cycle must be traversed in order to determine what proportion of the heat energy available can be utilized by conversion into mechanical energy. This is one of the most essential of all the principles comprehended in the modern science. This "Carnot Cycle" was, afterward, represented graphically by Clapeyron.

Carnot shows that the maximum possible efficiency of fluid is attained, in heat engines, by expanding the working fluid from the maximum attainable temperature and pressure down to the minimum temperature and pressure that can be permanently maintained on the side of condensation or rejection, *i.e.*, if we assume expansion according to the hyperbolic law, by adopting, as the ratio of expansion, the quotient of maximum pressure divided by back pressure. He further shows that the expansion, to give maximum efficiency, should be perfectly adiabatic. These principles have been recognized as correct by all authorities, from the time of Carnot to the present time, and have been, not infrequently, brought forward as new by minor later writers unfamiliar with the literature of the subject. Introducing into the work of Carnot the dynamical relation of heat and work, a relation, as shown by other writing, well understood, if not advocated publicly by him, the theory of the steam-engine becomes well defined and substantially accurate. The Count de Pambour, writing in 1835, and later, takes up the problem of maximum efficiency of the steam-engine, shows the distinction to be drawn between the efficiency of fluid and efficiency of machine, and determines the value of the ratio of expansion for maximum efficiency of engine. He makes this ratio equal to the quotient of maximum initial pressure divided by the sum of the useless internal resistances of the engine, including back pressure and friction, and reduced to equivalent pressure per unit of area of piston. This result has been generally accepted, although sometimes questioned, and has been demonstrated anew, in apparent ignorance of the fact of its prior publication by De Pambour, by more than one later writer. De Pambour, applying his methods to the locomotive, particularly, solved the problem, since distinctively known by his name: Given the quantity of steam furnished by the boiler in the unit of time, and the measure of resistance to the motion of the engine; to determine the speed attainable.

Professor Thomas Tate, writing his "Mechanical Philosophy," in 1853, gives the principle stated above a broader enunciation, thus: "The pressure of the steam, at the end of the stroke, is equal to the sum of the resistance of the unloaded engine, whatever may be the law expressing the relation of volume and pressure of steam."

Professor Clausius applied the modern theory of the steam-engine to the solution of the various problems which arise in the practice of the engineer, so far as they can be solved by the principles of thermodynamics. His papers on this subject were printed in 1856. The Count de Pambour had taken a purely mechanical mode of treatment, basing his calculations of the work done in the cylinder of the steam-engine upon the hypothesis of Watt, that the weight of steam acting in the engine remained constant during expansion, and that the same assumption was applicable to the expanding mass contained in engine and boiler during the period of admission. He had constructed empirical formulas, published in his work on the theory of the steam engine, in 1844, for the relation of volume and pressure, during expansion, and had based his determinations of the quantity of work done, and of expenditure of steam in the engine, upon this set of assumptions and formulas, considering the steam to remain in its initial condition of dry and saturated vapor, or of moist vapor, as the case may be, from the beginning to the end of the stroke. Errors were thus introduced, which, although not important in comparison with those often occurring when the results of purely thermodynamic, and in so far correct, treatment was compared with the actual case, were, nevertheless, sufficiently great to become noticeable when the true theory of heat engines became known, and correctly applied. Clausius proved that, in the expansion of dry and saturated steam, doing work in the engine, condensation must take place to a certain extent, and that, consequently, the weight of steam in the cylinder must be somewhat reduced by the process of expansion beyond the point of "cut off." During the period of compression, also, the reverse effect must occur, and the compressed mass must become superheated, if initially dry. He showed that the amount of work actually done in a non-conducting working cylinder must be sensibly different from that estimated by the method of De Pambour. Taking advantage of the redetermination of the constants in Regnault's equations effected by Moritz, Clausius obtains numerical results in the application of the true theory, and deduces the amount of work done in the steam-engine under various conditions such as are met with in practice. He shows how the action of the engine may be made that of the Carnot Cycle, and determines the effect of variation of the temperature of the "prime" steam. The investigation is, in the main, purely theoretical, no application is made to the cases met with in real work, and the comparison of the results of the application to the new theory to practice in steam-engineering is left for others.

The work of Clausius is, throughout, perfectly logical, and beautifully simple and concise, and his application of the theory to the steam-engine amounts to a complete reconstruction of the work of Carnot and his followers, upon a correct basis. He develops with mathematical exactness of method and work the fundamental principles of the science of thermodynamics, constructs the "fundamental equations," the so-called "General Equations of Thermodynamics," and in the course of his work proves the fact of the partial condensation of saturated steam, when permitted to expand doing work against resistance.

Professor Rankine began his work upon the theory of the transformation of heat into mechanical energy at about the same time with Clausius (1849), and published his first important deduction, the form of the General Equation of Thermodynamics, nearly simultaneously, but a little earlier. He gave much attention to the then incomplete work of development of applied thermodynamics, and produced not only the whole theory of the science, but very extended papers, including solutions of practical problems in the application of the science to heat engines. Stating with singular brevity and clearness the main principles, and developing the general equations in substantially the same form, but by less easily followed processes, than his contemporary, he proceeded at once to their application. He determines the thermodynamic functions for air and other gases, exhibits the theory of the hot-air engine, as applied to the more important and typical forms, deduces expressions for their efficiency, and estimates the amount of heat demanded, and of fuel consumed, in their operation, assuming no other expenditure of heat than that required in an engine free from losses by conduction and radiation. He next, in a similar manner, applies the theory to the steam-engine, proves the fact of the condensation of steam during the period of expansion, estimates the amount of heat, fuel, and steam expended, and the quantity of work done, and determines thus the efficiency of the engine. He makes a special case of the engine using superheated steam, as well as that of the "jacketed" engine, considers the superheated steam-engine, and the binary vapor engine, and reconstructs De Pambour's problem. Applying the theory of the steam-engine to a considerable number of cases, differing in the steam pressure and in the ratio of expansion adopted, and including both condensing and non-condensing engines, he constructs a table exhibiting the efficiency of the steam, and the probable consumption of fuel (assuming a somewhat low efficiency of boiler) which table represents the limit of efficiency under the assumed conditions, a limit which may be approached as the conditions of practice approximate to those of the ideal cases taken, but which can never be reached.

As Rankine was not aware of the often enormous difference produced in the performance of the steam-engine by the extra thermodynamic phenomena involved in the operation, he does not indicate the fact that the results of his calculations must be taken with the qualification just stated above, and his figures are still sometimes supposed to represent those of actual performance. The fact is however, that the consumption of steam, and of fuel, in actual practice, always considerably exceeds those obtained by the solution of the thermodynamic problem, and, often, as already stated, exceeds that quantity by a very large amount.—*Thurston.*

CAUSES OF MILL FIRES.

The Millers' National Insurance Company during the past nine years has paid out over $375,000 for losses on mill property. Not a dollar of that great sum has been paid for damages resulting from the heating arrangements, and but a small percentage for damages known to have been produced by hot bearings. Fully 75 per cent. of all losses sustained have been night burnings, the origin of which we know nothing and can only surmise.

Allow, if you will, a proportion for fraudulent and incendiary fires equal to what may be attributed to the same causes where other property is concerned, and still you have an immense percentage enveloped in the mystery which is peculiar to mill hazards. I think I can point out some of the sources from which these fires emanate.

I assert as a self-evident proposition, that when a mill is shut down and the machinery is at rest (bating the very remote chance of rats tampering with matches), there are only two ways in which flames can be developed honestly in the building. One of these is by spontaneous combustion, and the other is from fire which was ignited while the mill was in operation, at some point where it was concealed from observation, and smoldered until it found its way to the air and then burst into flames.

All combustion is a chemical process, by which heat is evolved, and, as ordinarily observed, is one taking place in the presence of atmospheric air, the oxygen of which gives it life. What we call decay in animal and vegetable matter, or rust in metallic substances, is only combustion, and the degree of heat evolved depends on the rapidity of the process. Scientists tell us that a log, decaying, throws off as much heat in the aggregate as it would if actually consumed by active fire. In the one case the process is so gradual this effect is nearly imperceptible, while in the other it is so rapid that the heat is felt, and its intensity can be measured.

There are certain organic substances or combinations of matter that are peculiarly liable to chemical changes which produce decay or fermentation so rapidly as to cause ignition with its consequent fire and flame. This is what is commonly called spontaneous combustion. It would be foreign to the purposes of this paper to enumerate all the various substances or combinations which will produce this result. I will refer only to those which may be found in almost every flour-mill.

Oil or grease mixed with inflammable matter is always a dangerous combination, the rapidity of the chemical action depending largely on the kind and age of the oil used. The vegetable oils, such as linseed, cottonseed, olive, almond, and rapeseed, are the most rapid in their action, and these, if old and rancid, are more dangerous when fresh and new. Lard-oil and fish-oil will produce the same results, though not so quickly. Oily rags used for cleaning purposes should never be permitted to remain inside the mill for an hour, unless they be kept in closely covered metallic vessels. Oil mixed with mill-dust, with bran, or with middlings, will produce fire if the proportions and the atmospheric conditions be favorable. I have known fire generated by the drippings of a bearing falling on middlings, and again in a mass of sweepings piled up in a corner on the husk. A mixture of oil is not always necessary. Water in many cases will be as effectual as oil is in others. Damp cotton, damp bran, or oatmeal and damp gunnybags will ferment and heat oftentimes to the point of ignition. Buckwheat hulls and oat hulls will do the same thing. I know of several cases where fires have been ignited in this way.

Steam mills using bituminous coal have an additional liability to spontaneous combustion in their coal piles, especially if they keep a large supply in store for any length of time. Such coal usually contains the sulphuret of iron, in the decomposition of which great heat is evolved. Refuse or slacked coal contains a larger percentage of this mineral, and lying more compactly than lump coal, is more dangerous. I know of one mill in Indiana that has been fired twice in this way, and the quantity of coal in their pile was not a large amount either.

Now when fire may be generated by conditions which are ever present in most mills, is it so very strange that so many of them are destroyed under circumstances that appear mysterious, and indicate fraud or incendiarism? When one knows the causes which make spontaneous combustion possible, the course to be pursued to prevent its occurrence is apparent.

Permit no oily waste or rags to remain in the mill.

Allow no sweepings with which oil may be mixed, or which may gather dampness, to lie in the nooks and corners, awaiting the opportune moment to do their work of destruction.

In a word, know and appreciate the danger which is continually hanging over you from this source, and govern yourself accordingly.—*American Miller*.

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PETROLEUM AS FUEL.

Considerable activity seems to prevail at present among inventors in the adaption of petroleum to general use as fuel in all sorts of industrial operations. It is a matter of some interest to note the fact that there are, at least, three points involved in the usual methods of treatment of crude oil as an industrial fuel, upon one or all of which they stumble, either through want of information or by reason of misapprehension of facts. One of these stumbling blocks is the effect of "super-heating" upon steam, which is so largely used by oil experimenters, and which is believed to be transformed into hydrogen by the trifling superheat which they impart to it.

Another halting place is found in the quantity of heat needed to vaporize the oil, so that it shall burn with some freedom, and hence in such quantity as to appear to be doing actual work. This heat is obviously derived from, and absorbed out of, the store of heat which is produced, or ought to be, in the fire-box, and in which the useful work, if any, must be done. That there should be this large absorption is an obscure puzzle of a very trying kind to the ingenious inventor.

Still a third difficulty is encountered by those who attempt to make what they call a fixed gas from the oil, in order that the fuel may be readily distributed over a wider area in a works, and rendered more completely applicable to the purposes for which it is intended. This difficulty lies in the length of time during which the vapor or gas in process of formation, must be retained, in passing through the hot retorts, in order that it may be fully transformed into the new series of hydrocarbon combinations due to changes of temperature. The anxiety to get a large production of gas leads to the over-crowding of the retorts, to rapid cooling, or to an excessive and unexpected consumption of fuel beneath them, to a tarry development that will not be checked, to a choking (with soot and coke) of the smaller passages, and, at length, to a suspension of operations, and a drawing of fresh breath, soon to be expended again in the chase after the same game; either with a fresh outfit, the rents and wear and tear having been mended, or over a field wholly new.

Those who study this line of industrial effort know that the nature of the oil used is such as to shut out even the pretense of a paying use of it in any of these ways, except in the very rare cases of a special need of quality in the flame, and an unusual range of prices. That so many experimenters can be found who ignore this fact, can be accounted for upon ground more rational than that they merely know that oil burns with a hot flame, and, therefore, suppose it can be used for any kind of heating, without reference to the quantity of heat which must be developed in any given case, its intensity, or the cost of application.—*Mining and Engineering Journal.*

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OLD AND NEW ATLANTIC STEAMERS.

The *Oregon* and *America* both left New York on Wednesday, the 8th of October, and both arrived at Queenstown on the 15th following, the *Oregon* running a distance of 2,819 knots, occupying 6 days 12 hours 37 minutes, which gives a speed of 18.01 knots per hour, the *America* running a distance of 2,777 knots, occupying 6 days 17 hours 43 minutes, a speed of 17.14 knots. The *Britannic* left New York on October 11th, and arrived at Queenstown on October 19th, after running a distance of 2,852 knots in 7 days 12 hours 17 minutes, which gives a mean average speed of 15.85 knots, thus occupying, say, one day longer than the *Oregon,* and about 18 1-2 hours longer than the *America.* By these figures it will be seen that in a period of ten years a gain of one day has been obtained in crossing the Atlantic; and assuming that the consumption of each ship was per day respectively 265, 185, and 100 tons per day, to gain this one day the *Oregon* burned about 1,656 tons, and the *America* about 1,174 tons on the passage home, whereas the *Britannic* burned only 750 tons.

If we, then, consider that in the case of the steamer *Oregon* it was necessary to burn 906 tons to gain 24 hours, and in the case of the *America* 424 tons to gain 18 1-2 hours, on the *Britannic*, it may well be asked, Do the new steamers possess the same efficiency as the old? Looking at the wonderful performance of the *Brittannic* and her sister-ship the *Germanic* during the past ten years, it seems as if they could yet be made to compare with their newer rivals in speed by increasing the power of their machinery in but a moderate degree, as it is plainly evident that their superior model serves them in good stead; and considering that the *Britannic's* last homeward passage is—if we are not mistaken—the fastest she ever made, the strength of hull would be amply sufficient to allow of the increased power being supplied, which the extensive use of steel would permit, to suit the existing portions of the ship.

When, then—as we stated in our former article—the boilers of these steamers require renewal, it should, in our opinion, be seriously weighed whether or not it is advisable to replace the existing machinery, excellent though it be, with either triple expansion or ordinary compound engines of such power as to increase the speed to 18 knots. In order to place more clearly before our readers how much it requires to obtain so little, the following table, showing the relative horse-power, etc., will be of interest:

	Fastest passage. Dys.	Hrs.	Mins.	I. H. P.	Consump.	Ton.	Speed.
S.S. Oregon...	6	12	27	12000	265 tons.	7250	18 knots.
" America	6	17	43	9800	185 "	5530	17.1 "
" Britannic	7	12	17	4900	100 "	5004	15.8 "

The *Umbria*, the latest addition to the Cunard fleet, attained a speed of 20 knots on the measured mile, and is, if we exclude torpedo boats, the fastest vessel in the world. Much curiosity is felt as to the result of her first voyage, and it is to be hoped that she will be more fortunate than the *Oregon* and *Austral* have been. Engines of enormous power, such as those of the *Umbria*, are, however, still somewhat in the experimental stage, and broken pistons are not unknown among them.—*Engineer.*

The *Umbria* made the passage over in 7 days 16 hours; about 15 1-3 knots per hour.—Eds. M. E.

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Governor Thompson, of South Carolina, expresses the following opinion in regard to the election: "there will be a general revival of industries; manufactures will be stimulated and developed by the application of additional capital; the working people will be better paid; the price of farm lands and of real estate generally will advance; that there will be for the whole people, without distinction of condition or class, an era of political and industrial progress"

COMMON SENSE AND LUBRICATION.

At a late meeting of the American Association of Mechanical Engineers, Dr. Arvin, chemist to the Standard Oil Company, said:

To a practical man who wants to know what he needs to put upon his engine, the value of "the co-efficient of friction" is extremely low. We know perfectly well that it depends upon many conditions that are difficult to maintain and to understand. Even the wisest admit that there is very little yet found out which throws a practical light upon that subject.

For instance: we know perfectly well when they decide the co-efficient of friction of paraffine oil, on two polished surfaces made to fit perfectly, we gain no light at all on what we need to use on bearings that do not fit equally well, or have the same finish. If we are to decide how to construct a bearing, what its proportions should be, how large a segment it should cover, all of these researches would be directly in point. But if we have an engine that runs hot, or a certain construction of bearing that makes it difficult to find a suitable lubricant, these investigations afford us no light whatever, and I think that any engineer will agree with me that crediting all possible value of researches regarding the co-efficient of friction, what we want to know is vastly beyond that.

For instance: an engineer comes to you and says, "I was using such a paraffine and my engine ran cold, I am now using such a paraffine and it runs hot." We find on examination that there is no practical difference between the two, but when we come to apply them to a bearing we find that for some strange reason the two oils did not work alike. When we apply them to spindles we find that two paraffine oils often bear no relation to each other in their practical behavior. We find that one will run at a much higher temperature for some obscure reason. We might think it due to its viscosity, but we find by our instruments that it does not depend on that. In some instances, too, the results which we obtain are exceedingly contradictory.

The Rochester and Pittsburg Railroad Company run their cars with a bearing, the surface of which is composed apparently of lead. There is a very thin flim of lead—it appears to be lead—spread over the inner surface of the composition box, which looks as though it might be gun metal. They say they will run an oil on this soft bearing that I know positively fails under similar circumstances, and on the same class of cars, on the Erie, New York Central, and Delaware and Lackawanna—just why, I cannot say for the life of me. I know that that shaft will sink down on that bearing, and yet it runs cold, and runs on a very cheap oil. One of the Standard Oil Companies manufactures an oil which is composed largely of a mineral base which is united with a fatty acid. All things considered, that oil has been the most successful for running cold of any oil used on railways. And yet that fails to equal some other cheaper oils on the friction-testing machines. We have had occasion lately to make some comparative tests on fast-running spindles of the Sawyer pattern.

We have half a dozen oils from Europe and several made in this country: Taking a spindle frame, and adapting a dynamometer of my own, I expected to find that oils which had the best body would be the best oils for those spindles. I found I did not know anything about it. After having read many papers and listened to a great deal of talk from gentlemen who know a good deal about it, I found that the spindles did not bear out anything that I expected. Now, a spindle that was nicely fitted behaved in one way; but a spindle that was badly fitted behaved very differently. The effect of this was to establish a friction of its own in addition to the friction which we generally speak of as due to the oil itself. If we put on oil that has good body the heat increased very rapidly. Now, we should say at first that that was an objection to that oil. But we found after running them for a short time that the oils that gave us the best results in the economy of power where the ones that produced the most rapid wear. We found that after running constantly at some 6500 revolutions a minute that it had lost as much as 1-10 of one gramme in actual weight. When we took another paraffine oil the wear was not one half of that, and there seems to be no apparent reason for it.

I have come to think lately that the question of wear on bearings as ordinarily found is one of vastly more importance than the cost of oil. One large mill owner came to me recently and said that he wanted an oil for his spindles. He said he did not care what it cost. He said, "after running some eleven mills for many years I have discovered that we sustain such great loss by wear due to poor lubrication, as to make the mere price of the oil unimportant.

When the engines of the Brooklyn Bridge were started the faulty construction of the bearings and journals caused rapid heating. I think it was generally believed by the engineers who examined them that the construction was faulty. The main bearings were like those drawn on the board, and the pinching on the sides appears to have been such as described. While watching those bearings quite intently one day I happened to put my finger on the shaft (which I think measures eleven inches in diameter) at a place where it showed extra pressure on the box, and I found it quite hot, while just an inch and a half from that section the shaft felt cold, showing how great and intense must be the heat generated when the conductivity of such a mass of iron failed to remove it. It seems to me that the conditions and behavior of those journals corresponded with what Prof. Thurston has just described, and the binding in all such cases being simultaneous with an increase of temperature, I am led to wonder if it be not due to expansion by heat rather than to yield in the journal.

We generally find that where we can use oils of higher viscosity ordinary machinery bearings run colder. But in some instances of high speed and heavy pressure only thin oils answer it all, and the bearing must be flooded. I believe the engines of the Edison Electric Light Company, which run the dynamos in Pearl street, are rated 75-horse power and run at the rate of 375 revolutions per minute. I am credibly informed that the oil they are using on these engines is the only sort yet found to run cold. This is an oil of about 32 deg. Beaume gravity, which is almost as light and fluid as common kerosene and requires to be supplied constantly. I have come to think that this arranging of a steady current of thin oil is a very desirable plan wherever it can be practically carried out, as in case of the Sawyer & Rabbeth spindles, and nicely finished and fitted bearings of larger dimensions like those in the machines these gentlemen have devised for testing oils.

With bearings nicely finished and journals carefully scraped and ground to fit, an abundant and constant supply of thin oil will give the best possible result in keeping the bearing cold and saving power. With such machines you may learn much of the proper proportions of bearings, and of the conditions of friction in relation to pressure and speed, and of oils, too, under the exact conditions of these machines, but nothing of the requirements of machinery in common use. Why, these gentlemen think of a journal and bearing as two cylindrical surfaces in perfect contact! It would be more scientific and practical to regard the fit of ordinary bearings like that of a pea in a bushel basket. In many instances one point of contact would be almost too much to expect, and the "body" or viscosity of the oil must make the fit. I know by my own observation that the results obtained in testing heavy lubricating oils on these machines do not correspond with the practical working of these oils on railway axles and other machinery, and any engineer to whom you might supply oils selected from such data, would soon come back to you, as the saying is, "with tears in his fist and his eyes doubled up." We have been there—both sides.

The fact is, the most important conditions under which these tests are made, are the very ones that can only be maintained under special and unusual circumstances, and are never found in the great mass of machinery that must be lubricated. This makes the frictional tests by special machines worthless as a means of selecting lubricants, and a delusion to those whose opinions of oils are thus founded.

I believe that the great value of these friction tests, and the machines by which they are made, lies in another direction; for we know that scientific research lies at the root of all industrial progress. But I think we must try an engine oil on an engine, a spindle oil on a spindle, and a wagon grease on a wagon, all as nearly as possible under the ordinary conditions, to learn anything of the real value of the lubricant.

While speaking of spindle oils, I should have added that I found their bearing parts did not wear bright. I considered their frosted look as indicative of a friction I saw no way of estimating, although it was attended with rapid wear. With oils of a higher viscosity and heavier gravity the bearing surfaces polish like a mirror, even though the friction, judging by the power consumed, is much greater with the more viscous oils. I infer that we cannot judge of the actual friction occasioned by the moving surfaces in contact, while we are unable to estimate separately that friction attributed to the oil itself. For using a thin oil we decrease that one friction so greatly that we cannot note any lesser increase in the other which occasions wear. If it be true that the question of wear is frequently of paramount importance in choosing special oils, then a low co-efficient of friction is no measure of value, and our frictional tests are worthless as a means of judging.

It is frequently said that we have petroleum oils which alone answer all requirements of lubrication. It is not so. I wish it was. I believe practical experience fully proves that in many instances compounded oils are best. Sometimes a thin petroleum oil, with a small portion of animal oil gives better results. You may find instances where the best petroleum oils do not answer on an engine, when lard oil or a mixture principally lard oil keeps the engine cold and is every way satisfactory. This is sometimes the case whether the petroleum be of heavier or lighter gravity than the lard oil. But I am glad to say these are rare instances, where petroleum oils do not answer every requirement.

I do not feel that I have much information as yet that will seem to you as profound or new. I can, at most, only hope in throwing out these rough suggestions, to give a clue to facts which may enable others here to learn much more of what we need to know than I shall be able to discover.—*Oil, Paint & Drug Rep.*

CALIFORNIA OLIVE OIL.

It will surprise many to learn that the olive oil made in California, by Elwood Cooper, is superior to foreign olive oil. This is one reason, says Mr. Cooper:

> "I make only one grade of oil, and after the first pressing use the pomace for feeding pigs, but in France three grades are made. After the first pressing there, the pomace is dumped out into a heap and lies there until the end of the season. Then this pomace, which in the meantime has moulded and fermented, is reground and repressed, the result being the second grade of table oil. Then the pomace is placed in vats and water poured over it. Fermentation again occurs and the oil that escapes is used for burning and lubricating. My investment has proved so profitable that I cannot afford to impair it by making a common grade of table oil, and it wouldn't pay me to make lubricating oil."

This oil sells on the spot for 30 and 40 cents per bottle higher than foreign oils. Mr. Cooper says:

> "At first it was necessary to ship the oil East, but it gained so rapidly in reputation that the demand for it on this coast soon out-stripped my possibilities of manufacture, and I do not send any East now, except when ordered for medical purposes. A considerable amount is bought for medicinal use, as all the foreign olive oils in the market, as can be proved by simple tests, are adulterated with either cotton-seed oil, mustard-seed oil, or sugar of lard."

◆

CASTING of bronze statues of Buddha, an Indian idol, is carried on in Bangkok. The process, says a late official report, is of the kind known as "en cire perdue," and the alloy used consists of copper and lead, sometimes with the admixture of a small quantity of zinc. A clay model is first made; upon this a coat of wax is molded, and over this again is put another layer of clay. The whole is then baked, the wax running off through apertures left for that purpose, and, the central core being kept in its place by iron pegs, the alloy is then run into the space previously occupied by the wax."

We fancy that this is incorrectly reported, the inner model, so called, is simply a core; it would be useless to give any shape to this, for, being inside, it would not show. If the alloy is run into the space previously occupied by the wax, that is the features, etc., would be inside the casting, and the exterior of it would be what it chanced to be.—EDS.

◆

DR. LENOX BROWN, of London, has obtained some photographs of a professional singer's larynx while in the act of singing. He made even a photograph of the chords when they were producing falsetto notes. But he succeeded in doing it only in this particular case, in which the singer, possessing an unusually unirritable throat, did his best to help him in his experiments, Mr. French, on the other hand, managed by the use of a kind of pistol camera and a magnifying glass to obtain photographs of all kinds of throats, healthy as well as infirm, irritable as well as unirritable, working as well as at rest. The great point was to catch the impression as quickly as possible, and by means of his pistol camera he managed to snap impression of deep inspirations as well as expirations of contralto, soprano, and all kinds of deep and high notes.—*Sun.*

◆

ONE OF THE LARGEST TUG-BOATS ever built in this country was launched last month by Neafie & Levy, Philadelphia. The vessel is 125 ft. long, 32 ft. beam, and 13 ft. deep. The engine is 650 hp. The boat is for Captain Eads, and is to be used in New Orleans harbor; she is capable of towing a ship of 3,000 tons at a good speed.

◆

AN OLD LONDON BRIDGE, recently blown up in England had been under water for 1600 years. Notwithstanding this, the oak beams and mortar comprising the foundation were found in excellent condition.

◆

REDUCED RATES FOR 1885.

In common with many other publishers, at this season, we have been in the habit of giving the last four issues of the current volume gratuitously to all new subscribers, and we herewith announce that we will do the same this year. We will furnish this paper from the current issue until Jan. 1st, 1886, to all new subscribers who may send in their names prior to Jan. 1st, 1885, and we hope that the number who will take advantage of these terms will be large. This offer will not extend beyond the period named, and we shall not be bound by it for any favors arriving after Jan. 1st.

Also, we announce, as a concession to old subscribers, that we will send two copies of this paper for $3.50, or $1.75 each. If our constituents, who have so long encouraged our efforts, can see their way to obtaining a friend to join them, they can save a trifle by so doing.

We have also reduced our club rates in accordance with the times. Realizing that many are out of work, and that those who are employed have been cut down, we have cut ourselves down as well.

Our club rates for 1885 will be as follows:

Five	copies	to any	address	each	$1.60
Ten	"	"	"	each	1.40
Fifteen	"	"	"	each	1.30
Thirty	"	"	"	each	1.20
Fifty	"	"	"	each	1.00

☞ Where lists of 12 names are sent, the rate for 10 names will apply, not that for 15 names. In no case will lower rates be accepted than those given, unless in the rate for 30 names, where 28 will be accepted. On the 50 rate the full number must be sent and no lower rate than $1 will be taken for any number of names.

These rates, it will be observed, are a material reduction from last year all through, and we hope to be favored with a response to them in such increased ratio as to, at least, cover the reduction. Those who feel that they are willing to aid us in our enterprise to the extent of soliciting their friends to come in, can merely send the names with the money, being particular to have the addresses distinctly written and correct.

Franklin Press, 323 Pearl and 80 Cliff Streets.

THE MECHANICAL ENGINEER.

New Series. Vol. VIII.—No. 12.
Enlarged 1883.

New York, December 13, 1884.

Single Copies, 8 Cents.
$2.00 per Annum.

NEW FRICTION-DRUM HOISTING ENGINE.

The engraving herewith shows a new form of hoisting engines which has many good features; respecting it, the manufacturers say:

"This engine has many new and valuable features. It transmits a uniform power throughout the entire revolution. It has no piston-rods, cranks, balance-wheel, cross-head, slides, eccentric, dead centre, or any complicated mechanism which forms the source of more than 4-5ths of the trouble encountered in the ordinary piston-engine, and has all the advantages of a double cylinder engine. It is perfectly reliable and will do its work when called upon. It has no valves to stick or get out of order. And there is no trouble experienced from water in the cylinder. The working parts of the engine are enclosed in a steam tight cylinder, reducing friction and wear incident to reciprocating engines by dispensing with the complicated mechanism involved in the use of them, for hoisting, either single or double. The reversible part of the engine consists
of an ordinary slide-valve with
ome slight modifications to
apt the same to the purpose
uired. This valve starts,
s, and controls the speed
e engine, as well as in-
reversing it, even when
need. This single cyl-
ine has all the advan-
double cylinder pis-
vith the additional
having one cylin-
ng it more eco-
use of steam,
r piston-en-
time avoid-
e engine
of 297
n and
not
team
ions per minute. The
rucible steel and is 1 3-4
rking in gun metal boxes.
nches in diameter and 18
ll hoist from 1500 to 2000
nute. The boiler is 30 inches
et high, with 53 tubes, 2 inches
d 45 inches long, the heating sur-
square feet. The size of the bed
:9″ by 6 feet.

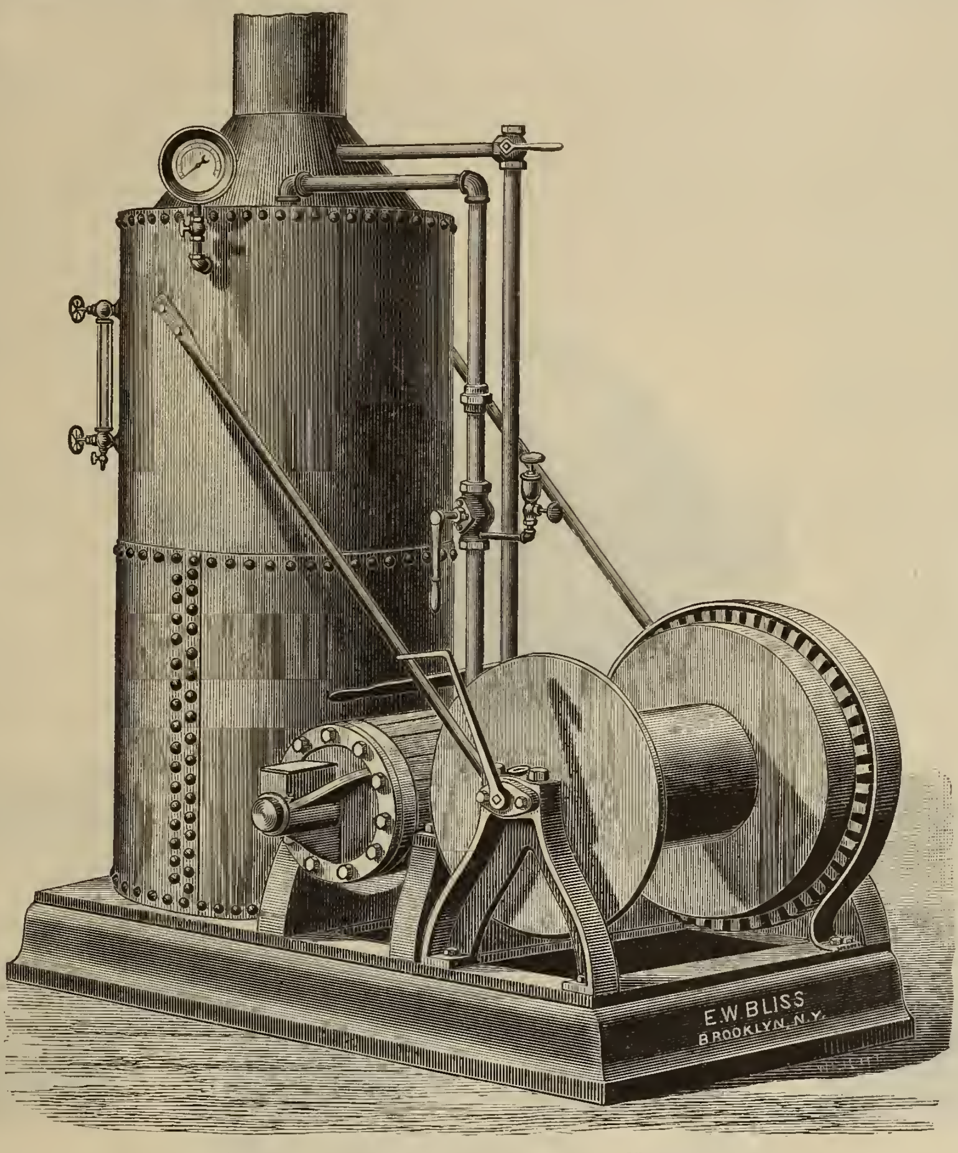
hoisting engine, is suited for bridge
s, pile driving, for mines, quarries, steam
lighters, barges, scows, schooners, steve-
warehouses, coal yards, and all other
purposes.

ther particulars, enquire of the manu-
E. W. Bliss, 17 Adams street, Brook-

◆

Metal Cap which will be placed
Washington Monument at the
has been manufactured at Phil-
of the Government, and is of
minium. It weighs only
ill be burnished, and as
ode by exposure to the
position, shine like
ightning-rod with
vided will be

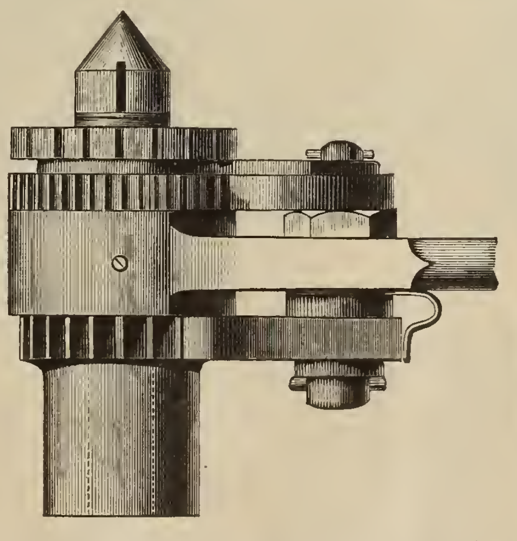
Watch The Next Man you see opening a globe valve, and observe him run the stem out three feet or so; supposing thereby that he gets more pressure with every turn. Two turns on a globe valve gets all the pressure there is to be had.



New Friction-Drum Hoisting Engine.

SELF-FEEDING RATCHET-WRENCH.

In speaking of the ratchet-wrench we have not always been so respectful as we should have, regarding so useful a tool. This is perhaps owing to associations, and circumstances



over which we had no control, and is the direct result of a hateful intimacy with it some thirty odd years since which we have not forgotten.
that time it was
l institution,
o can look
l on this

Our engraving, taken from the London *Engineer*, represents a new form of ratchet-wrench which is self-feeding, and the construction is so fully explained by the engraving that we need only present it. Fine and coarse feed, for large and small drills, are provided for, and it seems to be a decided improvement in a very useful tool.

◆

To Clean And Polish Brass Articles.—Any soiled and tarnished brass article can be cleaned and polished until it looks like new, by laying it a few minutes in some essence of vinegar in which a pinch of salt has been dissolved; then remove it and rub it between your hands, dipping them occasionally in the vinegar. When quite clean and bright, rinse thoroughly and dry in sawdust or wipe dry with a clean cloth. All kinds of brass articles can be cleaned in this way even when tinted (omitting the salt), or dipping them in vinegar and brushing with red chalk. But as vinegar corrodes iron and steel, any parts made of these metals must be entirely removed before dipping the brass into the vinegar.

Brass goods can be cleaned in this way, but as vinegar attacks brass much more rapidly than iron or steel the polish will be killed if the goods are left in vinegar and salt "a few minutes."—Eds.

◆

In Southern Utah, at Cove Creek, are located several mines of native sulphur. There are twenty-three claims located, and the body of brimstone so far surveyed extends 2100 feet in length, is 1800 feet wide and has a thickness of about sixty-four feet. This immense deposit contains many million tons and will ultimately yield to its owner a vast fortune. The purity of the sulphur is unquestioned. As the result of a carload recently shipped to a St. Louis firm, the purchaser wrote that it was absolutely pure — not a trace of arsenic in it. It is 99 and 80-100ths per cent pure sulphur. This is purer than the Sicilian article, which is in great demand, and which is only 95 to 96 per cent.

◆

Mr. H. B. Claflin of the firm of H. B. Claflin & Co. when asked about a rumor that he had discharged over two hundred employees owing to depression in trade, said:

"As for depression in business, I am sure, I have seen nothing of it and know nothing of it. On the contrary, within the last eight or ten days, since the result of the election has been generally accepted, I have noticed a very marked improvement in trade. Our business has certainly improved, and I have no doubt the business of other firms has felt the same stimulus. There was a time shortly before and shortly after election when there was some stagnation. In fact, I have not for many years known election excitement take hold on business so much as it did this fall. It is long since I have seen men so absorbed in politics, so given to talking politics at all times and in all places. That such a tension of the public mind should affect business is perfectly natural. But as compared with other Presidential years I think the reaction came quite as soon as is usual, and that, if anything, it is even stronger than in many years. I regard the outlook as very promising. I see indications all about me of a good and healthy business movement. The general sentiment among merchants, so far as I know, is one of confidence and security. I am sorry these preposterous rumors of depression gain currency."

◆

Minneapolis Flour Mills use 75,000 barrels weekly.

CONCERNING BUSH-WHACKING.

We begrudge the space occupied by the appended extract, but having been sufferers ourselves, we are willing to lend a hand to man the rope for the occasion.

"That journalistic ethics is not altogether an unknown thing, we have had ample evidence at various times. There are, however, occasionally such evidences of depravity exhibited by some journals as should exclude them altogether from the pale of respectability. It is not pleasant to be obliged to call public attention to such semi-barbarous characteristics; but private remonstrance, in such cases, always proves in vain, It is only a few weeks since that an editor of one of our brightest and most original mechanical journals spoke to us of the utter lack of journalistic honesty on the part of the *Chicago Journal of Commerce*. The complaint is not new—in faet it was only a repetition of what we had ourselves noticed and many others had spoken of. Now comes the same *Chicago Journal of Commerce* and steals outright (in its issue of Nov. 19), the article recently written for and published in *The Railway Review* by Mr. E. P. Vining. It does this without a word of credit or anything whatever to show that the article was not written for said *Journal of Commerce*, except that it was mutilated and shortened by the use of the scissors. The theft is all the more outrageous because the *Journal* knew that the article had been reprinted in pamphlet form by us, and is offered for sale, for the convenience of those who may wish it.

"As the original and contributed articles of nearly every other paper have been, and are still likely to be, seized upon remorselessly by the same pirates, is it not time for honorable journals to take up the lash and 'scourge the rascals naked through the world?'

"Since the above was written, our attention has been called to the fact that the same paper in its issue of November 12, perpetrated a similar theft by using a large portion af Mr Haines' article on "Efficient Railroad Management" without any credit to the *The Railway Review*. Any defence based upon "accident" or "inadvertency" is therefore out of the question. The editor of the *Journal of Commerce* evidently feels that

'It is, it is, a glorious thing
To be a pirate king.'

We freely award him the distinction; and suggest that he run up the black flag at the head of his columns at once."

We wrote sometime ago to the editor (?) of the *Chicago Journal of Commerce* and remarked that we had no objection to his stealing several paragraphs in each issue, but did not like to have him publish our articles and credit them to other papers. We wrote a very mild, and beautiful christian letter; although we watched the mail very carefully for many days, we never received a reply. After all we agitate ourselves about a small matter, for no one ever sees the paper in question except Italians, and the O I C man.

"Turn the rascals out."

◆

THE Pittsburg *Dispatch* reports the iron business of that locality unaffected by the election and better now than it has been for months.

◆

IN 1870, there were in use, according to the census, 51,018 water wheels and 40,161 steam engines. The same authority gives, ten years later, 50,483 water-wheels, and 55,404 steam engines.

◆

MOST PERSONS who look at vessels form opinions as to speed by the shape of the hull above the water. If the vessel seems sharp, and the contour trim and graceful, the observer jumps to the conclusion that the ship will be fast. Nothing is more delusive than this. The lines that determine speed are under water and cannot be seen; the veriest tub that will float may have the handsomest appearance above water.

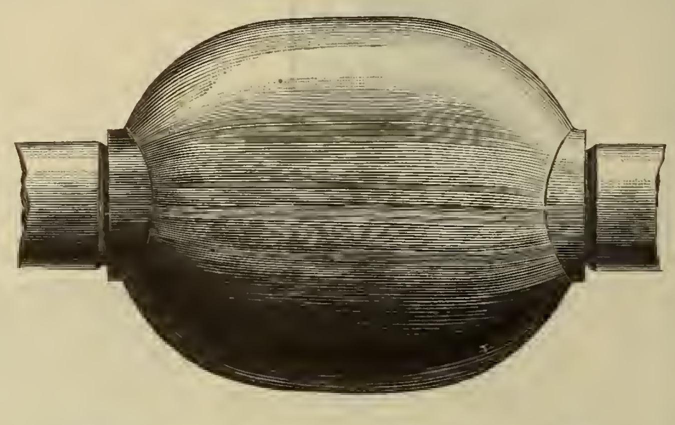
◆

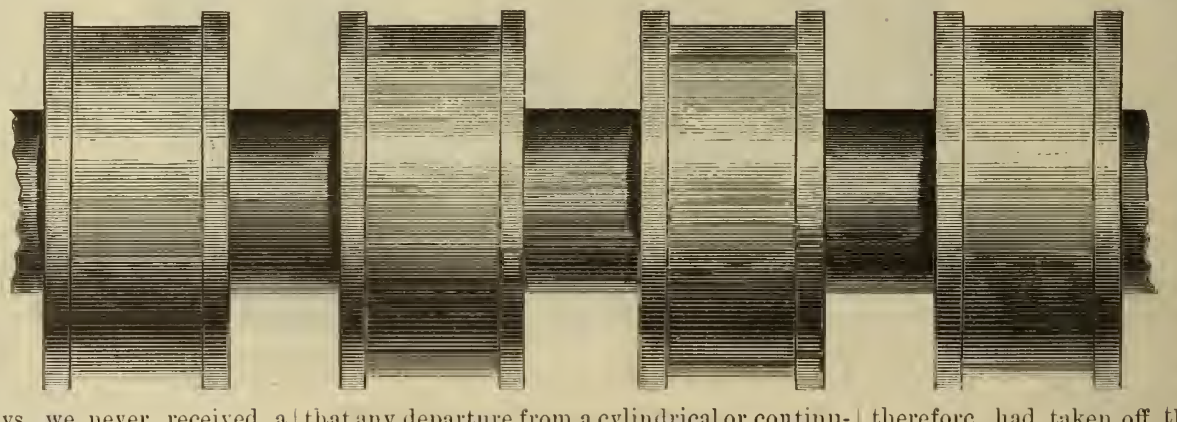
THE EAMES VACUUM BRAKE COMPANY has been re-organized by the choice of John C. Thompson, of Boston, as President, James H. Slade, of Boston, as Vice-President and Secretary, and George B. Massey, of Watertown, as Treasurer. Mr. Elisha D. Eames continues with the Company as Superintendent of the Factory, at Watertown, N. Y., and as a member of the Board of Directors. On and after December 1st, the main office of the company will be located at 123 Oliver street, Boston, Mass.

STEAM PIPES.

We have thought sometimes, that in the case of long steam-pipes which are not unusually large, it might be an advantage to increase the size to about the volume of the cylinder, at or near to the same. The engraving fig. 1 shows our idea, and the object of it is to create a reservoir of supply, which could be drawn upon during one stroke without decreasing the boiler pressure. In the case of the reservoir we think this effect would follow. When the steam-pipe alone is a source of supply, it is natural to expect a reduction of pressure, for, the main valves being open, the pressure is reduced by the flow into the cylinder. Theoretically, this reduction should not exist, for both reason and theory force us to conclude that the live steam from the boiler will keep up the supply. Indicator cards, however, show that this is not the case, and reductions of pressure are inevitable with long steam-pipes, that are not unusually large.

It may be argued that in providing such a reservoir we merely introduce another and more objectionable source of loss—namely, the contraction of the fluid vein. It is well settled that any departure from a cylindrical or continuous shape, rectangular or otherwise, by making a series of chambers of varying diameter in the pipe, lessens the velocity of the current. This is caused by the successive expansions and contractions of the fluid in entering and leaving the several chambers, as shown in fig. 2. We do not think, however, that this loss would be felt if the reservoir proposed was connected directly with the steam chest. An enlargement of the steam chest itself would be the proper thing to do, where cards show a drop in the steam line, as the result of long steam-pipes, but enlarging the chest is an expensive alteration while the reservoir is not. If we were losing boiler pressure from the cause mentioned we would try this as a remedy, and expect success.





◆

HOW MUCH?

Mr. Mugg, of Mugg, Pitcher & Co., tells the story of being called to a debtor in the country, who had been in honest business for forty years and had at last given out.

"Well Mr. Creambowl," said Mr. Mugg, "what can we do for you? Very bad fix?"

"So so, Mr. Mugg."

"What can you pay—seventy-five?"

"No, not so much."

"Well, how's fifty?"

"I think not."

"Thirty-three, then? We want to be fair, you know, with a customer of so long standing."

"Well, I don't know exactly," said the debtor. "By the way, Mr. Mugg, abo [illegible]
are they paying on [illegible]
—*Hartford Pos*

IT PAYS.

It pays in an establishment, where over fifty men are employed, to have a manager or superintendent who is not only acquainted with, but an expert in all branches of the trade.

It pays to employ first-class men only.

It pays to buy the best machines and material in the market. The best is the cheapest in the end, therefore it pays.

It pays to start a small business and enlarge it gradually, as the standing becomes more secure and the facilities are increased.

It pays to be truthful and honest to every body; it pays morally, and materially as well.

It pays to be punctual and orderly in all transactions. It pays to treat not only customers but employés politely and friendly. If you look to their interest, they will not fail to look to yours.

It pays to keep your place of business neat and cheerful. No one cares about staying long in a dreary, dingy place.

It pays for the man of business to have a well-defined idea of the state of both sides of his ledger, and to be well posted as to his own personal expenses.

It pays for every one, employer and employé, to read attentively a trade journal, and to keep the files of the same close at hand.

All this pays. It may not be momentarily in dollars and cents, but indirectly in the confidence and popularity which are acquired by it. It surely pays.—*Lithographer and Printer.*

◆

GOSSIP ABOUT THE STEAM ENGINE.

NUMBER 2.

Not many months since, a friend told me that he had been called in to examine an engine that made mysterious noises which could not be located. It appeared that at each revolution a loud slam, or clap, was heard in the vicinity of the cylinder, exactly where those in charge could not discover. They suspected that in some way the valve was the
seat of the troub
but were not sur
it. Sure or no
thought it wis
vent its "ti
as the pro
pressed
therefore, had taken off the stea
and inserted a stud on the un
the center, just so the valve w
it easily. This did not cure the
noise became so trouble some th
advice.

A little investigation of the valve
haust passages showed the investigat
valve closed the exhaust at about half
one end, and that there was, consequen
traordinary compression, greater in fact
the pressure in the steam chest; the result b
ing that the valve was lifted from its seat and came down again with a slam, making the mysterious noise previously alluded to. When the valve was properly set, the trouble ceased.

Steam engines in good condition should wo
noiselessly, and when anything unusual is hea
the matter should be investigated and locat
without delay. It costs money to make a noi
in a steam engine—whether pounding or a
other—and there is no expenditure less agree
than that which is paid for noise.

◆

A CASHIER in one of our city banks
ing up Brady street the other even
tween his feet he had a valise. A
sitting on the opposite side of the
at the valise and then said "Go
upon the cashier became v
we cannot explain.—*Daver*

◆

WHILE oiling
[illegible] Exhibi

A COMPOUND STATIONARY ENGINE.

Our engraving represents a compound vertical engine of English design, which was built to replace an ordinary high pressure engine, with the guarantee that there should be at least fifty per cent saving in coal, and in town water of 90 per cent. The old engine was 18″ cylinder and 4′ stroke, making 36 rev's per minute.

The engine here illustrated has a high pressure cylinder of 12 1-2 inches diameter by 18 inches stroke; the low pressure is 20 inches diameter. A novel feature is that the piston rod is never exposed to the air, and that both cylinders, the high and low, are packed (as to the rod) by one gland. The method of doing this is clearly shown in the engraving. It is a valuable improvement. The condenser is independent, and is 2′ diameter by 2′ 6″ long, and contains 162 brass tubes, size not stated. The condensing surface, however, is 84 square feet, the vacuum varies from 25 to 27 inches.

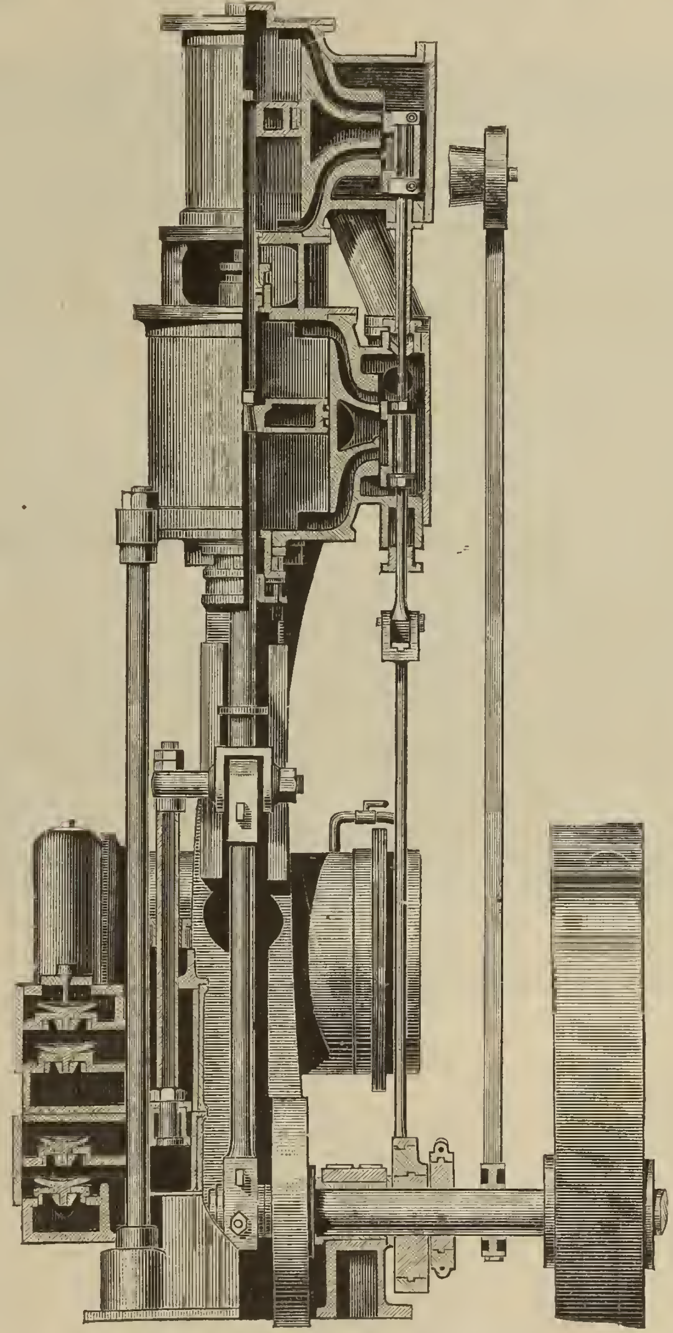
There is one pump, 6 in. diameter by 18 in. stroke, the bottom end of which is the air pump and the top end the circulating pump. It is lined with gun-metal, and has gun-metal bucket and rubber valves on brass grids. There is an air valve fitted on the cover between the valves of the circulating pump, by means of which the quantity of circulating water can be regulated, and which has the further effect, in combination with large air vessels, of keeping the pump noiseless. The air pump delivers to a hot well situate at the front of the engine, from which the feed pump, 2 1-2 in. diameter by 3 in. stroke, drains its supply. The pump is driven by an eccentric cast in one with the valve eccentric, and there is an arrangement in the hot well to prevent any grease being pumped into the boiler.

This engine is coupled direct to the mill shaft and runs at 118 revolutions per minute, at 60 lbs. pressure, the same as the old engine worked at. It has been in operation one year, and the results, in round numbers, are that it consumes $170 worth of coal in the same time, that the old high pressure engine it displaced used $500 worth; the period of time however, is not named. The water used by the high pressure engine was 14,000 gallons per week, the compound uses 1000 only. We take the engraving and data from the *London Engineer.*

◆

A PROPELLING BALLOON.

On August 9th an interesting and successful balloon ascent was made from Meudon, in France, by two Government aëronauts, Captains Renard and Krebs. The balloon was driven by a screw propeller, and steered by a rudder like a large square sail. Captains Renard and Krebs have been engaged for some years past in experiments on ballooning at the Government establishment in Meudon, and their past work culminated in the effort of Aug. 9th. The balloon, of light strong silk, is cigar-shaped and pointed at both ends. It is 197 feet long and 39 feet in diameter. A light netting covers it, and supports a platform 131 feet long by 10 feet broad. This is the basis of the car which carries the passengers and freight. The propeller, which consists of a screw of light wooden framework and air-tight cloth, is fixed to the front of the platform. It is driven by a Gramme dynamo, actuated by a current from a set of stored accumulators, or secondary batteries. It may be remembered that in a recent issue we gave an account of a somewhat similar ascent made by Gaston Tissandier. In the latter case the dynamo was driven by primary batteries. Captains Renard and Krebs ascended together, the former having charge of the propelling gear, the latter of the rudder. On being liberated from the ground, the aërostat rose quickly to a height of 180 feet, and then, the propeller being in full play, started off for Villebon, a town seven miles distant, which had previously been fixed upon as the destination of the trip. The day was calm, but there was a breeze blowing against the balloon at the rate of 18 feet per second. On arriving at Villebon the aërial craft was steered gradually round, describing half a circle, and started back to Meudon, where it arrived safely some forty minutes after it set out. When within 20 feet of the ground the vessel was eased, reversed, and stopped, then hauled to earth by a rope thrown from the car. Since this attempt, others equally successful have been made.—*Cassell's Magazine.*



◆

Recently, says, the *Iron Age*, a large scow, on which was a freezing machine, was towed to Stapleton, near New York. The machine was valued at $10,000, and was intended for large breweries. Workmen carrying the parts off the scow took only from one side, and the scow, of course, careened considerably in consequence. A passing ferryboat sent a heavy swell, the scow lurched more than before, the machinery shifted and in an instant $50,000 worth of it was deposited in the bottom of the harbor.

◆

Geese are successfully hunted in Lake St. Croix, by means of a steamboat with an electric light attachment. It is sure death, for when the light is turned on the flock it dazzles them, and they become an easy capture.

TRADE TERMS.

The *Trade Review* rightly deprecates the tendency to introduce new technical terms. It seems as if some persons, itching for notoriety, felt that the only way to achieve it is to rechristen old expressions. Nothing sillier in this line has been proposed than "*kals,*" in lieu of units of heat. If a steam company chooses to adopt it as a convenience in their trade the public generally have no concern in the matter, but if it is intended as a substitute for a term which expresses exactly what it means, it is a dismal failure. The nomenclature of any established art, or science, is fixed by custom and usage, and it cannot be changed without entailing great annoyance and confusion. Moreover, none of the proposed changes are in any respect an improvement on the old terms. The processes, formulæ, or problems they express are not altered, neither is their field so enlarged that the old terms do not cover them; there is, therefore, no reason for a change.

When we consider electricity, however, there is reason in discussion of technical terms. This field of inquiry is new. It was only yesterday that electrical science attracted general attention, and its terminology is very indefinite. There are but few expressions in it generally comprehended, and it will inure to the benefit of all, when time, and general usage, have settled upon the tersest and most useful names for specific action.

◆

We Regret To Observe that the *Railroad Gazette* joins the ranks of those who quote and credit "*Exchange,*" thereafter. Would the *Railroad Gazette* think we were quite square if we did this in quoting from their paper? In this especial case our contemporary quotes out "*Facts about Files*" directly from our columns; it is usually so honorable in respect of credits that we are desolated to think we have incurred its displeasure, and are singled out for reproof!

Moreover, this particular article contains facts never before published, and we should have had whatever credit attaches to such high enterprise!

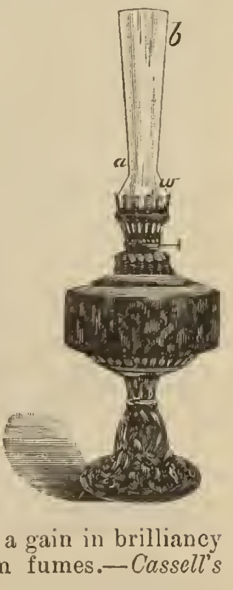
◆

The Pictures Of Men with abnormal noses, which show changes of weather by turning all sorts of colors, are made by soaking the paper in chloride of cobalt.

◆

A NEW LAMP-CHIMNEY.

A novel form of lamp-glass has been introduced by a Mr. M. P. Bayle, which gives a more perfect combustion of oils in lamps than the ordinary form of glass. As shown in the cut, it has the form of two cones united at *a*, the narrowest part, and opening out above and below. The angle of chamber in the upper part, *b*, should not be more than 5°; and that of the lower part should be between 35°. and 45°. The best effect is obtained when the height of the glass is about six times that of the diameter at the narrow part. The wick is shown at *w*, and the glass enters the lamp by means of a cylindrical part at its lower end. This glass resembles that of the Argand reading-lamp in the narrowing of the tube; but it is an improvement on the latter, and more scientific. If the lamp is intended to burn in an atmosphere free from draughts, the height may be reduced to four times the diameter of the neck. The best position of the wick is obtained when its top is just a trifle below the lower end or base of the lower cone. The glass is applicable to kerosene lamps, with a gain in brilliancy of light, and freedom from fumes.—*Cassell's Magazine.*



Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

A BADLY ARRANGED STEAM PLANT.

Editors Mechanical Engineer:

Some time since, there appeared in your paper, page 188, vol. 8, a letter on "*Boilers That Pulsate,*" signed "*Corliss.*" In your comment you said the data were insufficient. Now, as I am at present in charge of those same boilers, I wish to give you all the data concerning them, as also my idea of the causes leading to the pulsation, leakage, etc. I inclose a sketch of boilers and setting, with measurements which are approximately correct. The engine is a Harris-Corliss 16″ × 36″, making 92 revolutions per minute, with steam at 80″, vacuum 22″, (average per gauge). The valves lap when the engine is on the "center," thus: inlet ⅜″, outlet ⅛″. The engine has not been indicated (as far as I can ascertain) for seven years.

We use a "Buckeye" surface-condenser and air-pump (driven by belt from engine-shaft); a "Knowles" pump, 10″ and 6″ × 12″, for a circulating pump.

The exhaust-steam travels about 16′, making five bends in the distance to reach the condenser.

The condensed water is pumped into a tank; on entering which it comes in contact with the exhaust from the circulator, thereby raising its temperature from between 100° and 115° to 180° and 195°. We use the best mineral oil we can obtain, in the cylinder, and as small a quantity as is consistent with proper lubrication. We use a sight-feed lubricator of good design, which with careful attention enables us to secure the best results. We use "slack" coal for fuel, and I think the coal mined in Kansas is not very superior—especially the "slack."

This sketch shows the boiler and setting. Grate surface, 4′ 6″ × 8′ 6″. Two boilers, 44″ × 16′; thirty 4″ tubes in each. Steam-drum, 6′ 6″ long. Mud-drum, 10′ long. Tubes arranged in rows, vertically and horizontally. Steam-pipe to engine, 4″ in diameter 20′ long, with two elbows and an angle "throttle" valve, and connected to steam-drum through an angle safety-valve. Side walls touch boilers at level of upper tubes. Boilers covered, with brick and mortar in contact with shell. Steam-drum and pipes not clothed. Temperature of feed-water 180° to 195° F.

I think that the circulation is very defective, in as much as the spaces between the tubes are very small, and there are too many tubes for the size of the shell. The evaporating-surface and also the steam-room are too small and are further reduced by carrying the water so "high." But "high water" is a necessity in case of a stop of any duration, because we have no independent pump or injector. The feed-water should be delivered in the rear instead of through the mud-drum. The area of the cross-section of the tubes is twenty per cent larger than the area of smoke-pipe, causing sluggish draught through the tubes, making them to fill rapidly with soot, and reducing their evaporative efficiency. This, in turn, necessitates a fiercer fire and a more intense heat.

The signs of distress are slight sagging of the sheets over the fire, rivet cracks (from rivet hole to edge of sheet), and intermittent leakage of all the seams exposed to the action of the fire, and also of the tubes in the lower rows.

I think, the improper adjustment of valves and deficient steam-room are the causes of the pulsation, and that the pulsation, together with improper construction of boilers, is the cause of the distress and rapid deterioration of fire sheets. It may be that the quality of the feed-water plays an important part in matter of leaks, as, of course, it contains the oil used in lubricating the cylinders of the engine and circulating pump. To neutralize this oil, we have used at different times such articles as concentrated lye, sal soda, American Boiler Compound, etc., etc., with varied success, finding always on opening the boilers more or less grease on shell and tubes. I have heard a legion of theories advanced with regard to this "plant" by traveling engineers (?), but they were all sadly deficient in argument to substantiate their theories.

I have endeavored in the preceding to give you all the "points."

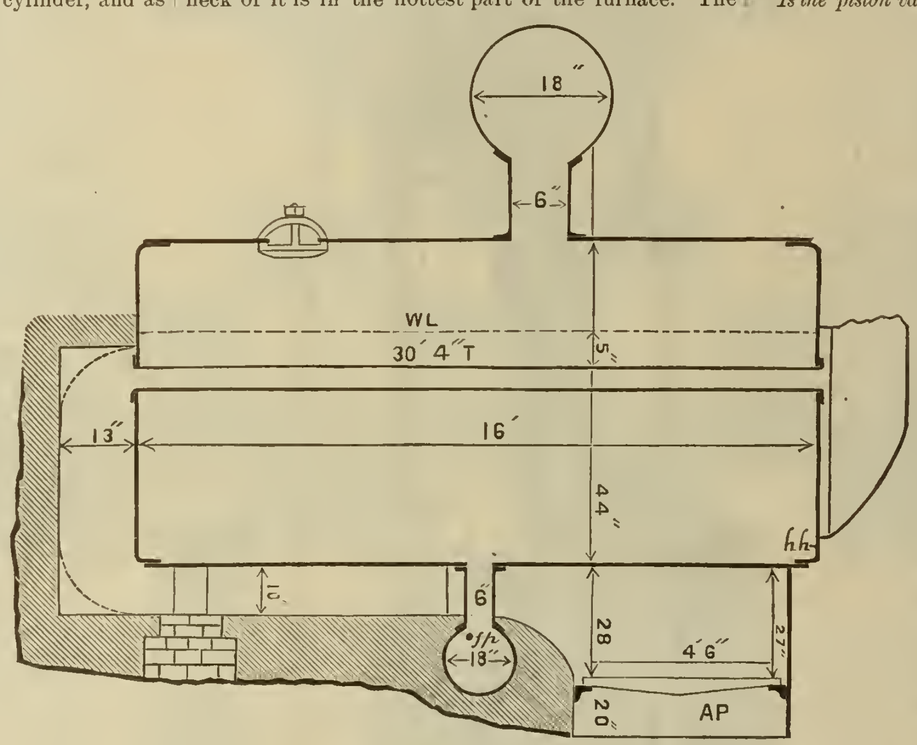
I would be pleased to have your advice on the subject, especially as in regard to the adjustment of the valves of the engine without the indicator. I am young in years and also in experience, and I am very glad to receive instructions from any superior source.

A Kansas Engineer.

[This is a badly arranged and proportioned boiler and setting which, we think, can be materially improved. The best modern practice allows 35 feet total heating surface to one of grate-surface. In this boiler there are only 23 to 1, allowing half the shell as efficient heating surface, and two thirds of the tube-area as efficient. The ratio of tube-area to grate-surface should be as 7 to 1. In this boiler the tube-area to grate-surface given is as 18 1-2 to 1. This shows that the tube-area is too large and should be reduced. This makes the total heating surface less, but it raises the efficiency of the remainder by improving the draught, and consequently the combustion.

The grate-area is large enough but the fire-box is too shallow. It would be an improvement, in our opinion, to lower the bars 10 inches, which would give 38 inches from grate-bar to boiler, and vastly improve the combustion. The ash-pit would then be only ten inches; this is not enough for convenience but it is ample for draught, and convenience must be sacrificed to economy in this case. The combustion-chamber under and around the boiler and the back-connection are, respectively, too large and too small. The first should be reduced to eight inches all around, and the walls brought down at the top six inches lower on the sides than they now are. The back-connection is too short and should be increased to 24 inches in all, and arches turned in the corners, as shown in the cut by dotted lines. The square corners now existing have a tendency to create counter-currents which affect the draft materially, and the short chamber "gags" the draft, or makes it turn sharp corners at short notice. This, in connection with the large space into which the gases are expanded beneath and around the boilers, tends to cool them and make the draft sluggish in consequence. The tube-area should be reduced by taking out the top row of tubes entirely; the space they occupy is needed for water. This would enlarge the steam space materially and also reduce the nominal heating surface, but as it would render that remaining more efficient, it would be a gain instead of a loss.

The mud-drum should come out and, if used at all, be placed outside at end, where it would be a quiet reservoir for the reception of mud. At present the neck of it is in the hottest part of the furnace. The feed-pipe should not enter it at all, or have any connection with it.



So far as we are able to compute it with the data at our command, these changes will reduce the total heating surface to 600 feet in round numbers, all of it effective. It will reduce the tube-area and increase the steam space, two things highly important. This amount of effective heating surface is ample for a 16″ × 36″ engine, making 92 revolutions per minute, with proper combustion. Regarding leakages, and other difficulties, we think our correspondent's conclusions are sound. The grease-trouble can be effectively remedied by using Colgan's Grease Ball. We have no hesitation in mentioning it prominently, for we are assurred by engineers who are personal friends that it is an absolute specific for the trouble in question. Anything that will do this should be made known far and wide.

The valves should be set the same as on any other engine. Harris recommends in his "*Pocket Manual For Engineers,*" page 198, from 1-32d to 1-8th lead according to the speed the engine is to run. The indicator should be used to rectify any errors.

These changes are inexpensive and will, we think, prove advantageous in all respects.—Eds.]

◆

SOME QUERIES ABOUT STEAM ENGINE DETAILS.

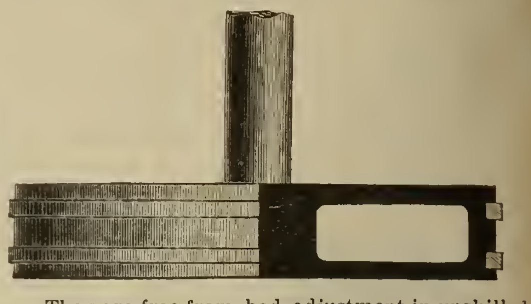
Editors Mechanical Engineer:

Which is the most economical jacket for steam cylinders, exhaust steam or live steam?

Live steam. The object of a jacket is to prevent condensation in the cylinder while the steam therein is doing work. Manifestly the jacket should be hotter than the cylinder, to do this. Exhaust steam cannot be used because it is colder than the cylinder. We contend that a steam-jacket should be fed with super-heated steam, *in circulation*, that is taken from the boiler and returned to it again.

Which is the best form of piston and packing ring for steam engines?

The most approved form of piston and ring is shown in the sketch. The duty of the piston is to form a sliding partition in the cylinder for the steam to act upon. It is not needed as a balance (in most cases) and weight in it is a great objection, particularly in horizontal engines. It should be as light as possible consistent with strength. It is, therefore, made hollow, without a follower, and the rings sprung in. These pistons are so made in this vicinity as large as 50″ diameter, and the superintendent of the line they are on, informs us he has never had the least trouble with them. They never leak, and never require packing. They are free from bad adjustment in unskilled hands, and no man can cut a cylinder with one by *jacking* the rings out against the cylinder.



Note.—The engraving is not exactly correct, the rings look as if they were dovetailed in and no clearance is shown behind them, but it is too late now to alter it.

What is the best mode of fitting up piston valves and rings for the same?

We are unable to say. We have had no experience with them, and do not know any one who has. We never advise upon points we are not familiar with. Guess work is of no value in steam-engine details, or anywhere else, for that matter.

Is the piston valve superseding the slide?

Not at all. The piston valve is almost as old as the slide, but its use is comparatively limited. It has the advantage of being easily handled, and this has caused its introduction in modern marine compound engines, where the steam pressures are high, but it necessitates a great deal of clearance space, and is not economical as compared with other valves.

What sort of machines are used for grinding piston rings to fit?

Nova Scotia. Callipers.

[None whatever. We do not know of any shop which grinds piston rings, or grinds anything at all except possibly cylinder head joints, and in the best shops even these are scraped, and barely tickled—if we may use such a phrase—with flour emery and oil for a minute, to take off any points that may remain. Everything is scraped, "iron and iron."—Eds.]

◆

Editors Mechanical Engineer:

I have been a reader of The Mechanical Engineer since its first issue nearly, and think that it gets better all the time. I want to ask for a little advice through its columns. I am a young man twenty-three years old, and have been running engines for seven years, off and on. I make this my business and aim to keep posted. The reason why I am not running all the time is that the engine which I have had charge of only runs part of a year, or for a season. How shall I go to work to get a position on a stationary engine, which runs regularly, in some good sized town? I live twenty miles from a town of any size, and cannot afford to go there to watch for jobs. Would you advise me to seek work through an employment agency, or would it damage my reputation as an engineer?

Engines in this part of the country are mostly run by a class of men who are willing to work for about $1.50 per day; and who put in spare time husking corn, chopping cord-wood, ditching, etc. One sees some queer things among them. The last that I noticed was the safety-valve lever of a boiler in a neighboring town. First, on the end of the lever was a car-link; then the weight which belonged there; then a chunk of round iron; then a piece of a grate-bar, and lastly, half of another car-link. The boiler looked like a pretty stout one, and I was glad of it—while I was there.

With regard to the new patent crosshead-gib, mentioned in your columns, allow me to say that an engine which I now have charge of, and another one which I have lately seen, both have gibs of this kind, differing slightly in detail but the same in principle.

Illinois. L. L. Davenport.

[The only way for our correspondent to get a steady situation is to start out and search until he finds one. Applying to an agency might get him a steady job at taking care of a horse, or doing odd jobs in the intervals of firing! The present is not a good time for a venture, but an ambitious young man like our correspondent, will find his opportunity when business revives. If he has no family ties to restrain him he has the ball at his feet, so to speak, and can make his future just what he wishes. Just now, home is the best place for all who have one, but the depression is only temporary.—Eds.]

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New Subscribers, prior to Jan. 1st, receive The Mechanical Engineer 14 months for $2.

FACTS ABOUT FOREMEN.

Editors MECHANICAL ENGINEER :

The Professor in the Machine-Shop has touched many chords which continue to vibrate pleasantly in the minds of the machinist and the engineer. The tune of "Foreman," in a late number, is a pleasing air, and I feel like joining in the choras.

"Deputy owner" is the fact, and the owner should give his deputy the same moral support which is given to a deputy officer of the law. To do this he must have confidence in him, and believe in the man, in his ability, his integrity, and in his good intentions. If the owner cannot, or does not show that he has this confidence, he cannot hide the fact that he has it not, and then—farewell to all dicipline in the shop; farewell to all ambitions that should inspire a true foreman, and farewell to all good management.

It is not necessary to accord absolute perfection to any man, not even to our dearest friend, whom we know often needs, and gets, our sympathy. If the owner and foreman be not in accord with each other, the workmen know it intuitively—they are the first to find it out, and then trouble begins.

The foremanship of a general jobbing machine shop affords a wide field for the exercise of the preceptive faculties, the powers of analysis, and executive talent. Human nature, mechanical laws, mechanical execution, and financial cost, must all receive earnest attention.

A foreman's education begins with his first lessons in the shop, and he begins it himself in learning how to get out work. Getting out work is the business of a foreman—bossing men is only an incidental circumstance, and should as much as possible, be kept in the back ground. Bossing the men instead of the work, is a very common, and a very great mistake.

New York State. ALONZO.

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CARDS MINUS LEAD AND BUT LITTLE COMPRESSION.

Editors MECHANICAL ENGINEER :

I called on Mr. S. H. King at Sharp's Rifle Factory, lately, and during my stay the engineer took a few diagrams with the indicator. The cards remind me of an article ln THE MECHANICAL ENGINEER, entitled "*A Point Against Steam Lead*," (vol. 6, No. V., p 55.), and if you look at the compression line you will see what I mean. Quite a number of Bridgeport engineers have seen the cards and pronounce them as being very good. Thinking you would like to see them also, I have enclosed a couple. Card No. 2, is the latest taken, the other being taken some two months ago. The card of the indicator was attached to the crank-shaft of the air-pump, no special rigging being used.

In conclusion I would say that I do not send the cards as being first class, but merely as "a point against steam lead." In card No. 1, I think the exhaust does not open early enough ; and card No. 2 shows loss from cylinder condensation. The point of cut-off being more rounding on the right side than the left, is probably due to the construction of engine more than anything else.

Bridgeport Conn. JOHN E. BREENE.

[The data with these cards is cylinder 26″ × 48, 400 feet per minute piston speed (50 revolutions) boiler pressure 55 lbs. vacuum 28″, 30 spring. The engine is an old style Corliss. Those who think an engine will not run well without more or less compression may observe that in No. 1 card there is none at all. The piston speed is not high, however. The steam line, boiler pressure, should always be drawn on cards, it being the only means of telling how nearly it is reached when at work. Also, on high pressure engines the atmospheric line should always be given.—EDS.]

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MORE INDICATOR CARDS.

Editors MECHANICAL ENGINEER :

I send herewith two cards, with the following data: Size of cylinder, 30″ × 60″; revolutions, 47½ per minute; boiler pressure, 80; scale, 40. The engines develop 279 horse-power, with a water consumption of 19.5 lbs. per I. H. P. per hour. The loss between boilers and engines is caused by a number of unavoidable turns in steam-pipe. The engines run finely, and the engineer is an old timer who has run both locomotives and stationary engines. The cards were taken with a Richards indicator. Both cards are from the crank ends of both engines.

Rhode Island. GIB.

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A BRADFORD, Fall River, Mass., has one of Babbitt's books dated 1850, containing the original receipt for Babbitt metal, also, for melting the same. Those interested can address him as above.

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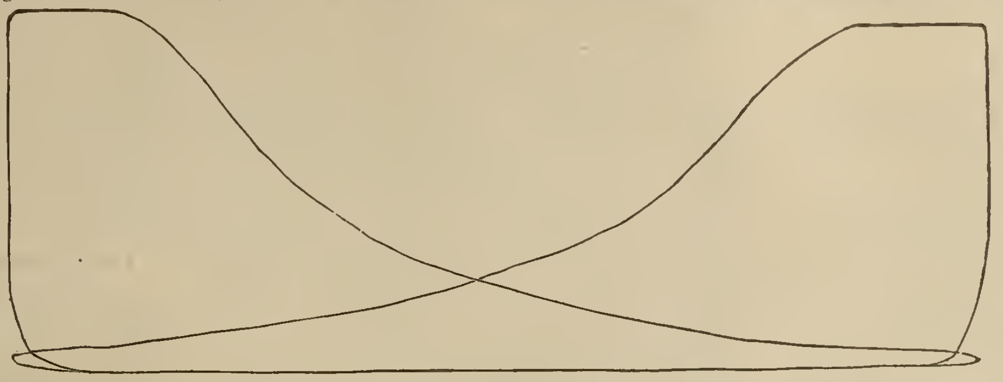
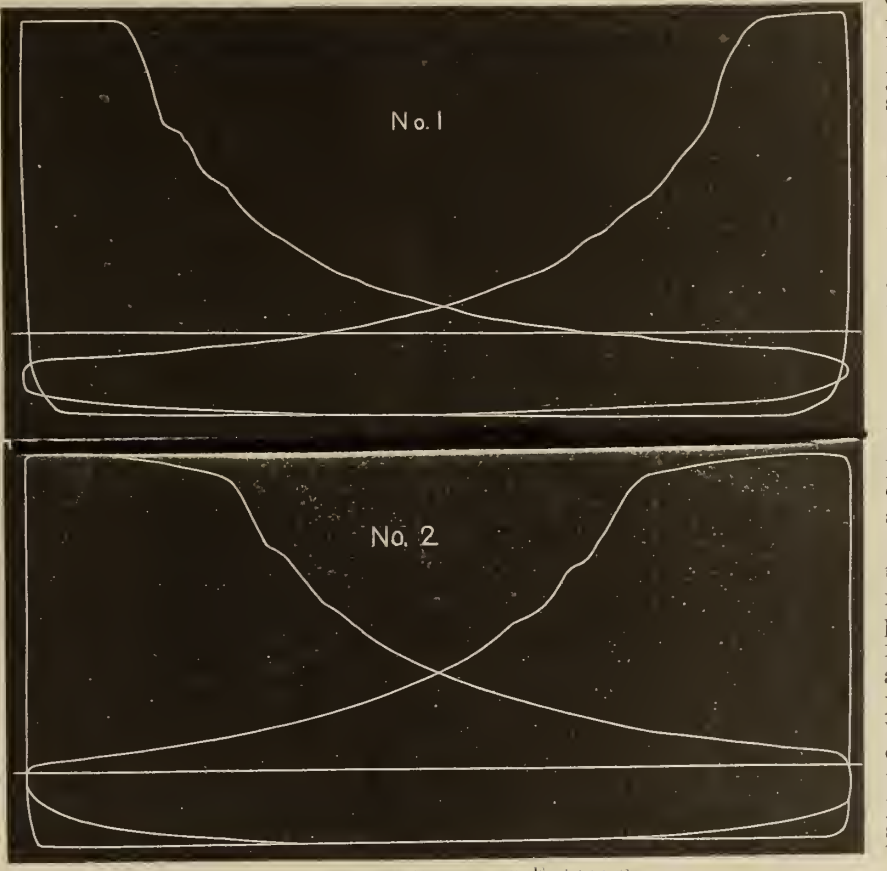
PROBABLY THE HIGHEST SPEED attained by a dynamo engine in this country, or elsewhere, is Ericcsons engine at the Delamater Iron Works in this city. It is a single cylinder trunk-engine, of five inches diameter by three inches stroke ; it makes 1250 revolutions per minute, and developes 10 horsepower with 35 lbs. effective pressure. It is self-lubricating, and runs for long periods of time with no attention whatever.



INDICATOR CARDS FROM GIB.



INDICATOR CARDS FROM JOHN E. BREENE.

A SPECIAL REQUEST.

It is respectfully requested that, for the next five years at least, the technical press will kindly refrain from publishing the following items, captions alone here given :

Drilling holes in glass.

Turning hard iron by the aid of turpentine.

How to harden cast-iron.

Drilling holes in saws to prevent cracking.

M. Clemandot's process for tempering steel by compression. (November 29th, the *Scientific American* had this on the editorial page!)

Filing hand-saws.

Tempering mill-picks.

How to cut glass with a red hot poker.

Formula for a pattern varnish (German origin).

Sharpening files with acid.

Soluble glass (no allusion to it allowed).

Hair side, or flesh side of belts (dead and stinking).

Stuff about antiseptics (nothing new in this line for years).

How to tell good flour. (Stop it!)

How to loosen a tight screw with a red hot poker (rubbish).

Empirical, and alleged cures for diphtheria.

Whether water-wheels run faster at night than they do by day.

The top or bottom of a wheel, which travels the faster?

Whether the piston stops at the end of the stroke, and if so, why so?

These are only a few of the ancient and venerable items which cumber the columns of too many exchanges. These items are entitled to honorable discharge and a pension ; they no longer instruct or amuse, and should be given a rest. We have collected only a few which occur to us on the spur of the moment. Many have undoubtedly got away which are much worse than those cited.

"Western papers please copy."

USEFUL DATA FOR ENGINEERS.

By SMOKE ARCH.

Engineers should bear in mind that every cubic inch of water condensed from steam is equivalent to one cubic foot of steam of one atmosphere, approximately, and a corresponding loss of sensible and latent heat. With a proper steam plant, intelligently managed, every 30 lbs. of water pumped into the boiler should equal one horse-power of work done by the piston every hour. A boiler may generate dry steam and do it very economically, but the steam may reach the cylinder in a partly condensed condition. The cylinder may be too large or too small. The piston or valves may leak, or the steam may be improperly applied. The amount of clearance, back pressure, compression, and many other things must be carefully studied and adjusted, in order to reach high results from the water evaporated. In ordinary cases, a pump that will deliver four gallons of water into the boiler per hour for each nominal horse-power, will be the required capacity of the boiler-pump. Hence, if we wish to determine the displacement of the boiler-pump per hour, we multiply the horse-power by 924, which gives the required displacement in cubic inches per hour. This allows 33.2 lbs. of water per hour for each nominal horse-power, to which we might add one fifth for contingences, leakage, etc.

It has often been demonstrated that the most desirable speed to run the piston of a small steam-pump is 50 feet per minute, therefore we will consider it the standard speed in estimating the capacity of the pump. Suppose we wish to know the required diameter of pump-cylinder to elevate a certain amount of water per minute, say 400 gallons. The square root of one half the number of gallons we wish to pump will be the required diameter of the water-piston in inches.

Example : 400-2 = 200 ; the square root of 200 is 14,142136 ; consequently, 14.14 is the diameter of water-piston in inches. To prove this we will figure out the displacement of the 14.14 inch piston, travelling 50 feet per minute. We first multiply 50 by 12 to get the piston-travel into inches. This gives us 600 inches that the piston moves each minute, the area of our 14.14 inch piston is 157.03 square inches, which multiplied by 600 gives 94218. cubic inches displacement per minute. This divided by 231, the number of inches in one gallon, equals 407.87 gallons per minute. In this case, if the piston speed had been decreased one foot per minute it would have elevated exactly 400 gallons per minute.

(To be continued.)

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NATIONAL ASSOCIATION, STATIONARY ENGINEERS, PLEASE TAKE NOTICE.

Sec. G. C. Minor, N.A.S.E., advises us that charters have been issued to Laporte Association No. 5, Indiana, and Bridgeport No. 4, Conn. The following will soon be chartered : Evansville, Ind., Fort Worth, Texas, Newark and Paterson, N. J., Dayton, Springfield, Columbus, Portsmouth, Piqua and Massillon of Ohio, Cairo, Ills., Pittsburgh, Altoona, Williamsport, Pa., and New Orleans, La. Associations in arrears for quarterly dues, Oct. 1st, will please send them in so that the Secretary can prepare a consolidated report of great interest to the order.

John Fehrenbach, an active member of Cinn. Ass'n No. 2, has been appointed by President Arthur as Commissioner of the Labor Bureau. This is satisfactory to the workingmen of Ohio,

The Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

150 Nassau Street, New York.

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We shall be pleased to publish engravings of useful inventions without charge when they meet our approval. As this is wholly gratuitous service we claim the right to reject any that are offered.

No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-pratice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may have possibly chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

THE POSTAL LAWS ON SECOND CLASS MATTER.

The postal laws of the United States are, apparently, interpreted by postmasters in the most contradictory manner. In order to be entitled to second class rates publishers are not allowed to mail anything inside of papers except subscription blanks, notices of expiry, and supplements, these last, of course, being confined to extra matter not possible to print in the regular edition; not ostensibly supplements, but in reality advertising circulars. The provisions of the law are well defined and cannot be misunderstood in the ordinary meaning of words and sentences. It seems, however, that it is quite possible to pervert them so as to mean what postmasters wish to have them.

Here is a chapter from our own experience. Desiring to mail club-forms in the copies of our paper sent out, and subscription blanks also, we submitted both to the postmaster here, asking if they were mailable. The answer returned was that the subscription blank would pass; the club-form the post-office authorities would be *disposed* to pass, but that we had better write to the Assistant Postmaster General at Washington for his opinion. Taking this as a tacit assent to the mailing of the club-forms, we did so mail them in the body of our paper. We received notice immediately from the post office authorities here, stating that they would not be passed.

At the same time we received in a Western exchange a supplement; this was about the size of ordinary note paper. One side of it was wholly an advertisement, the other side contained reading matter only. The word "supplement" was merely printed on one side of this circular, without the name of the paper issuing it, the place where it was printed, or anything to show it was not a mere advertisement. The law on this point is explicit, and not liable to misconstruction. It says that supplements (to be mailable) shall be to contain news germane to the publication which cannot be published in the body of the regular issue, and not primarliy for advertising purposes. Thinking that this supplement did not conform to the law we showed it to the postmaster here, who said that it did not, and that any one so disposed could make trouble for our friends. We communicated this—in a friendly spirit—to our contemporary, apologizing for the apparent interference in their affairs. To this they responded as follows:

> "We do not consider that you have taken any undue liberty in calling our attention to the matter referred to in your favor of the 17th inst., on the contrary, we thank you for your good intentions. At the same time, we desire to say that we conform scrupulously to the postal laws so far as we are able to keep track of them, and to this end we consulted with the Assistant Post Master at——(a large western city of over 160,000 inhabitants) and received his assurance that they did not in any way come under the law."

We make no comment upon this, merely appending our subscription blank, and our club form:

"Messrs. Egbert P. Watson & Son, 150 Nassau St., N.Y. Enclosed find $ for which please send THE MECHANICAL ENGINEER for months, as per your offer.

"This offer is:—to all yearly subscribers received on or before Dec. 31, 1884, we will send the last four issues of 1884 free, making 14 months for the price of a year ($2.)"

This was passed.

This is our club-form:

THE MECHANICAL ENGINEER CLUB.

☞Use this form only. Names sent in the body of a letter are likely to be overlooked.

We, whose names are appended, authorize Egbert P. Watson & Son, 150 Nassau St., New York, to send THE MECHANICAL ENGINEER to our address until Jan. 1, 1886, at $ each. Please find enclosed $

CLUB RATES.

Single Subscription, One Year,			$2.00
Two copies,	"		3.50
Five Subscriptions,	"	each,	1.60
Ten Subscriptions,	"	"	1.40
Fifteen Subscriptions,	"	"	1.30
Thirty Subscriptions,	"	"	1.20
Fifty Subscriptions,	"	"	1.00

Payable invariably in advance.

One subscription free to the organizer of a club of ten or more names.

☞Names sent in before Jan. 1st, 1885, will be entitled to the last four issues of 1884, gratis. Money can be sent either by Express, Money Order, or Draft on New York. Rates must be adhered to. Clubs of 12 will not be taken at rate for club of 15. In all cases next lower rate rules where lists overrun special rates, except when within one of it. In all cases the cost of sending must be borne by the subscribers. Money in unregistered letters is at the sender's risk.☜

☞Write all Names and Addresses distinctly.

This was mailed in the paper and returned, with the statement that the sentences here italicised, rendered it unmailable: "*Use this form only.*" *Names sent in the body of a letter are overlooked.*" *Rates must be adhered to.* "*Write all names and addresses distinctly.*"

Now our position is, that if one of these announcements was mailable the other was. Neither of them contain any information not pertinent to the nature of the announcement.

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THE FUNCTION OF THE TRADE PAPER.

Observation and facts both show that, in the past ten years, very great changes have taken place in the management of workshops and mills. Without specifying all of these changes in detail we may briefly allude to the methods of keeping and storing patterns and drawings; the increase in small tools and fixtures, an elevation in the tone of workshop management, greater exactness of measurement, and lastly, but by no means the least, recognition of the value of trade literature by manufacturers.

It is within the memory of many who are not yet valetudinarians, when the reading workman was not one in ten thousand. The proportion of readers in the mass is very much larger than this now. The establishment of libraries in shops, to which the help have direct access, and the encouragement afforded to periodicals that appeal to certain trades, has very greatly aided in bringing about these changes, and we may claim, without arrogance we think, some credit for trade journals in it. Through them individuals have specified certain ways of doing work, or explained their systems, and these, when good, have been widely adopted, with the results spoken of previously—an advance in workshop methods all over the country.

We speak for our own trades only, for the reason that we are better acquainted with their progress than with that of others, but there is no reason to doubt but that the same influences have brought about similar changes in other branches of manufacture. Critical comments on the conducting of woodworking establishments, flour mills, paper mills, all and sundry, have undoubtedly wrought good, as all criticism does that is sound and sincere. Journals representing other trades than ours, devote much space to the discussion of moot points in method and theory, and elicit valuable advice from actual workers.

Deeper then all these material advantages, however, is that other and inestimable one, of the cultivation of the worker himself. We say inestimable because the trade journal which encourages its readers to write and to think for themselves, to leave tradition behind, is doing a work that cannot be measured as to its future value. The hewer of wood and drawer of water is always dangerous, or, if not wholly this, he is a barrier to progress; but the thinker is the benefactor of the present and the future.

Trade papers encourage thinkers, and are encouraged by them in turn; this mutual support inures to the direct benefit of all trades everywhere.

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SOCIETY PAPERS.

The reading of papers at periodical meetings of technical societies, excites some opposition. It seems to us natural that it should. Persons who attend such meetings are not always in a frame of mind to give attention to or grasp the details of a new proposition, and many seem to prefer that the formal reading should be abridged and *viva voce* discussion substituted in lieu of it.

Our contemporary, the *American Engineer*, makes these pertinent remarks upon the matter in which we concur:

> "The system pursued by the American Society of Mechanical Engineers of having the papers in print prior to the sessions is so excellent, that it is to be regretted that it is not to be utilized to its full advantage. At the recent convention the various inroads caused by excursions and other matters, limited the time left to the presentation and discussion of professional papers, so that members were loath to express their views for fear of encroaching on the rights of others. A number of hours might have been gained if the individual authors of papers had occupied five or ten minutes in giving an abstract, instead of taking, on an average, one-half to three-quarters of an hour each, to read in

> full what was in print and in the possession of every member in attendance. This lack of any necessity to read the papers already in print could be clearly noted in the bearing of the member who put in their time more profitably in private discussion during such perfunctory reading. The absurdity of the thing became painfully evident in one case, where an author took almost one hour and a half to read a ten-page paper, struggling with difficulty through the printed matter, and insisting on drawing the cuts on the blackboard, when every listener had an exact copy of the cuts in his hands. We fancy the annoyance was sufficiently apparent to cause a change by the next meeting, when, it is to be hoped, the papers will all be in print and in the hands of the membership some time before the meeting, and authors be limited to a ten minute's abstract. The result will be not only that the discussions will be fuller, but also more valuable."

And again, in another article, it says ;

> "Opinion as to society papers is largely based on point of view. To the journalist, matter a month old or that has been printed, whatever its intrinsic value, is 'stale' or not fresh, in the same sense that a dictionary or an encyclopedia is stale. Farther than that, it may be dead, as possessing only current value. In either event, a meagre abstract satisfies journalistic requirements, and even this may be unwilling if manuscript matter is available. The reprint serves its principal purpose as stuffing.
>
> "When, to the member, the question arises as to whether his paper will do him most good in a news journal or in the proceedings, then has dry-rot begun its work. If the paper is of value to the member, he should be able to realize on it fully. If of value to the membership, it certainly should be a part of the proceedings. The society is a mutual organization for the benefit of its members, not subservient to its archives, and the question of 'market value' cannot introduce itself."

As to what should be read at such meetings there does not seem to be ground for an argument. The matter offered in our opinion should be only that which is new. Mechanical Engineers, of all other men, cannot at such meetings, with the limited time at their disposal afford to listen to things which, though new to the author of the paper, are not new to the older members. There should be a rigid censorship established and carried *out* as regards papers. As the matter now stands, discussion, the life and spirit of such meetings, is greatly restricted.

NOTE ON HIGH SPEED ENGINES.

Every one who had anything to do with high speed engines since their general introduction can recall the reception they first met with from the trade generally. To put the case mildly, this reception was not in the least enthusiastic, and in some quarters very active opposition was made to them. Faults in design, material, and workmanship were attributed to the system itself, and many persons were led into putting themselves on record in a matter which ran exactly counter to their own experience. Superficial speeds of one metal on another, revolutions in a given time, lubrication, all these were declared impossible in the high speed engine, when the fact had been already established for years, and these impossible things achieved.

The troubles arose in a measure from the want of sufficiently experienced persons to manage these high speed engines, and so soon as this was remedied, by time, less trouble was encountered. It is rare now that high speed engines are thrown out of a factory, solely because they run at high speed.

If it is supposed that the want of familiarity with the system laid wholly with the engineer in charge, and that difficulties arose from this cause, it is erroneous. As often as otherwise the proprietors, or the users themselves, made the loudest objection. We remember some ten years ago, when high speed engines were a novelty, going into a large rolling mill where one of these engines was directly connected to the rolls. We happened in at an opportune, or inopportune time—we have never decided which—for the engine was stopped with a crowd around it ; among whom, the loudest and most profane, was the proprietor himself. It transpired subsequently, in cooler moments, that the engine was the worst ever heard of. Nothing was too bad to urge against it. And why ? It stood right at the end of the train, uncovered and unprotected in any way, with all its fine workmanship and accurately fitted surfaces exposed, and the proprietor wondered that it wore out gibs, and heated its bearings.

This is not an uncommon case, and many similar operated to delay the general adoption of high speed engines, but to-day all piston speeds are higher, as a rule, than prior to the advocacy of the special high speed engine. Now that their peculiarities and management are better understood we hear but little of the "impossibility" of them.

DELAYS IN THE PATENT OFFICE.

It is stated in press dispatches of the 25th ult. that Mr. Butterworth, Commissioner of Patents, is making such efforts as he can to push forward the work which is so badly in arrears. The various chiefs of divisions have been instructed in plain language that there must be no lagging among their clerks or themselves, and the Commissioner is striving to distribute his limited forces in such a way as to make the most of their services.

"One source of complaint among inventors is the fact that some inventions are much more quickly passed upon than others. In some of the divisions the examiners are within a few weeks of current business, while in others they are months behind. The result is that of two inventions equally important to their originators, and laid before the office at the same time, one may be patented or rejected long before the other is taken up for examination. The inventor who is forced to wait remarks this as an injustice, and his fellow-inventors agree with him. The force of examiners is about equally divided among the various branches of the Patent Office. Some inventors think that by putting more examiners on duty in the division where the work is most in arrears, taking them from the divisions now having the least to do, this discrimination might be avoided."

This is very interesting, so far as it goes, but that, it seems to us, is a very short distance. The status is in no wise changed. And the significant threat that no lagging will now be tolerated, makes it very clear that it has been hitherto.

An aggravating feature about all this routine and philandering is that the officials seem to feel that they are, in some sense, privileged persons. This is a great error, and, in our opinion, the cause of the public dissatisfaction. Aside from the want of facilities which may or may not be felt, there is no private patent agency which would exist one year if it did not do its business in a business fashion, and the Public Patent Agency is in no whit different. Examiners should do just as much work therein as in private offices ; they are simply men working for hire, and not entitled to any more privileges than their fellows outside of government employ.

Supposing, as a practical test, that the Commissioner of Patents owned the business he is now carrying on for the people, does any one suppose that there would not be a radical change inside of one month ? Most assuredly there would be.

MEMORIZING.

Memorizing seems to be purely mechanical. A waiter in a restaurant will attend to five or six different persons, and take half a dozen orders from each one, making in all, at least 24 different articles he has to collect. He will do this promptly, and without fault. If the same man were given the ten commandments to commit to memory, or twenty five words that he did not know the meaning of, it is exceedingly doubtful whether he could repeat one fourth of them. It is, also, more than problematical that a thorough student could go, off hand, to six persons, have each name six different articles to be brought to them, and perform the task with anything like the accuracy an illiterate waiter performs his. What increases the difficulty of the waiter's task is the innumerable distractions of the situation. The interference of his superiors with him, and the delays and peculiarities of his calling ; also the fact that in the ante-room where the orders are procured, there are twenty or thirty other waiters with similar orders, bawling them out at the top of their voices ; making confusion, compared to which Bedlam is a vale of peace.

Memorizing, or recalling words and events, seems to be, then, a purely automatic action of the brain ; hinging, in some degree, upon the avocation. The engineer goes through the bewildering routine of his business daily, unconscious of any mental effort to recall certain duties, but even his task is trival beside the one first mentioned. The engineer's is the same, day in and day out, while the public servant's changes with every moment.

OPEN TO ALL.

A friend in a western city writes to ask if the fifty dollar rate for fifty subscribers includes old names. We reply that it does, and new ones also. Our club rates are open to all, and those who sent clubs last year can send the same this year at reduced rates.

In despite of the hard times, and general business depression, we have, during the month of November, received very many more subscriptions than in 1883, for the same period. We openly express our satisfaction at this, as it is exactly what we publish THE MECHANICAL ENGINEER for. We think those who favor us with their presence for another year will certainly get full value for their outlay.

THE INTERNATIONAL EXHIBITION IN LONDON.

Our readers will observe on the advertising pages a matter of interest concerning this exhibition. The latest date for the reception of applications for space at the International Inventions Exhibition, to be held in London next spring, has been extended from September 15 to January 31, 1884. Especial attention is called to one of the regulations, which states that untried and unpatented inventions will not be accepted unless recommended by competent authority. Any information concerning the exhibition can be obtained from Mr. J. Pierrepont Edwards, the acting consul-general for Great Britain in New York, who will furnish papers and forms on application.

HOW IT WORKS, SOMETIMES.

This is how free trade works in the old country—England—sometimes. The *London Engineer* says :

> "We are informed that 200 hands, out of several hundreds under notice, were discharged last week from the Great Western Engine Works at Swindon, and the remainder put on short time, because locomotives can be procured more cheaply from Germany than they can be made at home. Some people contend, however, that in the long run it is cheaper to spend one pound in labor at home than to send nineteen shillings abroad, and it certainly does seem that in the one case twenty shillings are added to the national wealth, but not so in the other."

Don't speak out too loudly on this question, some one might hear you and argue the matter. He might show you the true way to prosper in this world is to argue the bread and butter out of your own mouth into that of some other man in a far country.

THE PROFESSOR IN THE MACHINE-SHOP.

NUMBER 70.

Some six weeks ago one of the large mills here was troubled with a hot crank-pin. The pin was 6″ diameter by 8″ long, and ran too hot for comfort at all times. The engineer in charge is a bright, smart, sensible young fellow, and it rather hurt him to think that the pin persisted in keeping hot in spite of his good management, for he had done all that he could to it. As a last resort he sent for Jacob, and asked him if he could tell what ailed it. Jacob said he didn't know until he had tried, or at least examined into the matter, and this he proceeded to do. He took cards and found the valves all right ; the compression was only moderate and everything was in line, in short there was nothing the matter anywhere externally.

"Now," said Jacob, "let's look at the pin itself."

This was disconnected, and the surface examined. So far as superficial appearances went there was nothing out of the way, and our young friend said there was no use looking at that any longer.

"Yes, there is," said Jake ; "if I look at it long enough it will talk right out and say where it feels bad, and is sick ; it has said so now, plain enough."

"What do you mean ?" Mr. Hess.

"When you look in a sick man's face," said Jake, "what do you see ? Paleness sometimes, or yellowness, or some kind of disturbance that shows the man is out of health. Now, when

I look on the face of this crank-pin I see that it is sick, but the sickness does not come from itself, but the company it is forced to keep, and that is the box which envelopes it. I will tell you what's the matter with this pin, to my notion," said Jake, "and that is nothing at all; the trouble is in the box, and it affects the pin because it keeps pretty close to it all the time. In plain English, the box is too soft, that's what the matter is."

"What makes you think so, Mr. Hess; what do you see to form an opinion on?"

"I see this," said Jacob. "The face of that pin should be as bright and smooth as a watch movement. It ought to shine like a mirror, but it looks dull and dead."

"That's because it has been so hot all the while," said the engineer."

"No," said Jake, "you have got the thing wrong end first. It always looked so, and it got hot because the box was too soft."

"It did not always heat," said the engineer. "It only began about two months ago."

"That was just about the time when you ran nights, and drove the engine all it was capable of doing, isn't it?"

"Yes, sir."

"Well that is easily accounted for. If you go back to the same work you were doing before, the pin will run cold enough, because it is within the capacity of the box to stand it, but if you are going to keep up the load you want to get another metal."

"We are going to slack down a little, but I want a brass in that rod that will stand any work we have to do."

"Look here," said Jacob, taking out his jack-knife and literally whittling the corners of the brass off; "do you see that? That box has too much lead and spelter in it. If I were you I would get a brass cast out of copper and tin, just as hard as it could be made and worked under the tool, then it will be satisfactory under all loads, heavy or light. In a week that pin will shine like a looking-glass, and the friction won't be a fraction of what it is now."

"That is what makes a crank-pin heat first, last, and all the time. You may lay it to half a dozen, yes, twenty different things, but the name of all of them is friction. Suppose, for example," said Jacob, "the pin is too small for the work; that means too little surface, or in other words too heavy a load on what surface there is; that makes friction. Or, perhaps, the brasses do not bear properly in the strap or against the butt of the connecting-rod, that also makes friction. If the shaft is out of line, or the bed-plate springs, if the box is too soft, so that the surfaces of the pin and of it are forced into intimate contact, that again makes friction. In short," said Jacob, "there is nothing else to lay a hot crank-pin to but friction, and all we have to do is to find out what causes that to remedy the trouble. I say a hard brass will do it, for the reason that the grain is closer. A cast-iron box would be the best if it was not so treacherous, and I have sometimes thought it would be a good trick to take a brass shell and line it with cast-iron, instead of using a cast-iron shell lined with brass, for crank-pins or other bearings under great stress. The only danger from cast-iron lies in its brittleness, otherwise it is a perfect bearing-metal."

The box was ordered to be made as hard as possible, and when it came it was hard, and no mistake. The brass founder said it couldn't be cut with a steel tool, but there is where he was in error, for we bored it, after a little trouble in getting good tool steel. For my own part I saw no necessity of having it so extremely hard, but it was put in and the heating was stopped at once. A few days ago I went over, as the engine was stopped for the day—they are working on three-quarter time—and the the surface of the pin looked like quicksilver.

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The Quickest Time ever made between Philadelphia and Jersey City was made by locomotive "5000," (the five thousandth built by the Baldwin Locomotive Works,) on May 14, 1880, over the Bound Brook route. Distance, 89.4 miles. Time, 98 minutes. The weight of the train complete was 148 tons. The return trip was made in 100 minutes.

LIEUTENANT ZALINSKI'S VIEW OF THE KEELY MYSTERY.

Lieutenant Zalinski is an officer in the Ordinance Corps of the United States Army and a gentleman of scientific attainments, as he needs must be to hold his rank, he is also the inventor of "a range fender," "an instrument which," said Mr. S. A. Pratt of the Pratt and Whitney company, "is one of the most ingenious I ever saw." Lieutenant Zalinski is an unbeliever in the Keely mystery and openly expresses his ability to do more than Keely by the aid of compressed air.

A Times reporter saw him recently and thus records the Lieutenants remarks:

"After the experiments at Sandy Hook, there was some controversy. The old opinion in relation to Mr. Keely's alleged force did not seem to have suffered any very striking contradiction. The Keelyites had been using Col. John Hamilton's name considerably, and at last invited him to come to Philadelphia, to bring with him some of his friends, and give his opinion of Mr. Keely in that illustrious gentleman's own workshop. Col. Hamilton was unable to avail himself of the invitation, but seemed to think that I was the fittest man to take his place. The Keely people felt that I was prejudiced, and I had better not come. I succeeded in showing them that not one particle of prejudice existed in my mind; that if Mr. Keely was what he claimed to be I would be the first man to acknowledge it, and that if he had a new scientific agent I wanted that agent as much as he did. To be brief, I went to Philadelphia.

"Mr. Keely and his friends treated me royally, and I had every inducement to open my heart and believe. I did open my heart, but—Well, let me relate things chronologically. I viewed Mr. Keely's efforts in silence for some time, and then I felt my time had come. I noticed that Mr. Keely was unwilling to have his force measured honestly and fairly. There was a large reservoir which he was going to attach to an engine and make the locomotive run. You are aware that he claims his ability to generate force in a few seconds to any extent. Well, I suggested to him that it would be fairer and a much more complete test of his power if he would first open all the cocks of this flask, so that everything in it could escape, and then recharge it by his generator.

"Ha! ha!" laughed Lieut. Zalinski. "He said he could not do it. It would take two hours, and the flask had been carefully negatized. Please note the word negatized. It is a unique expression. Well, that is proof positive that his claim of being able to generate force in a few seconds fell to the ground, isn't it?

"I remained down stairs while the engine to be worked was down stairs. Mr. Keely appeared to be very uneasy as I prowled about the downstairs regions. Finally he came to me and announced the startling fact that there was an accidental break in a pipe, and that he must put off the experiment, as he could not work the engine on that account."

Lieut. Zalinski's mirth interrupted him at this point. "Now," he resumed, "when I started for Philadelphia I was careful to take with me a 10,000-pound gauge. That was my little equipment. This, you must take my word for it, is a standard instrument. As soon as the Keely people saw this gauge they said to me, 'You had better not show it to Keely. It would only anger him!'

"Much I cared about angering him! I wanted justice. One of his partisans, however, informed Mr. Keely that I had brought this gauge with me, and the great man replied that he would not use it. In the course of his experiments he said he had got 50,000 pounds pressure. But (observe the but) he then remarked that he had broken all the pressure gauges he had. Consider that I have spoken those last words in italics, please. I then quietly rejoined that I had a pressure gauge which was only capable of registering 10,000 pounds. Said I, 'I would like to have you put it on, and break it for me.' Mr. Keely made no immediate reply to this. Shortly afterward, however, he remarked, with an air of feeble assertion, 'I do not believe in pressure gauges, anyhow.'"

The subject appeared to be excruciatingly funny to Lieut. Zalinski. "It is to be noted," he continued, "that not a single series of experiments was carried on continuously. A full and proper test of the correctness of his claims as to the power he is said to possess would be to start afresh outside of a shop, generate the force, and use it continuously, not only for a few seconds, but incessantly for several hours; in fact, for a day or more, under competent supervision.

"Don't think that this was not suggested to him. I suggested it to Mr. Keely. But ne'er a word said he. I am quite convinced that the gentlemen who are supporting Mr. Keely honestly believe that he has a power. But he has been working at his alleged power for years and years, and if he really does possess it, surely he ought to be able to utilize it now. Much that he did at Philadelphia smacked of the legerdemain business, and the spectators were not allowed to examine the details of the business, even to that extent which a well-regulated conjurer would deem advisable for the sake of his reputation to allow.

"For instance, Mr. Keely made a globe revolve by means of a turning fork. All the world wondered. That was all there was to it. Its enlightenment was deemed necessary. When he fired his gun, much of the mechanism which was ostentatiously shown at Sandy Hook was omitted. More than that, he also omitted all that hocus-pocus tapping of the cylinders, which at Sandy Hook made the spectators imagine that he was going to conjure a few hundred yards of ribbon from his mouth in the most approved style. He certainly indulged in a great deal of inexplicable manipulation, and I have no idea what he meant by it, except the hocus-pocus idea."

"I have been informed that a gentleman interested in the Keely motor concern has offered to give me $1000 gratuity if I could accomplish as much as had been done by Mr. Keely at Sandy Hook. This offer has not been presented to me in tangible form, but I don't mind telling you that I will perform the experiment without compensation, asking simply the loan of the plant used at Sandy Hook, or funds sufficient to construct one, which shall be outwardly a counterpart of Mr. Keely's apparatus. The flask used may readily contain a pressure of 2000 pounds per square inch and much more. The velocities attained would indicate a possible pressure of about 700 pounds per square inch, when the diaphragms were broken and the shot expelled. The volume of the bore of the gun, and the probable chamber, fondly supposed to contain vibrators, vitalizers, and such remarkable scientific articles), was so small compared to the volume of the compressed air contained in the flasks used, that the percentage of reduction of pressure was very small. A considerable number of rounds could readily be fired without a reduction of the pressure below that required to burst the vulcanite diaphragms. Increasing initial velocities may readily be obtained by placing either more or stronger diaphragms in the gun. In this way the pressure accumulated in the gun chamber will be greater before rupture of the diaphragms can take place, thus giving the higher velocities of projection."

Lieut. Zalinski spoke very deliberately, and his technicalities had been evidently carefully considered.

"I question Mr. Keely's ability," he resumed, "to fire the gun continuously for 100 rounds, maintaining the same high velocity without discharging his flask. Should the trial be made, as previously proposed," said the Lieutenant, "I would suggest that it be arranged to commence the experiments sufficiently early in the day in order that there may be ample time for a satisfactory continuance of the firing. This was not the case at Sandy Hook, as you are well aware. It would also better establish Mr. Keely's claim to an increasing rather than decreasing pressure if a place were provided in the flask where a standard pressure gauge, furnished by some disinterested persons, could be attached. Don't forget the disinterested persons, please," added the Lieutenant, laughing.

"One more point. As a guarantee that the interior—shall I call it arrangements?—of the gun have not been changed, so as to make the conditions more favorable, and also for purposes of direct comparison, I would like Mr. Keely to bring his flask charged with the so-called etheric force and fire at first. I will then recharge the flask with compressed air—I stick to my compressed air—and produce similar phenomena. The relative force imparted to the projectors can be measured by penetration into wood, or other media, by ranges obtained under a given elevation, or by the measurement of initial velocities. As the vaporic force is so simply generated—ahem !—it would appear to be a slight matter for the company to take steps for the institution of this trial, and thus demonstrate practically Mr. Keely's ability and their own faith in his power to produce transcendent results.

"Science is not easily revolutionized nowadays. Something more serious than tapping on cylinders and necromantic airs are required to satisfy the world that it is in the possession of a force which has hitherto escaped the attention of learned men.

"But," continued the Lieutenant, with an affable smile, "I have been to Philadelphia now and can still smile in derision. I repeat my offer and don't want the $1000 which the interested individual has been stating that he is willing to bestow upon me. Virtue is its own reward. So will compressed air be in this case."

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SOUND WAVES.

If you want to know the length of a pedal pipe, you can calculate it in this way.

I know the velocity of sound in feet per second. If I remember rightly, it is 1,089 feet per second in dry air at the freezing point, and 1,115 feet per second in air of what we call moderate temperature, 59 or 60 degrees, in round numbers let us call it 1000 feet per second. Sometimes we call it a thousand musical feet per second, it saves trouble in calculating the length of organ pipes ; the time of vibration in an organ pipe is the time it takes a vibration to run from one end to the other other and back. In an organ pipe 500 feet long the period would be one per second ; in an organ pipe ten feet long the period would be 50 per second ; in an organ pipe twenty feet long the period would bs 25 per second at the same rate. Thus 25 per second, and 50 per second of frequencies correspond to the periods of organ pipes of 20 feet and 10 feet.

The period vibration of an organ pipe, open at both ends, is approximately the time it takes sound to travel from one end to the other and back. You remember that the velocity in dry air in a pipe 10 feet long is a little more than 50 periods per second ; going up to 256 periods per second, the vibrations correspond to those of a pipe two feet long. Let us take 512 periods per second ; that corresponds to a pipe about a foot long. In a flute, open at both ends, the holes are so arranged that the length of the sound-wave is about one foot, for one of the chief "open notes." Higher musical notes correspond to greater and greater frequency of vibration, viz., 1000, 2000, 4000 vibrations per second correspond to a piccolo flute of exceedingly small length ; it would be but one and a half inches long. Think of a note from a little dog-call, or other whistle, one and a half inches long, open at both ends, or from a little key having a tube three quarters of an inch long, closed at one end ; you will then have 4000 vibrations per second.

A wave length of sound is the distance traversed in the period of vibration. Alternate condensations and rarefactions of the air are made continuously by a sounding body. When I pass my hand vigorously in one direction, the air before it becomes dense, and the air on the other side becomes rarified. When I move it in the other direction these things become reversed ; there is a spreading out of condension from the place where my hand moves in one direction and then in the reverse. Each condensation if succeeded by a rarefaction. Rarefaction succeeds condensation at an interval of one-half what we call "wave lengths." Condensation succeeds condensation at the full interval of what we call wave lengths.

I may say that 30 vibrations per second is about the smallest number which will produce a musical sound ; 50 per second gives one of the grave pedal notes of an organ, 100 or 200 per second give the low notes of the bass voice, higher notes with 250 per second, 300 per second, 1000, 4000, up to 8000 per second give about the shrillest notes audible to the human ear.—*Sir William Thompson.*

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SCIENTIFIC MEN VS. PRACTICAL MEN.

In a recent address to an English Engineer's Institute, Prof. Kennedy made the following remarks :

Professor Kennedy said, "he was very glad to have an opportunity of putting before younger engineers some of the ideas which ten years' experience in combined academical and professional work had brought to his mind. On the one hand, there was the man who prided himself on being practical, who would barely hear it said that there was any science of engineering and who would condemn beforehand any propositions, or schemes, in the devising of which he imagined that scientific method, or, worst of all, mathematical calculation, had been employed.

"On the other hand, the man of science pure and simple, and especially the mathematician, was prone to find out that because so much engineering work could be done, or at any rate was done, without calculation—and in particular because so few engineers were really able to solve, (or even to comprehend), mathematical problems, which to him were quite simple, engineers were mere empirics ; that no science worthy of the name existed in engineering, and that engineers could only be considered scientific men by a stretch of courtesy.

"It was right to say that such extreme opinions were not held by first-rate men, either as engineers, or men of science. But fourth-rate men were much more free of their opinions, much more dogmatic, more positive that they only had the truth (in engineering as in other matters) than those of higher rank. Let 'science' include all the exact knowledge, and let 'scientific' mean the method of arranging, comparing, reasoning on, and applying such knowledge. It did not follow that if they did a thing that had been done by some scientific forerunner, they, too, were necessarily scientific. Whether it be scraping up a valve-face, or drawing a stress diagram, the work might be scientific or unscientific, according to the spirit and method in which it was done. In both cases the methods of procedure had been invented for them. They had not anything novel in the way of scraping or of girder stress diagrams. If they did either because they had been told to do it in a particular way, without knowing or caring anything as to the why or wherefore, their work was no more scientific in the one case than in the other. But in both cases equally the work might surely be thought scientific if it was carried out with a knowledge of the meaning of what was done.

"Of why, for instance, scraping in this case was to be preferred to planing ; of why it was an improvement on the old grinding process ; of why the scraper was not ground like a cutting tool, and so forth." Professor Kennedy mentioned as examples of engineering work more or less familiar to them the two very different things, scraping a surface and drawing a stress diagram. He chose them because the latter belonged to the class of work frequently called scientific, when the former was called mechanical. To this he objected. On the whole, the drawing of the diagram was much the easier of the two things. It was just as easy, moreover, to do it unscientifically, or as one might say, by Molesworth.

One was bound to say that the actual problems with which a workman was daily brought face to face were in not a few cases more complex and difficult than those to which the name of scientific was sometimes alone given. Thus no engineer need be a mere tradesman or handicraftsman. In every grade, in every branch of their work, they handled materials and carried out operations which gave them plenty of food for thought, and plenty of opportunity for scientific method. They had the proud distinction of belonging to the profession which of all others was *par excellence* scientific. And no profession of the delights of ignorance on the part of unworthy members of it could alter what appeared to be the plain facts of the case. He was sometimes amused with the zeal with which an enthusiastic physicist would proceed to throw all their mechanical units to the winds, and to improve upon all the ideas of engineers by expressing them in terms which were unintelligible except to a very select few. He had occasionally come down heavily upon such improvers of mechanics by suggesting that for every mechanical calculation they had to make outside an examination paper, engineers had to make twenty. So it was hardly fair to improve mechanics out of sight of the few people who degnitely and positively knew it and use it in their every-day life.

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MANUFACTURING INTERESTS.

There has been a panicky feeling for a few days among operatives in Connecticut. The idea has gone abroad that the winter is to be one of unusual business depression, and many of the employees fear that when cold weather sets in they will be thrown out of employment. This apprehension is partially due to the business depression that has prevailed throughout the fall, to the senseless warnings on the stump during the canvass, and to reports that there was to be a general shutting down by manufacturers in the state. It is a fact that some manufacturers are holding back until they see whether there is to be any tariff agitation at the coming session of Congress, but as a general thing they have no idea that there will be such bad times as to cause them to shut their mills or greatly reduce their time, and some predict early and great revival of prosperity.

So far as can be learned very few mills have shut down. The Putnam Manufacturing Company's great mills have done so because there has been a large accumulation of stock for which there is no market. They expect soon to resume. The flourishing brass mill in Thomaston has shut down because of the depression in that industry, and the comparatively small cartridge works at Coventry have closed their doors temporarily for the same reason. There has been, however, a considerable reduction of time and hands by a number of the leading manufactories. The large works of Tuttle & Whittemore at Naugatuck are running on only nine hours a day. The Converse Mill at Stafford Springs is running on only half time; the Douglass Plump Works in Middletown on eight-hour time, and the Stevens Company at Cromwell are running some of their hands on half time and some on eight-hour schedules. The great works of the Yale Lock Company in Stamford are running on eight hours ; the Pemberwick Bolt Company, one of the largest in the United States, run only five days a week ; The Parker Gun and the Charles Parker Screw Company of the same place are running on short time and with a reduction of force. The Union Hardware Company in Torrington has discharged twenty hands.

Yet it is found that many of the manufacturers are doing well, and some are rushed with work. The Sargent Company's immense hardware works in this city are running full time and force. The flourishing mills at Rockville are receiving orders that keep them busy on full time. The Williams Lock and Hame Company of Middletown has had a very encouraging revival of business. The Marlin Gun Works and the Russell Manufacturing Company of Middletown expect to run on full time and an increased force this winter. And the Shelton Bolt Works is running full time on increased orders. The Birmingham corset factories are rushed with work, and the great mills at Glenville will soon begin on full time. The cotton mills of Eastern Connecticut, however, do not regard the outlook for the winter as very promising.

Manufacturers, as a general thing, think that the bottom has been reached. Many of them have been so advised by their New York correspondents, who, in the main, look for an early and a most prosperous revival of business in all kinds of manufacturing industries.—*New York Sun.*

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THE LOSS of registered letters in the current year is only one in 21,795.

A SELF-ACTING MACHINE GUN.

The mitrailleuse, or machine gun, as hitherto constructed, is a weapon in which all the functions of loading, cocking, firing, and extracting the empty shell from the gun, are performed by turning a crank or by working a lever. The first successful gun of this kind was the invention of Dr. Gatling, an American. This gun was brought out during the war of the American rebellion, and before metallic cartridges, which are so essential to the success of a machine gun, had reached their present degree of perfection.

Dr. Gatling did not succeed in getting his gun used to any extent in the great American war. The first machine gun which ever saw service in the field was the French mitrailleuse. This gun was large, absurd, and clumsy, and so heavy that it required to be drawn by horses; it would fire but 150 shots per minute. It did not comprise the necessary elements of success, and consequently failed.

The next machine guns to make their appearance were the Hotchkiss, the Lowell, the Nordenfelt, and the Gardner. All of these, except the Nordenfelt, were operated by a hand crank, the Nordenfelt alone being actuated by a reciprocating lever. All of these guns must necessarily be mounted upon a firm base, and be trained and elevated by screws and worm gears. If they were made to work freely upon a pivot or universal joint, they would not be firm enough to remain stationary while the crank or handle was being operated.

The safe speed at which a machine gun can be fired depends in a great measure upon the kind and age of cartridges used. For instance, if cartridges have been made some time, a trifling amount of moisture may have accumulated in the powder near the primer. When this dampness occurs, the cartridges do not explode at the instant of being struck. Suppose that one cartridge in a thousand should hang fire, it would be necessary to operate the gun sufficiently slowly on the entire series, to give this slow cartridge time to explode, otherwise it might be drawn from the barrel before it exploded, or in the act of exploding, in either of which cases it would disable the gun. To this may be attributed a great deal of the trouble in operating machine guns, and their liability to get out of order when most needed.

In the machine gun which is the invention of an American, Mr. Hiram S. Maxim, slow cartridges do not offer an obstacle to the rapid firing of those which will explode quickly, from the fact that no cartridge can be drawn from the gun until it has exploded, as it requires the force of its own explosion to unlock the block from the barrel and extract the empty shell. In Mr. Maxim's new gun there is but one barrel, and all the functions of loading, cocking, firing, withdrawing the empty shell from the barrel, and ejecting it, are performed by the recoil resulting from the explosion.

This gun may be likened to a small engine, the barrel under the influence of the recoil acting as the piston, the block as the crosshead, and the sear and trigger as the valve gear. The cartridges to the number of 333 are placed side by side in a canvas belt, secured together with brass eyelets and strips. One end of this belt is connected to the arm, and the gun is operated by hand until the first cartridge is driven into the barrel. Then the trigger is pulled, this cartridge explodes, the breech bolt is unlocked from the barrel, the empty case is extracted, moved to one side, a loaded cartridge is brought in front of the barrel, the arm is cocked, the cartridge pushed home and the trigger pulled, when the explosion of the second cartridge operates the same as the first. Thus the firing may be kept up automatically, without any action on the part of the attendant as long as there are any cartridges in the belt.—*Engineering.*

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A WOMAN'S EXPERIENCE WITH A SAW MILL.

The letter appended is from Mrs. Harriet Smith, of Tuckertown, Fla., who wields a sufficiently vigorous pen. At the request of the *Northwestern Lumberman*, she gave them the results of her experience, and it seems sufficiently interesting to the general reader to republish.

"I will state at the start that I am not in the business through choice, but having loaned money to parties with which to purchase a saw mill, I was compelled by their failure to take the machinery from them. I then put my son-in-law, who promised great things, in charge. I told him I knew nothing of saw milling, but I knew that the saw dust was too fine, and the scratches on the boards too close together. I left him to run the mill, but in a short time I found he could do no better than other men and I took him out of there so quick it made his head swim. I moved the mill a distance of 20 miles, fording the Hillaborough river, and placed it near my own house, at an actual expense of $9; and in a few days I had every thing in good order.

"Although accustomed to manage my own affairs, I found difficulties enough in making lumber, and I have often said that a saw mill and Satan belong in the same family, and some people say that since I became the owner of one they are sure of it; but while they talk I am at work. This is the trouble with half the country saw mills: There is too much talking and not enough work. Why, Mr. Editor, the most of men talk over a log long enough to saw it into inch boards. Then when they get started they discover that the fireman has not steam enough; then they must all sit down and talk again. By the time steam is up and one or two boards sawed, a belt must be repaired, which might just as well have been attended to before working-hours in the morning or at noon. Then one man sews the belt while all engage in talk again. When the belt is ready the sawyer gets it into his mind that the machinery needs oiling; then he hunts up the oil can, for he never has a place for anything, and goes around squirting oil into every hole but the right one, while the other hands go on with their talking. The next day they are out of logs and the mill hands do nothing except to allow "their time to go on." The day following some of the men are reported sick and more time is lost. At the end of the month there is little lumber and no money and they all wonder why saw milling does not pay.

"I knew well enough that machinery is made to run, and when running it should be at work, and all I had to do was to keep the saw cutting for 10 hours a day and six days in the week. In order to do this the mill must be kept in good order, not by repairing broken parts but by keeping it from getting broken. And I soon saw that the parts of machinery out of sight were neglected the most. I would suppose any man would know that it is the inside of things that needs attention—the inside of the boiler, the inside of the cylinder, the inside of the pump or inspirator is of far more importance than the outside. Nothing makes me more angry than to see a man rubbing up the ouside of his boiler when I know the mud is six inches deep inside, baking, burning and blistering the iron; yet I have seen but few saw mills except my own. But I saw how that was managed before I took possession of it, and I am told others are managed no better.

"Many a man in the saw mill business would do well if he could get skilled labor, but this state is cursed with a tribe of saw mill tramps who claim to know everything and when tried can do nothing. They are always on foot and out of money, yet if we were to believe them they have been the superintendents of the largest mills in America. Everyone of them has been Gov. Drew's principal sawyer for at least 10 years, receiving not less than $6 a day. They all know more of machinery than the men who make it, and are ready, not to commence sawing, but to commence cutting, changing, splicing and rebuilding with a promise that if I will give them $3.50 per day and board they will double the capacity of my mill and be ready for work in about three weeks. I have never been deceived by one of them, but they leave their mark wherever employed. One half of them ought to be hung and the other half sent to the penitentiary. One came to me a few days ago who was an exception, for, notwithstanding he was "the best sawyer in Florida," he was willing to work for $10 a month, and board, or $12 if he boarded 'his self'—hungry looking wretch! I wouldn't have boarded him even a day for $2, and I knew he couldn't board himself at any such price. Said I, 'Do you see that road out there?' He very meekly said he did. 'Then,' said I, 'you go out there, and when you get to it you take either end you like; the one that will put you out of my sight the quickest will suit me the best.' He went. If he had not I would have put the dogs after him in three minutes.

"I employ none but the best hands—not paying too much or too little, for one fault is as bad as the other.

'I can't say just what my lumber costs me, but I know that when sold I have taken in more money than I have paid out. I am 53 years old, or about that, was born in Florida, and was raised at a time when bookkeeping was not thought of.

"I now have my second husband, and I am the mother of nine children, seven of whom are now living. Several of the elder are doing business for themselves, yet they always come to 'mother' for advice, and when they don't take it they wish they had. I have always managed my own business, and I expect to while I live. I awake in the morning and plan the day's work while the men are asleep, and at the breakfast table I give every one his orders, including my husband, who never objects to my doing the thinking for the family.

"My first advice to men who contemplate going into the saw mill business is—don't do it, for not one in 20 of you has the ability to succeed. If, however, you are determined to try it, be careful that you get the best machinery, strong and heavy enough to stand the bad treatment of awkwark hands. Buy the most durable belts, no matter what they cost, for half the failures in our backwoods mills are caused by constant breaking of belts. And when a complete outfit is secured, locate where you can get timber and sell lumber. Keep your machines in good order, taking special care of all parts out of sight. Pay your hands in cash and not in promises, for they work for the money and not for any love they have for you or your business. When yo can't pay, shut down, stack your lumber, and discharge all hands. Your mill will neither eat, drink nor wear anything while standing still. But when you do run, work everything to its full capacity."

This is a level-headed woman.

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SAFETY - VALVES AND THE STRENGTH OF BOILERS.

The ignorance oftentimes displayed in the management of safety-valves renders it desirable to give some necessary data with regard to them, such as hints on their management, and also the proper pressures to which boilers may be subjected under different circumstances.

The carelessness sometimes displayed by engineer (?) who have charge of boilers is simply criminal, and deserves the severest penalties. A recent occurence will illustrate this. Visiting an establishment where we had boilers insured, our attention was attracted by the suspicious actions of the engineer. Watching for a favorable opportunity, he climbed on top of the boilers and headed toward the safety-valve, always keeping as nearly between it and us as he could, but not, however, succeeding in always keeping it from view. Reaching the valve he busied himself a few moments about it, and then returned with a nonchalant air to where we were. The following conversation then occurred:

Inspector. "Tired of living, are you?"

Engineer. "No; what do you mean?"

Inspector. "I thought perhaps you were."

Engineer. "What makes you think so?"

Inspector. "Why, from the use you make of that wedge you now have in your overalls' pocket. I see that you had the safety-valve fastened down with it. Now if you want to die, why don't you go and jump into the river, and drown yourself; then nobody's life but your own would be endangered?"

Engineer. "Those boilers are all right. I don't believe a boiler can blow up so long as there is plenty of water in it. I have been running boilers twenty years." And so on to the end of the chapter.

This fellow had actually made an iron wedge, and driven it into the forked guide above the lever, so that it was impossible for the valve to lift, in order to "bottle up the steam," as he expressed it. And this in spite of the fact that the pressure was all that could be safely allowed, and he had also moved the weight out on the lever fifteen pounds beyond the limit allowed. This is an actual occurrence.

Now it stands to reason that if we have a boiler of a given diameter and thickness of plate, if we wish to run it for a reasonable number of years, we must limit it to a safe pressure. And by *safe* pressure we mean a pressure under which it will do its daily duty for a term of fifteen to twenty years without showing signs of distress. Now what is this limit? Experience teaches us that from one-fourth to one-fifth of the bursting pressure is the greatest under which a boiler should be habitually worked. In the above case the boiler was 48″ in diameter, plates 1-4 inch thick, single-riveted seams, and had been at work for about sixteen years. The greatest pressure at which such a boiler should ever be worked is seventy-five pounds per square inch. If, with fair usage, we wished to get fifteen years' services from it with safety, it would be better to limit it to sixty pounds per square inch from the beginning. There would then probably be no necessity for cutting down the pressure after the lapse of a few years. For the benefit of young engineers, and those interested in the safe use of steam, we will repeat the rules used for calculating the bursting and safe working pressures of boilers.

TO COMPUTE THE BURSTING PRESSURE OF A BOILER.

Data required: Diameter of shell. Thickness of shell plates. Tensile strength of shell plates per square inch of section. If no brand is to be found on the plates, it should be taken at 40,000 pounds per square inch. Pitch of rivets. Diameter of rivet holes—usually about 13-16 of an inch.

First ascertain the percentage of the plate left after the rivet holes are punched, as follows:

$$\frac{\text{Pitch of rivets—diameter of rivet hole}}{\text{Pitch of rivets}} \qquad (1)$$

That is: *From the distance apart of the rivets from center to center, substract the diameter of the rivet hole and divide the remainder by the first number; the quotient is the percentage of plate remaining to the solid plate.* This percentage is what we must use in calculating the strength of the shell.

Second: *Multiply the tensil strength of the material of which the plates are composed, by their thickness in parts of an inch, and this product by the percentage of plate as found above; divide this last product by one-half the diameter of the boiler; the quotient will be the bursting pressure per square inch.*

The bursting pressure thus found, divided by the factor of safety, will give the safe working pressure.

As an illustration suppose we have a boiler 54 inches in diameter, plates 5-16 in. thick, made of iron branded T. S. 50,000 lbs., pitch of rivets =3 1-8 inches, rivet holes 3-4 inch diameter; what would be the bursting pressure?

The percentage of plate in such a joint would be, $\frac{3\ 3\text{-}8 - 3\text{-}4}{3\ 1\text{-}8} = .76$ of the the whole plate.

Then we shall have $\frac{50{,}000 \times 5\text{-}16 \times .76}{27} = 440$ pounds nearly as the pressure required to rupture the shell.

If we assume a factor of safety of 5, which is about right, we shall have 440-5=88 pounds for the safe working pressure.

It is immaterial in most cases whether a boiler is single or double riveted so long as the *pitch of the rivets* is the same.—*The Locomotive.*

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An English physician has recently been trying to count the hairs on the human head. Taking an ordinarily hairy head the number of hairs per square inch was found to be 1066. This would give about 128,000 for the entire head, while some would have as many as 150,000.

It would not take him long to count the hairs on some heads we know of, and he would not find half so many!

PULVERIZED COAL AS FUEL FOR STEAM-BOILERS.

Col. J. A. Price recently made some remarks before the Scranton Board of Trade, in the course of them he said:

"It may be asserted as an axiom, that combustion of carbon by its union with oxygen must take place before any force can be derived. We then fall back upon the principles of combustion. Here, after all, is the keystone of all research—the end to which every energy must be directed. The fine dust, which has been hitherto the impassable barrier, has all the elements of usefulness of the best coal in the bed; it only awaits the mechanical means of extricating its imprisoned energy. That means will be found.

"It is my belief that the use of this factor for power purposes rests in the ability to sustain combustion with a powdered fuel. And why not? The lump of coal in the furnace only burns upon its exterior surface, while the interior mass is without activity. The dust is but the smaller, or an infinite subdivision of the lump, and all the advantages of a fiercer combustion can be maintained among the particles of the dust. The surface presented for the action of the oxygen in the powdered is infinitely greater than in the mass of coal, hence it is reasonable to conclude that powdered coal possesses in reality the larger elements of usefulness; and that the combustion of coal in the lump is not the best and far from the most economical use. As the chemical change goes on only at the surface where atom combines with atom to produce motion, heat, power, and as the surface of the divided mass is extensively broader, it follows as mathematical deduction, that, with properly adapted mechanical appliances for sustaining combustion, we shall reduce to powder all carbon before using. In this light our present waste is nearer the proper mechanical condition for use than that which we value so highly. To this standard, it is my firm conviction, we shall come. Powdered coal is the fuel of the future.

"I am satisfied, from certain experiments already made with imperfect appliances, that it is not only a possible but a highly probable attainment. The introduction of the fuel to the furnace by a proper method of stoking and a corresponding adaptation for the support of oxygen and hydrogen, a process that must be automatic and continuous—solves the question before us. I am also satisfied that the heat energy in a pound of powdered coal is several times that of the same in mass, and that the waste of combustible gasses is less in the process, while ash is reduced to its minimum."

Messrs. Whepley and Storer, of Boston, took out a patent some twenty years ago, and experimented extensively with coal dust as fuel. They fitted up an apparatus on one of the Sound boats for its use, but for reasons unknown to us it was abandoned.—Eds.

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ADVANTAGES OF LONG SHEETS IN BOILERS.

At the last meeting of the *Am. Soc. of Mechanical Engiueers* Mr. Frederick A. Scheffeler, of Erie, Pa., read a paper upon boilers, proposing the introduction of longer and larger sheets in them. The advantages claimed are these:

I. By carrying the longitudinal seams above the water line (say two inches above the top of the flues) and closing up the brick setting at that height, there will be no seam exposed to the fire, other than the lower half of the back head. This is a positive advantage over boilers as commonly constructed, when there are from four to eight seams exposed to the fire.

II. By thus eliminating the exposure of the seams, a greater reduction is apparent of the chances for a leakage around the rivets.

III. The advantage of equal expansion and contraction is so great as to also be of great benefit, and the usual excessive strains are largely reduced.

IV. For cleaning the boiler, no question can be raised as to the benefit of a single plate on the bottom. There are no rivets for lodgment of scale, sediment, etc., and there are no seams to interfere with a thorough scraping of the shell.

V. There being no seams vertically, the boiler must be stronger, as there are no holes punched for rivets. A member said:

"This latter fact is the one, I apprehended, that would give rise to the most serious discussion of this paper. I am inclined to think some member will question whether one large plate, extending the whole length of the boiler, will be as strong as the same plate, cut into two or three pieces and then single-riveted together. I believe that the former is the stronger of the two, and if the boiler is properly supported (as all boilers should be) there will not be any trouble with the boiler springing or the plates warping."

These points strike us as being well taken, but the idea in itself is not new. Mr. J. C. Todd, of Paterson, New Jersey, and, we think, some western makers of portable engine boilers, have done the same thing for years.

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A MECHANICAL ENGINEER.

A mechanical engineer is a man who contrives some machine to execute work which had hitherto been done by hand tools, or executes works principally by the use of power machinery. The mechanical engineer is a production of the present century; until the invention of the steam engine mill-wrights did the mechanical work of the country, which was confined principally to windmills, water wheels and their gear. The invention of the steam engine has really created the mechanical engineer, and since its invention mechanical work has multiplied at a most wonderfully rapid rate, until at the present moment mechanical engineers are sub-dividing themselves into marine engineers, sanitary engineers and telegraph engineers. The mechanical engineer concerns himself with the manufacture and distribution of gas and electric lighting, with the raising and distribution of water, with the heating and ventilation of our dwellings, with the manufacture and laying of the wires for disseminating news all over the world. The mechanical engineer is the individual who has made improvements in printing presses by which news is printed for millions of readers.—*The Mechanical World.*

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BOOK NOTICES.

Stationary Steam Engines, especially as adapted to electric lighting purposes. By Robert H. Thurston, A ., C.E., etc. New York, John Wiley & Sons.

This is a republication, in book form, of a series of reviews of all modern American high speed steam-engines. These articles originally appeared in the *Electrician and Electrical Engineer*, for which paper they were written, and contain information of value to all who use and run steam-engines. The merits of all styles and systems are impartially set forth, and in so lucid a manner that even those unskilled in a technical matter can derive benefit from them. Included in the descriptions are valuable data concerning the origin of the several designs, and the author has given due credit to the first discoverers of certain methods and systems, although their names are not identified with the engines they are applied to. We regard this as a valuable work of its kind. The price is $2.00.

Treatise on Valve Gears, with a special consideration of the link-motions of locomotives. By Dr. Gustav Zeuner; translated by Prof. F. J. Klein, Lehigh University, Bethlehem, Pa. New York and London, E. & F. N. Spon.

This is a well known work of great value to designers of advanced education; or to speak more plainly to mathematicians. Those unfamiliar with this science would have great difficulty in following the problems. The work is fully illustrated and all the principal link motions of the period are alluded to and their peculiarities pointed out. It is not adapted to the general reader, but to a special class, who will find in it most valuable aid.

Dynamo Electric Machinery. A manual for students of Electrotechnics. By Silvanus P. Thompson, B.A., D.S.C., etc. New York and London, E. & F. N. Spon.

This is a large and important work on a subject which is now attracting universal attention, and which all persons, connected with the operation of electric lights feel the need of information upon. The author's name is a sufficien guarantee of his ability to instruct the reader as he is one of the leading electricians of England. The style of the work and the general treatment of it are adapted to the mass generally, and no one can fail to derive very much more than the cost of the book from its pages.

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LOCATION OF FEED PIPES.

The evil results likely to arise from the improper location of the feed, or rather the delivery of feed water into a boiler at the wrong place, are more serious in their character and greater in extent than is generally known. We might say that, as a rule, if plain cylinder boilers are fed with cold water through the bottom of the shell, and no provision is made to allow of its thorough incorporation with the water already in the boiler, before coming in contact with the bottom plates of the boiler over the fire, these plates will crack through the girth seams, and the owner is fortunate if the boilers do not explode. The force of contraction under such circumstances is irresistible.

It is very bad practice to put up cylinder boilers and introduce the feed through the mud-drum. It should enter the boiler and be delivered just below the water line. By this means it mixes with and attains a high temperature before it comes in contact with the shell plates, and much trouble is avoided. —*The Locomotive.*

Chippings and Filings.

A Natural Barometer.—The natives of the Chiloc Islands have a singular barometer in the shell of a crab which is very sensitive to atmospheric changes. It is almost white when the weather is dry; it becomes spotted with small red points in damp weather, and it becomes completely red when rain is falling. The accuracy of the indications has been confirmed by members of the Belgium Mission, who were sent to Chili.

Most anyone can tell when rain is falling, without a red crab.

◆

"A Word In Season, how good it is!" It is, in this instance, good for five new subscribers. A California friend writes:

> "I promised you when I subscribed that I would try and get a few more, and I send five with a wish that they were more. I subscribed myself through the influence of a friend."

A benefactor is defined by some one as he who makes two blades of grass grow where one grew before. This leaves much to be desired, such a person is a howling misanthrope compared to one who makes five subscribers where there was one before.

◆

Mr. E. B. Wall, superintendent of motive power on the P., C. & St. L. R. R., is considering the question of introducing the system of "coal premiums" which has been in operation for some time on portions of the Pennsylvania system. The plan referred to is as follows:

> "Each engineer is allowed a certain number of pounds of coal per mile for each car on his train. Whatever he can save out of his allowance, is distributed as follows: To the engineer one-fourth, to the fireman one-fourth, and to the company one-half. In some cases very large savings have been made. The largest in one month, was $80, which was saved on a 'consolidation' engine."—*Railway Age.*

◆

The Latest Thing in the "make up" of periodicals is to write an article and then break it up into a series of paragraphs, either by asterisks or dashes. This gives the matter an hysterical, ejaculatory, and explosive character, which is not at all warranted by the topic. It also imbues the readers with the idea that the writers think in sections, forget what they started out to say, and didn't care much about it anyway. We are unable to see the beauties of this innovation, except to consume space which should be valuable.

◆

The dexterity with which pilots handle the immense ferry-boats, that ply between this city and those opposite, is wonderful. Threading in and out of tortuous thoroughfares, dodging this vessel and that, in reaching their slips, they carry millions of persons yearly without accident. Some of these ferry-boats are huge vessels many hundreds of tons burthen, yet they are handled as easily as cockleshells. The pilots run up within fifty feet of the slip under full headway, and stop without jarring the structure.

◆

A Master-Key has been exhibited at the Wolverhampton Exhibition, Eng., which, the inventor claims, is capable of opening 22,600 patent lever locks, all the locks to be different; that is to say, each of the 22,600 may be different in its combinations. The key weighs three ounces, and is nickle-plated. It has taken the inventor three years to complete the drawings of the different wards and combinations, which enabled this extraordinary product of human ingenuity to be made. Master-keys capable of opening 100 different combinations have been known to the trade for many years, but nothing approaching the key in question has, it is said, been accomplished before.—*Amateur Mechanic.*

◆

Our Next Issue will be the last for the year, and will contain a complete index of both volumes, VII and VIII, which will be supplied to all subscribers. At this time, also, we are revising our books and subscription lists, and those who mean to favor us with their support another year can assist us—if convenient to them—by renewing now. We open new books every year, and retain only names which have paid in advance. By so doing we avoid all question or complication, as to who has paid and who has not—for every one on said books is paid for.

◆

At All Times during the past twenty-five years this call has been made:

> "Romero, the Mexican Minister, has transmitted to the Secretary of State, at Washington, a decree issued by the State of Yucatan, Mexico, offering a prize of $.0,000 to the inventor of a machine which shall successfully extract the fiber from henquin, under the following conditions: It must be automatic and not require skilled and experienced workmen to manage it; it must be entirely free from danger to the operators; it must require less motive force than the machines now in use with relation to its producing power; it must increase the production or extraction of the fibre within a given time, diminishing its loss, compared with the various machines now in use. The reward is to remain open for three years, and is without prejudice to the right of proprietorship or of patent."

How many patents are there already on such machines? There must be a large number.

◆

James F. Hobart tells in the *Cabinetmaker* how to choose a band saw. "When you are buying a band saw, especially a cheap one, insist upon having it untied and straightened out. Now, take the saw in both hands, lift a bight of it over your head and see if it hangs true and smooth. If it kinks and hangs snaky-like, just leave that saw for the dealer to keep in stock. Buy it and your sawyer will be heard from early and often. He will kick and we don't blame him. No matter how much pains you take in jointing and setting it, such a saw will always run badly; it will rattle in the guides and cut as if not set even. It won't run true. Sometimes it is on the back edge of the wheel, then on the front, and when you draw it out of a cut, off it will come. Once in a while you can find a cheap saw that is good, but generally they are not worth carrying home."

◆

The More Mechanical Skill the inventor possesses the better is he equipped for his work. To be able to make a machine, as well as to devise it, is a double acquirement. In fact, it seems essential that the best inventors should possess a certain degree of mechanical skill. The training necessary to obtain it is highly beneficial, in showing him the properties of the material of which his machine will be made, and the difficulties in the way of adopting means to ends in bringing it forth.

The inventor not unfrequently meets with trouble in the machine-shop, owing to the fact that the principle of his invention is not grasped by those attempting to execute his orders. The result is that work has to be undone, delays occur, and the cost of construction is greatly enhanced. The fault is sometimes that of the inventor, who has not sufficient knowledge of shop work to give the proper instructions for producing the exact article desired! In such instance it is a cut-and-try experiment until the desired end is reached."—*Industrial World.*

Some Of The Nicest Veneers are still made, by preference, with the saw, notwithstanding the results obtained by knife machines. Woods like ebony and lignum vitæ can not be cut with a knife, while finely figured and close-grained mahogany is also difficult to cut by other means than the saw, the latter necessarily very thin, and so finely adjusted that hardly the slightest variation shall be possible in the thickness of the veneer turned out. While a nicely-arranged circular saw will turn out boards varying only the twentieth part of an inch, such a lack of uniformity in thin sheets would prove damaging.

The amount of steaming required by various woods to be made into veneers differs considerably. Thus, it is stated, that black walnut, which has an open grain, will steam sufficiently in six hours, while the close grained South American woods require thirty-six hours. Mahogany, tulip, and rosewood, being hard to cut, require more and careful steaming and a knife in the best condition.—*Wood-Worker.*

◆

REDUCED RATES FOR 1885.

In common with many other publishers, at this season, we have been in the habit of giving the last four issues of the current volume gratuitously to all new subscribers, and we herewith announce that we will do the same this year. We will furnish this paper from the current issue until Jan. 1st, 1886, to all new subscribers who may send in their names prior to Jan. 1st, 1885, and we hope that the number who will take advantage of these terms will be large. This offer will not extend beyond the period named, and we shall not be bound by it for any fovors arriving after Jan. 1st.

Also, we announce, as a concession to old subscribers, that we will send two copies of this paper for $3.50, or $1.75 each. If our constituents, who have so long encouraged our efforts, can see their way to obtaining a friend to join them, they can save a trifle by so doing.

We have also reduced our club rates in accordance with the times. Realizing that many are out of work, and that those who are employed have been cut down, we have cut ourselves down as well.

Our club rates for 1885 will be as follows:

Five	copies	to any	address	each	$1.60
Ten	"	"	"	each	1.40
Fifteen	"	"	"	each	1.30
Thirty	"	"	"	each	1.20
Fifty	"	"	"	each	1.00

☞ Where lists of 12 names are sent, the rate for 10 names will apply, not that for 15 names. In no case will lower rates be accepted than those given, unless in the rates for 30 names, where 28 will be accepted. On the 50 rate the full number must be sent and no lower rate than $1 will be taken for any number of names.

These rates, it will be observed, are a material reduction from last year all through, and we hope to be favored with a response to them in such increased ratio as to, at least, cover the reduction. Those who feel that they are willing to aid us in our enterprise to the extent of soliciting their friends to come in, can merely send the names with the money, being particular to have the addresses distinctly written and correct.

◆

RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which make a reduction in their rates in connection with us.

All complaints of irregularity in receiving other papers should be made directly to the publishers of them, not to us.

	Publication Price per year.	With The Mechanical Engineer.
Railroad Gazette	$4.20	$5.25
Scientific American	3.20	4.56
North-Western Miller	2.00	3.50
American Miller	1.00	2.75
Modern Miller	1.00	2.75
Builder and Wood-Worker.	1.00	2.75
Manufacturer and Builder.	2.00	3.50
American Machinist	2.50	4.30
Trade Review	3.00	4.50
North-Western Lumberman,	4.00	5.00
Mechanics	1.00	2.75
Cotton, Wool and Iron	3.00	4.25

Any periodicals not on this list will be furnished at a discount from regular rates.

THE MECHANICAL ENGINEER.

New Series. Vol. VIII.—No. 13.
Enlarged 1883.

New York, December 27, 1884.

Single Copies, 8 Cents.
$2.00 per Annum.

THE BLEVNEY SPLIT PULLEY.

An ingenious and mechanical method of fastening a split pulley on a shaft is herewith illustrated. It is made by the Blevney Manufacturing Company of Newark N. J., and has no bolts or keys employed in its construction.

The method of holding the halves of the pulley in place is plainly shown, it being merely a wedge working between two lugs, one on each half of the pulley. This may be termed a clamp-wedge as it both draws and binds the parts together. There is no machine-work upon these, as they are set in the sand when the pulley is cast, and make their own seats. The pulley is held to the shaft by the chuck-coupling shown in the center. This is peculiar in construction and cannot be described without drawings. Those interested can address the Blevney Manufacturing Company at Newark, N. J., for price lists and particulars.

◆

"THE MOST UNKINDEST CUT OF ALL."

No one can say English free traders are not consistent in the practice of their doctrines. Recent cable dispatches say:

> The steel manufacturers of Sheffield are furious over what they characterize as an attempt by the English Government to make England's necessities a source of profit to foreign competitors. The iron and steel industries throughout England have been wofully depressed for months past, and there is great distress.
>
> When the agitation for an increase of the navy was started, the iron-masters saw a gleam of hope. They contributed by every means in their power to bring it about. The building of new ships and guns would involve employment for their furnaces and foundries.
>
> The cabinet eventually asked for large appropriations for the construction of new ships and armaments. On Dec. 2, Lord Northbrook, submitted plans for the construction of fifty-two new vessels, to be built within the next four years, and asked for nearly $30,000,000 for the first year's allowance.
>
> The naval estimates were passed by the House of Commons without opposition.
>
> Now, the steel manufacturers of Sheffield have ascertained that, even before the estimates were passed. the Admiralty were in negotiation with founders in France and Germany for foreign steel, on the ground that English steel was not of as good quality as that desired.
>
> A French firm was asked, it is said, to furnish steel for the new guns, and a similar proposition was made to Krupp.

No remark can add force to this statement.

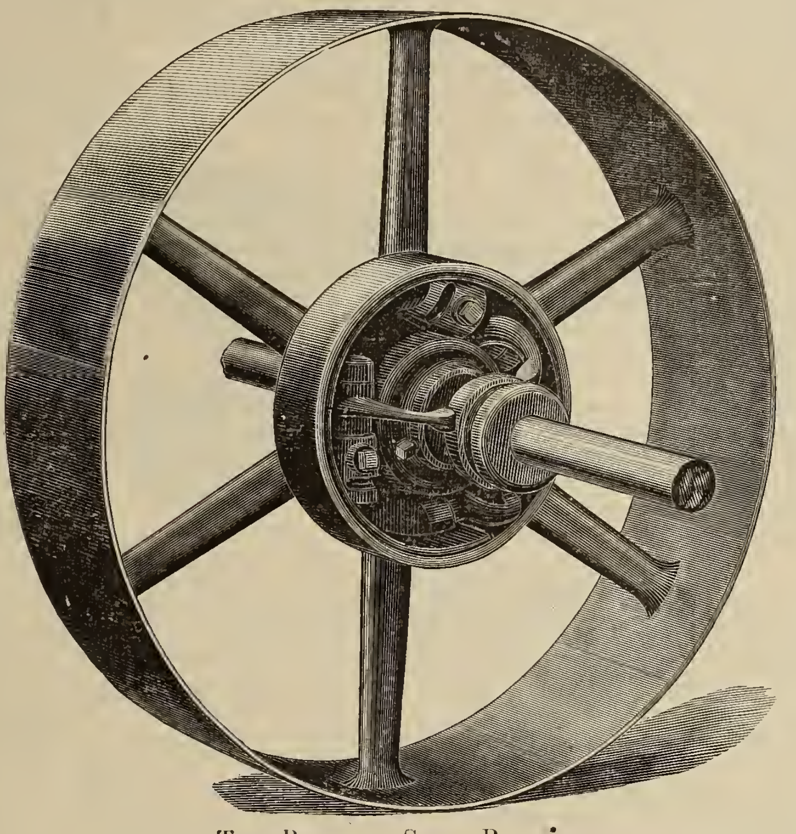
◆

COMBINING ELECTRIC MOTORS.

An important step was taken on the 25th ult. toward the practical consolidation of the interests represented by the several electric motors. Nearly a score of gentlemen interested in electrical inventions and improvements met, and resolved to form a company for the purpose of combining the various electric motors now in existence. It was resolved that the new company should have a capital stock of $1,000,000, one-half to be paid in cash and the other to be apportioned among the owners of the five different motors, according to their ascertained relative values. The representatives of these motors agreed to submit the question of relative values to a commission to be composed of the following gentlemen: Prof. Sir William Tomson, of Glasgow; George B. Roberts, President of the Pennsylvania Railroad; James H. Rutter, President of the New York Central; Robert Harris, President of the Northern Pacific Railroad, and Charles R. Cross, Professor of Physics in the Massachusetts Institute of Technology, at Boston. This commission will be asked to investigate the merits of each of the five motors named and grade them according to their practical worth. The avowed intention of the new company is to get not only the best motor, but also to utilize the best features of the different motors. Mr. Field said that it was hoped that the commission would render a decision within the next three months.

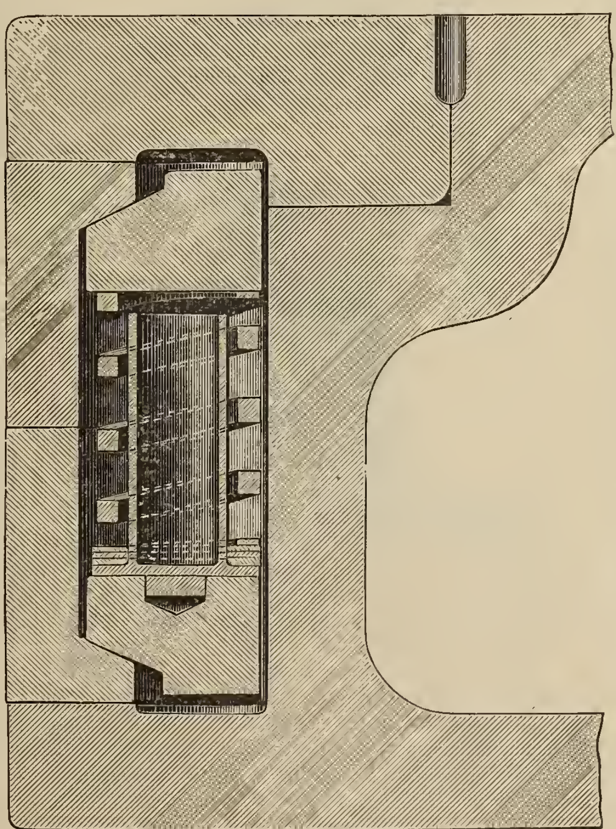
◆

ANYONE may try an experiment, but few are competent to deduce correct results therefrom.



THE BLEVNEY SPLIT PULLEY.

A NEW ENGLISH PISTON PACKING.



The engraving represents a new method of packing steam pistons recently introduced in England. The device explains itself in the engraving. It would never become popular with American engineers, for the reason that it is too expensive to make and is of doubtful practical value. The rings are set out by the wedge-shaped faces of the inner rings, forced apart by helical springs between them. It is apparent that if these appendages are not most accurately fitted up they will leak; if they are accurately fitted up the springs will have a great deal to do to keep the rings out against the cylinder. Immediately in front of these springs the packing would be forced out, but in the space intermediate, between the springs, there is nothing to prevent the rings themselves from being forced back, or being sprung by steam pressure, except the wedge-shaped faces. We know of better piston packings than this, costing very much less money.

◆

TECHNICAL COLLEGES.

We are very far from deprecating the education of engineers in theory, and willingly admit that it is, perhaps, impossible to find men better able to instruct in this than the professors of engineering in our colleges; but much more than this is required, and no persons are more ready to admit it than some of the ablest professors of engineering we have. The mistake made lies not in teaching theory, but in the assumption that it can be made to supersede practice. Another mistake is, to assume that the persons who insist on this are competent to pronounce any opinion whatever, of value, on the subject.

No one is so fitted to say what the training of a youth intended to be an engineer should be, as an engineer who lives by his profession; and such men will be the first to repeat, as the result of long training, that an ounce of practice is worth at least a pound of theory.—*London Engineer.*

We should say a ton!

◆

THE BABCOCK & WILCOX CO. are replacing old style boilers as follows: Ansonia Clock Co., Brooklyn, 214 horse-power, in place of duplex boilers; Empire Refrigerating Co., Hunter's Point, New York, 184 horse-power, in place of Root boilers; Pitts' Agricultural Co., Buffalo, New York, 100 horse-power, in place of tubular boilers; New York Herald Building, New York City, 244 horse-power, in place of locomotive boilers; Ingenio Emilia, Cuba, 240 horse-power, in place of two-flue boilers; Nottingham Mills, Providence, Rhode Island, 208 horse-power, in place of cylinder boilers.

◆

WHAT PLUSH IS.

In response to the reporter's inquiry Mr. Goodall said, "Plush is made of mohair, silk, or wool. Nothing else is equal to mohair; silk is not its equal in many respects, and wool 'mats' and loses its luster. Mohair," he continued, "is perhaps misleading to you. When a woman calls for mohair cloth at the store, she gets something stiff, brittle, and unbending. Now that is not what we think of as mohair. Feel of that plush. Catch the luster. We get our mohair from England. It comes from Turkey, where it grows on the back of the Angora goat. It comes in fleeces. The staple after being combed is as long as that (measuring nearly two feet with his hands). Out of one hundred bales received in London from Turkey, we get only ten per cent in sorts. That is, in sorting one hundred bales we get ten bales of the finest. It costs us about $1.00 per pound. In combing, fifty per cent is waste. We call that the noils. The mohair is so fine that it can hardly be told from silk. Mohair is the material for plushes. It is susceptible of the most delicate shades. It will wear like iron. There is the old saying that nothing will wear like leather. As a material for car seats it has been practically demonstrated that mohair plush will outwear leather. The Sanford mills make immense amounts of the plush for car seats. Mohair can be bought in all the grades from 25 cents to $1.00 per pound. Mohair is alive, and you can't kill it."

Mr. Goodall exhibited a novelty in the plushes invented by himself during the last year. There were eight colors in it. "First the pattern is drawn in water-colors," he says, "then the machinery has to be made. We have just got this running, after months of labor. We have been obliged to stop all other plushes and run all our help on this. We have sold up for months and months ahead. One New York firm handles it all." "What is the firm?" we ask. Mr. Goodall prefers not to say. "Probably," we suggest, "it passes for imported goods." So, in fact, Mr. Goodall assures us. "We have sent samples of it to Paris to be imitated," said he. "We cannot make it fast enough. A dozen samples are now on the water, bound for France."

The feature of this novelty was its flower-like embossed work in combinations of colors. Great eyes of color look out from its depths. The rich red of the center faded into lighter shades and then into a molten gold. They looked like great lilies and roses. These goods are used wholly in upholstering, and can be made nowhere else by machinery in the world. The secret of the machines is kept within the four walls, and the only mohair combing machines in America are in the Sanford mills; they are made in England. The looms for the mills are made in America, and the more important parts are made within the mill. Two or three years of patient study have been put upon single points of the machinery. These are the secrets that are guarded.—*Boston Journal.*

◆

A SCANDALOUS RESOLUTION.

Some of the Superintendents of Railways in this country appear to have lost their senses, judging by the following resolution, offered at the late meeting in Boston. We find it in the *National Car Builder*, whose comments we also append and echo. We quote the resolution herewith:

"'*Resolved*, That whenever any employee of any road represented in this Association shall be discharged, by reason of such violation of orders or regulations, or failures to comply with the same, as shall be considered by the Superintendent of such road as of sufficient importance to do so, he shall notify by circular letter the fact of his discharge, giving the name of the party, the position he occupied, and the reason for the discharge.

"*Resolved*, That in the employment of men who shall have come from other roads, it is the sense of this meeting that no engagement shall be made unless, or until the applicant shall procure a letter from the Superintendent of such road, bearing a date not more than 30 days prior to such application for employment, indorsing such applicant as a suitable man for the service he proposed to perform."

Our contemporary says:

"It does not appear from the official report, as published, that any definite action was taken on these resolutions. It is our impression, however, that at a previous meeting of the Association a resolution of similar tenor was adopted, and is now, or has been in force upon the roads represented in the organization. But a very little reflection must make it clear that such a method is liable to flagrant abuse. As there are two distinct interests involved, the matter should be looked at from two points of view, from the superintendents' and the employees'. On one side there is unrestricted authority, and on the other absolute helplessness. If the weaker party is wronged there is no appeal by which the wrong can be rectified. This is at war with all fundamental ideas of justice. Even if every railway superintendent were conscientiously careful, to guard against the possibility of making any mistake in sending out circular letters of the kind indicated, the propriety of such a proceeding would be open to very serious question.

"Is every employee who is discharged in railway business, or any other business, for alleged dishonesty, negligence or incompetence, such an utter outcast from his chosen occupation that he must be forever debarred from entering it again?

"Are all railway superintendents so perfectly upright and scrupulous that the rights of employees are always safe in their hands?

"As practical business men, charged with grave responsibilities, they are, as a class, second to no other in ability and good intentions, but no class of men is so good, or so exempt from moral or mental infirmity, as to be intrusted with the exercise of arbitrary power over an inferior class."

We are sure that our contemporary does not mean to say that there are "classes," in this country, or that workingmen are an inferior class.

◆

CORRESPONDENTS, to insure answers to their favors, must in every instance append their names. We will not publish them, but we want to know who our friends are.

ADMIRAL PORTER'S SUGGESTIONS ON THE NAVY.

Admiral Porter, in his annual report, says there is a general impression throughout the country that a very large amount of money (over $300,000,000) has been spent on the navy since the war without anything to show for it, and this impression has hindered the advance of the navy. It must be remembered, he says, that after the war and up to 1869 a large sum of money was drawn from the Treasury to pay war debts, as well as to provide for them aintenance of the navy, and it was not until 1869 that the navy settled down to run on a reasonable annual appropriation for its maintenance. Since 1869 the average annual expenditure has been about $16,000,000. He urges the building up of the navy, and says the assertion that we want "a small but effective navy" does not cover the case. No small navy can be an efficient one if we consider the needs of the country. Admiral Porter proceeds to describe the features of a modern vessel, citing the *Esmeralda*, a ship of 3600 tons, built in England for the Chilian Navy, as the most perfect ship of her class ever constructed. She will, he thinks, prove a more formidable vessel than either the *Boston* or the *Atlanta*, and shows herself to be unsurpassed as a commerce-destroyer. There is no reason, he says, why we cannot build a ship of 5000 tons on the lines and plans of the *Esmeralda* that will give a speed of 19 knots an hour, which would quite equal the speed of any merchant ship afloat.

Admiral Porter submits, in conclusion, what he thinks the Government ought to do in the next two years: First—Complete the unfinished monitors and arm them with heavy rifled guns, making them rams as far as their models will permit. Second—Appropriate money for all the vessels that were proposed to Congress last winter. Third—Build, as a commencement, four of the heaviest monitors, of great endurance and speed, each to carry four 6-inch rifles in turrets. Fourth—Build 20 torpedo boats of not less than 100 tons each, with a speed of 20 knots. Fifth—One cruising ironclad of not less than 4000 tons. Sixth—Have all our ships of over 1250 tons supplied with torpedo boats, fitted with noiseless condensing engines, so that they cannot be heard when approaching an enemy. The ship's launches which are now called torpedo boats in our navy are perfectly useless.—*Press dispatches.*

◆

MECHANICAL BIRDS.

A French experimenter, Victor Tatin, has been trying to make a flying-machine modeled upon a bird, and thus mentions, in *La Nature*, his want of success:

"During the course of our researches, which lasted for several months, we constructed a large number of mechanical birds of all sizes and various weights, and reaching a spread of wings of more than two meters (about 78″). We varied the form and relative extent of the wings *ad infinitum*, as we did the number and amplitude of their strokes. We compared the advantages and disadvantages accompanying the use of wings of birds, and finally obtained results that have never been surpassed, nor even reached, but always by exceeding a power that was out of proportion to the effect obtained. We afterward tried to find, as exactly as possible, the value of this excessive expenditure, by constructing compressed-air machines. These apparatuses were the largest that we experimented with, and their extreme lightness permitted us to furnish a mechanical bird nearly ten times its weight in kilogrammes per second.

"After modifications without number, the results were so unfortunate that we had to give up the struggle, at least in this direction. Is that to say that a mechanical bird is a machine impossible to realize? In no wise; we must not conclude from our defeat that better cannot be done, but we shall not advise any one to try it with a view to obtaining a practical result in aëronautics. The complex motions of a bird's wing during flight are very difficult to imitate in mechanics, and, if nature has used them, it is because the organs of these animals could not adapt themselves effectively to other and simpler motions that mechanics make use of—rotary motion, for example.

"It will be thought, perhaps, that we have been a pretty bad mechanic. We admit this very willingly, but at present we are convinced, by force of time and money, that the imitation of nature has no other interest than that of making us better understand the means that she employs. It seems to us inadmissible to construct a mechanical bird in order to navigate the air."

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HOW THE FINISH ON WATCH MOVEMENTS IS MADE.

Machinists, and amateurs are always interested in anything that pertains to fine finish on metals. The details here given are from the *Amateur Mechanics*, by a watch-maker:

"We propose now to say something about finishing, for no man ought to undertake to do anything about a watch without due consideration of workmanlike finish. File marks are reduced by using finer cut files, and these marks are removed from gold, brass, silver, nickel and such metals by the use of a Scotch stone. This is a process of grinding that works pretty fast, and the marks of this honing process are removed by burnishing, which at the same time leaves a beautiful polish, or by buffing with rotten stone, and finally polishing with jewelers' rouge, then washing and drying in boxwood sawdust.

"Great care is required in the preparation of flat, round, half-round, and circular buffs. Coarse linen thread charged with requisite material for the different grades of polishing is useful, especially in corners, or small eyes and rings. Buffs of all kinds can be purchased from dealers in watch tools and material, but the inventive genius can easily manufacture to suit himself. Great care should be exercised to have a place specially provided for the different grades, so as to keep them free from dust, dirt, and grit.

"Rapid motion is important in all fine polishing, and the most superb luster is produced by it and a gradual decrease of pressure. File marks are removed from steel by honing with an oil stone, powdered oil-stone dust, and the different grades of emery. Emery hones, and emery paper, are also used with good effect on the softer metals. Small pieces are finished perfectly flat on glass or metal plates, smeared with fine oil-stone dust mixed with oil. If you cannot get any ground glass, find two pieces of thick glass, and grind them together with flour-emery mixed with water or oil.

"Polish is produced by fine crocus and oil, applied with a piece of bell metal or fine brass. Soft steel can be burnished, but care must be taken not to produce dark spots by overdoing. Steel receives the finest polish when hardened. Practice does more to produce a fine finish. There is nothing like the knowledge gained by actual practice—but we have described the tools and materials used.

"Vienna lime and diamantine are used for polishing, the last with very good effect, but the greatest care must be used to remove every vestige of polishing material."

◆

STEAM COAL.

Steam coal being, as everybody knows, unquestionably the most important and largest expense in the manufacture of steam, is deserving of most careful investigation by engineers and owners, who, unlike chemists and college professors, consider the subject wholly in a practical way as relating to the coal bills of their establishments.

Useful knowledge of the every-day economy of coals is seldom gained by "tests" conducted by experts, for several reasons, so plain that they hardly require explanation.

1st. The cost of the fuel used in "tests," whatever may be stated, is too high, average or "every-day" coal not being used. The experiments are made with picked men and picked fuel, for brief periods, with everything at its best, and the results obtained, if looked for in the ordinary run of business, will be a disappointment in the results of the wholesale order.

2d. Men working, as firemen, twelve or fourteen hours per day in the hot furnace rooms, cannot be expected, with the ordinary appliances, to watch where every lump of coal falls when feeding the furnaces, nor to clean the grates any oftener than they are compelled to do.

3d. Moreover, too many employers favor the low wages plan, and for an apparent saving of a few dollars per month waste many times the amount in their furnace doors, and render their establishments most disagreeable to their neighbors by a free distribution of unconsumed carbon, or what is commonly called *soot*, and of which most people have no appreciation.

4th. Little or no encouragement is given for careful or economical firing as a rule. The fireman who oftentimes wastes as much as his entire wages, secures the same pay as the man working alongside of him who saves it all. It may be remarked that this is "not business," but many are the concerns who run their steam plants this way. Careful handling of coal in firing pays better than any other thing about a steam plant, and it is economy to secure good and careful men for it.

As is well understood, the condition of circumstances attending the combustion of coal for steam purposes, embraces a wide range. A very few establishments work under conditions that admit of a high attainment of economy by having a fixed performance of duty, and their plants well proportioned to the regular work, but by far the largest number have a fluctuating demand for steam, and in that respect are largely at a disadvantage. Many furnaces are badly constructed, others suffer from an insufficiency of draft, and in many cases there seems to be no end of complications detrimental to best results.

These practical difficulties and uncertainties, which are well known to every experienced engineer, and to many steam users who give this important department their study, render any investigation worthy of the name, slow and laborious. It has taken considerable time and research to arrive at the conclusion, though differing from the preponderance of hearsay or guess-work evidence, that now at least "*the highest-priced coal is not the cheapest for steam production*," and that in fact the reverse is undoubtedly true, at least in the Western country. Late improvements in the construction of grate-bars have undoubtedly added largely to the value of the Western soft coals. The great difficulty in former times of ridding the furnaces of the incombustible part of these very valuable coals, has been removed by the improvements mentioned, and there is no doubt but that a large number of extensive establishments in Chicago and vicinity are, and for some time past have been, obtaining the same duty from the Illinois bituminous coals, that they in former years obtained from the high-priced Eastern coals.—*American Engineer.*

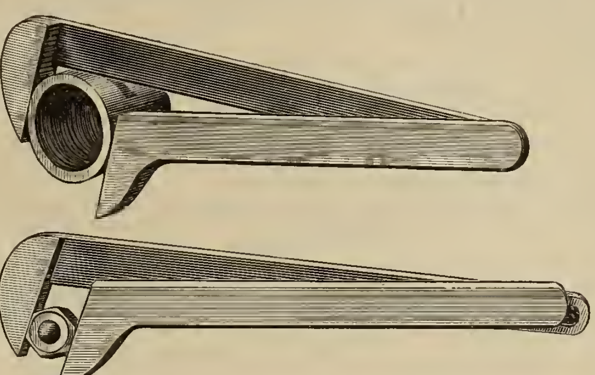
HOW PAPER WARE IS MADE.

The making of paper ware had been a study for years in various parts of the country, the particular article upon which attention was principally, perhaps solely, directed being pails. Fifteen years ago pails were manufactured out of binders' board bent over into a truncated cone and riveted, and given bottoms and bales. They were crude productions compared with paper pails now made, but turned attention to the subject, and experiments led to the invention of machines. It was found that the pail with a seam was not durable or strong, and that what was needed was a seamless pail containing a great deal of the best fibrous material compressed so as not to be bulky. The difficulty lay in making the taper of the seamless pail, but it was finally mastered. The pulp which forms the body of the pail is made of old rope, Sisal hemp, etc., cut up, steamed and ground. It is then run through a board machine in one thickness, making a board about 48 inches wide and one-eighth of an inch thick, cut into pieces convenient for making the different wares that it is to compose. This board goes into what is denominated "pressed work," under which is included wash-basins, mats, bottoms for pails and spittoons, etc.

All the paper wares are put in a water proofing liquid which thoroughly impregnates them, and makes the paper look of a dark brown color. When the liquid has well permeated the wares, they are kiln dried in a temperature of 250 degrees for 48 hours. The first coat of paint is then given, and the wares are again kiln dried. They are then put on a lathe and sand-papered inside and outside. A second coat of paint is now given, and subsequently the granite work, stencil and hand decorating. The granite work is such a fine imitation that it cannot be told from the genuine. All the ware of the Syracuse company bears a label reading, "Guaranteed to stand hot or cold water, not to crack or soak, and to wear longer with same usage than any article of the kind now in the market."—Condensed from *The Paper World.*

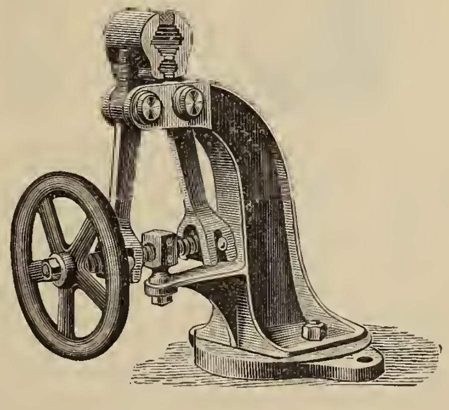
A CURIOUS WRENCH.

A wrench lately patented abroad is shown herewith. It consists of two parts, one working in a slot in the other, and the grip is obtained by the tendency of these parts to fall into line when strain is put upon them. The parts are apparently merely laid together, and not fastened in any way at the bottom, and the device itself is very interesting and curious as illustrating the effect of strains. It would seem that, in one direction, the wrench would open, and also that one part would slide down the slot and slip when under strain, but this is not the case. The wrench is self-acting and self-gripping, and, we may add, finger pinching, if the user is not wide-awake.



NEW PIPE VICE.

One of the most useful pipe vices we have seen lately is shown herewith; it can also be used as an ordinary vice on emergency, as may be seen by the shape of the jaws at the top. The vice is adapted for bench use, and has a swivel base, so that it can be turned in any direction. It is of English design and is patented.



The Kansas City Association Stationary Engineers, Missouri, No. 4, favor us with a complimentary ticket to their grand ball, on December 17th, "to raise funds for school of instruction in the use and care of steam engines and boilers." This is so praiseworthy an object that almost we are persuaded to take the first train for the scene of action. In default of that, however, we can only wish that the receipts may be overwhelming. Action of the kind our friends have taken, is the best answer that could be given to adverse criticism.

◆

The best and safest way to send money is by Post-office Order, or bank draft on New York; next, by registered letter. For fractional parts of a dollar, send postage-stamps. Do not send Canadian stamps.

AMERICAN AND ENGLISH RAILWAY SYSTEMS CONTRASTED.

A writer in *The Scotchman* who has recently returned from a visit to this country dilates at some length in favor of our baggage checking system. He likes it, but does not like the English plan. Hear him:

"Now, mark the contrast: I arrive at Liverpool, give up my baggage to the Railway Company without any voucher or check being interchanged, and proceed by a suburban railway in ill-smelling carriages, which my American fellow-travelers scornfully stigmatized as 'bunks,' and into which we were locked like criminals. It was a wet, gloomy day, and after my pleasant American experiences I felt like one who had 'come down in the world.' On afterwards applying for my baggage, I was not only obliged to produce my card as evidence of identity, but I had to go down into a deep, dark cellar to point out the packages, and after all this unnecessary bother I had to pay more than at New York, where baggage was carried double the distance. But the charge is a mere secondary consideration. It is the restless anxiety and worry our entire want of system needlessly imposes on starting, till arriving at your destination, that is so provoking.

"Americans cannot understand how we quietly submit to travel in carriages in which we are half-frozen in winter, which are very very stuffy in summer, and in which murder and other outrages may be committed with impunity, while our baggage system they regard as simply barbaric.

"It is because I agree with my American friends that I have noted down these reflections in the hope that they may contribute, in however small degree, to rouse our railway directors to a recognition of the disgracefully uncomfortable, and inconvenient accommodations afforded by them to the traveling public."

Well, he won't rouse them any. Does he think the custom of a century is to be overthrown by a letter? English people like the railway carriages of their country: that is why they have them so.

CLEAR AS MUD.

Some time since, page 262 vol. 8, we ventured to inquire whether vibration affected the balance of machines. A writer in *Cotton, Wool and Iron* settles the question promptly. He says:

"The vibration or visible movements of a machine have nothing to do with the balancing of the running parts. On a rotating mass the connecting rod is just as much out of balance, proportionately, at one speed as at another, only its time of action differs materially with the synchronous movements of the bed plate on its supports. At a given speed the inertia of the reciprocating parts acts in harmony with the vibrating wear of the engine, and helps at every movement. At a greater or slower speed many of these effects of inertia are applied to check these visible movements, as they take place at an instant when they are of no use to keep the bed in motion on its foundation. A reciprocating mass cannot very well be balanced by a rotating body, but can be equalized at least in one direction, and where the movements are to be guarded against, horizontally, the unequal effect should be left vertical and bring the hammer blow on the supports similar to that of the wheels of a locomotive on the rails, then there will not be felt any of that shake to the building when the machinery is in one of the upper stories."

It is good to know all about a thing and say so promptly, but in the above lucidity we think the writer strains himself without lifting anything. What is the "vibrating wear" of an engine? Has any one ever seen wear vibrate? It is safe not to try to explain to others what you don't understand yourself.

◆

For Some Inscrutable Reason inventors of car-couplers are singled out for ridicule. We see no particular occasion for the car-coupler man to be made a butt of, any more than other inventors who are busy on similar things. Why not give him a rest, and concentrate a shot or two on parties who re-patent things that have been in use a couple of centuries or so? A man has lately patented the indentations cut on the borders of directories, etc. Try a pot-shot at him.

◆

Recipes For Restoring Burnt Steel abound; the best one we ever found was to throw the burnt steel in the scrap heap, get a new piece, and use more care in working it.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

ANOTHER SIDE OF THE FOREMAN QUESTION.

Editors MECHANICAL ENGINEER:

Did those writers who advocate bossing the work only, ever have any trouble from the workman "running up on them" as horsemen say? Running over them, as I would say of men.

Mankind has to be guided a good deal in this world, and a strong hand on the reins is generally liked quite as well as a weak and vacillating one. Workmen like to have some one they can depend upon and whose word is law. They may not say they like a rigid, exacting foreman, but, if they do like a good-natured easy-going man, why do they so often impose upon his good nature, get sick and tired of their work and disgusted with themselves? It is because they have their own way too much, and their way is not the best way. It is not what we want to do, but it is what we have to do that brings us prosperity and happiness.

Men left too much to themselves get into ruts of listlessness and indifference—"do not care whether school keeps or not"—and they have no idea of what ails them. Let a hurried job come in, and let the foreman give quick and positive orders with the tone of authority in his words, and see how quickly this listlessness and indifference disappears, and see how much better the workmen feel!

Now with the kind-hearted, sympathetic, easy foreman, business is dull most of the time, while, with the resolute foreman, who is entirely master of the situation, and who means business in every word, business is lively all the time, as far as men on duty are concerned, and there is no chance of listlessness and indifference, and they do not get into the dumps.

"A little bossing now and then
Is relished by the best of men."

New York. A. CARNOT.

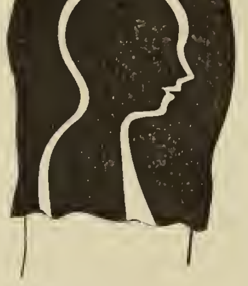
[We should say it depended somewhat on the men one has; if they are the kind our correspondent mentions, they undoubtedly need a head, but if they are intelligent and ambitious they don't require bossing.—EDS.]

◆

A CRITICISM THAT IS WELCOME.

Editors MECHANICAL ENGINEER:

I hope you will pardon me if I should not agree with you as to an item in your last issue on the casting of bronze statues.



You say that the inner model is only a core, and it would be useless to give any shape to it. You say also that if the metal be run into the space left by the wax the features would be on the inside. True, but if I make a model of clay and over the said model I put 1-16th of wax equally, then put on the other layer of clay, when the wax melted out would there not be a space for the alloy? When I removed the outside clay wouldn't I have the features of my original model 1-16, all over, larger? Now the way I look at it I see no difficulty at all about the wax, if it is put on equally all over. There should be no difficulty in making models in that way. Knowing that you like criticisms I have, for the first time, taken that liberty.

Galt, Ont. JOHN H. MCGREGOR.

[Our correspondent is correct in his conclusions, and we have made a little sketch showing the plan. We were misled in our remarks by the modeling of the features on the core, or rather making two models. one on the core, as it may be called, and afterward modeling the features in wax. It is clear that only one modeling is needed, for the inside form may be a square plug. We are glad to have the correction made. —EDS.]

◆

HOW I GOT UP A CLUB.

Editors MECHANICAL ENGINEER:

I wish to tell you how I got up a club for THE MECHANICAL ENGINEER, and wish you would ask the "Professor" to put it in his words, for he can do it so much better than I can. Leave out some of the rough words in it.

I went to John Rollins, who runs a chuck-lathe and said I wanted him to subscribe for THE MECHANICAL ENGINEER.

"For what?" he says

"THE MECHANICAL ENGINEER," says I.

"What's that, something good to eat? I never heard of it before."

"It's a paper," says I, "and here it is."

"Give us a hold of it," says Jack.

I gave it to him and he looked at it; the first thing he lit on was the foreman letter of the Professor's some time ago. "Begad," he says after a little, "that chap's head is level. How much is this thing? Does he write such stuff all the while? What do you want me to give you?"

"I want $1.30 each for a club of fifteen, and I am going to have that lot or break a leg."

"Put me down first man," says Jack.

"Give me the money," says I.

"Money," says Jack, "do you think I am full of money? I will give you the money when I get the paper." "Then you won't get it," says I, "I want the money first and paper next."

"You're the worst book agent I ever saw! You'd make more at it than you ever will at a vice job. Go way from here," but he gave me the money all the same.

Then I went over to Silas, on the planer, and I had the same row with him, but I got $1.30 from him too. I then got six names more from fellows all round the shop. Three of them had left their pocket-books home on the piano, the rest paid me. In the afternoon I went back to the piano chaps and dunned them for the money. Two paid and one didn't. The next day I went up in the pattern shop and got three more names. Pattern-makers are lousy with money and they paid me on the spot. They don't get much to read, I guess, and are glad of a chance to get hold of something decent. I got the rest in various holes and corners. I laid out to get them and I did. Enclosed find money order for $19.50 and it's the best job of soliciting I ever did.

NO NAME.

[The Professor would say that if he touched this he would spoil it. We print it just as it is written with the exception of name and locality. EDS.]

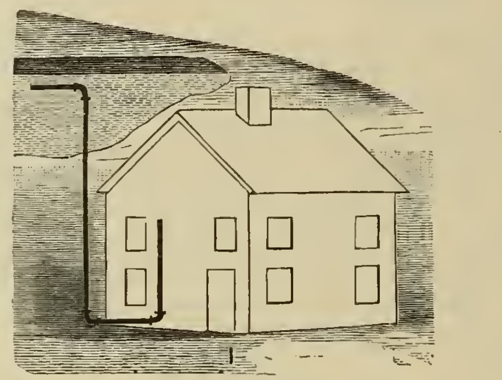
◆

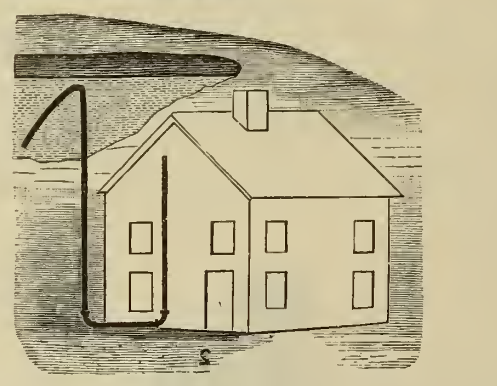
LOSS OF WATER PRESSURE BY FRICTION IN PIPES.

Editors MECHANICAL ENGINEER:

Seeing that you answer a great many questions for readers of your valuable paper, and being one of them, I come to you for an explanation, hoping to receive attention at your earliest convenience.

A person wishing to receive water from a pond situated above his house, took the following plan, as shown in Fig. 1, and after letting the air out of the pipes, and seeing no leaks therein, he was surprised to find that the water did not come up to the height required.





After consulting with a friend of his he was told to bend the end of the pipe in the pond, as shown in Fig. 2, and he would have no trouble. He did so, with the result that the water was forced to the top of the house. By answering this you will oblige one who is terribly

Newburg, N. Y. "PUZZLED."

[The loss occurred through friction in the pipe and at the elbows. By bending the pipe as stated greater pressure was obtained, with the result stated. The loss by friction in small pipes is very much greater than is generally supposed, and increases as the square of the velocity. A $\frac{3}{4}$ pipe discharging 5 gallons per minute loses 3.3 pounds pressure on each 100 feet in length, while with 7.25 gallons discharge per minute the loss is 13 pounds pressure per square inch for each 100 feet in length.—EDS]

◆

BRIDGEPORT ENGINEERS FALL INTO LINE.

Editors MECHANICAL ENGINEER:

I take pleasure in informing you of the organization of the Bridgeport Association of Stationary Engineers No. 4, of Connecticut, which took place on the evening of Dec. 7. We start off with sixteen charter members, among whom are included some of the oldest and most intelligent engineers in the city. Other applications for membership are already being made, and it is not improbable that in a few months the Association will be in a splendid condition.

The following officers were promptly elected, and installed by F. A. Foster, assisted by President Wakeman, Vice President Ricketts and others of New Haven: Frederick Keppy, Past President; J. M. Tucker, President; Ismond Tyler, Vice President; John E. Breen, Recording and Corresponding Secretary; Wm. Croker, Treasurer; Edward O'Donnell, Financial Secretary; Thomas Whalen; Conductor; Wm. M. Williams, Doorkeeper, Trustees were appointed as follows: Frederick Keppy, E. L. Andrews and James E. Deas. Frederick Keppy was elected delegate to the National Convention.

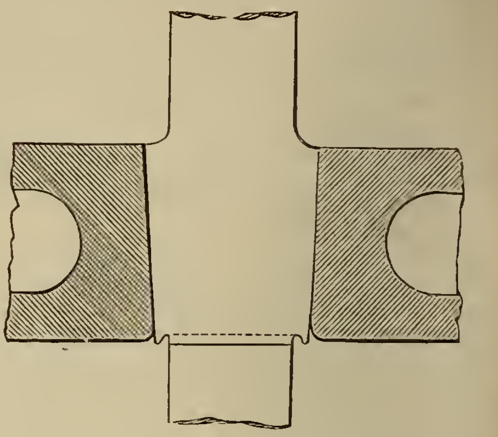
Bridgeport, Conn. JOHN E. BREEN, *Secretary.*

◆

RIVETING A PISTON ON IN THE CENTER OF A ROD.

Editors MECHANICAL ENGINEER:

An acquaintance informed me that he recently saw a pump bucket riveted on in the center of a rod. He insists that the bucket was secured only by the rivet just the same as if the rod was tapered into the piston and riveted over outside, on the end of a rod. This is commonly done in many places, but I can't very well see how a rod can be riveted when the piston is in the middle of it; there being nothing to rivet. By answering this you will settle



Boston, Mass. A POSER.

[The engraving shows how the work our correspondent mentions can be done and has been in some instances. We cannot say we like it, or would trust it without a key. An annular groove is turned in the rod and the lip turned over on a countersink.—EDS.]

Chippings and Filings.

PROMPTNESS IN BUSINESS is money in the pocket. It takes longer to do things that are deferred than to do them at once, where it is possible.

◆

THE latest wrinkle in the way of advertising is a *papier maché* man which moves by clockwork, constantly raising to his lips a cigarette, taking a strong pull and puffing out a cloud of smoke. It is, of course, a tobacconist's sign.—*Boston Courier.*

Friend, this was put on the market in the War of the Rebellion, if that is late.

◆

THE BOSS ECCENTRIC.—*The London Engineer* says: "Messrs. Hick, Hargreaves & Co. have in hand marine work of a specially heavy character, and amongst this an eccentric 7ft. 6in. in diameter, and 15in. wide on the face, weighing five tons, which is probably as large a piece of work of the kind as has ever been turned out."

And won't there be some friction on it in running!

◆

A HEAVY wheat train pulled into Fargo by one engine, a few days ago, on the Northern Pacific Railroad, consisted of 110 cars loaded with wheat. This would make, allowing 550 bushels to the car, a weight of 3,620,000 pounds, while the cars weigh 2,759,000 pounds, making 6,359,000 pounds pulled by one locomotive, or about 3,180 tons. The train was over three-quarters of a mile in length.

◆

CUT AND DRIED formulæ for construction are a snare to the feet and a stumbling-block to the unwary. A contemporary says:

"A graduate tried to design a valve some time ago from formulæ which were guaranteed not to fail, but his engine would not run, and it was necessary to consult with experienced engineers before he could make any progress."

"'Twas ever thus." Experience makes the (engineer) man, the want of it the graduate.

◆

SIMON CAMERON the veteran politician hits it about right when he says:

"The secret of long life is to keep moving. Men grow old only when they sit down long enough to get rusty. I want to live just as long as I can be happy. When I reach the point where my friends, seeing me come up the street, say, 'Let's get on the other side; there comes that old fool,' I want to die. Men make a great mistake in this life by holding on to any position after they have lost their grip.

MR. CAMERON is 86 years old, and still hale and hearty.

A Reader in Montreal sends us an item concerning the manufacture of paper bottles in Germany and says it is hard to believe it. The term "paper" is improperly implied to so many articles nowadays that his incredulity is not remarkable. Celluloid might as well be called paper, as tissue paper is a chief ingredient. In the case of paper bottles, lime, bullock's blood, and sulphate of alumina combine to form a composition of which paper and wood pulp are the basis.

◆

We Find this in a Collegiate journal:

"Mr. —— (a graduate) is with the —— Steel Works, deducing laws for the different tools by which the maximum amount of work can be obtained in the least time."

This is a novel enterprise. Mr. —— may find when he gets on a little further that tool steel is a factor in his "laws;" also, that when he obtains the "maximum amount of work in least time," some man with a pair of overalls on will come along and double his maximum amount, without any laws.

◆

An aeronaut says that no balloon has ever gone over a second sunset. The moment the sun goes down the gas condenses and you get through the night better than the day. But the next day, in the presence of the sun, the gas expands and you mount to great elevations; but every mount the balloon makes cripples its power, and it is only a question of hours, if not minutes, how long you can keep up. If an aeronaut could have forty-eight hours of night he could travel a great distance. The highest rate of speed he had ever attained, with a strong wind blowing, was eighty miles an hour.

◆

A Foreign Paper says:

"One of the most important adjuncts to the engine is its governor. It should be sufficiently sensitive and reliable in action to keep the engine within 5 per cent of its normal speed, with a load varying 90 per cent and a boiler pressure varying 10 lb. per square inch. No mechanical governor can do this, and consequently a good electrical governor, which would automatically open and close the throttle valve, in perfect synchronism with the load or work to be done, and leave the valve in its last position until a change was made, either in the load or in the steam pressure, is greatly to be desired."

Mechanical governors do this with ease and certainty—in this country. They do not vary one per cent under any load or pressure.

◆

Mr. Hatton recommends the reduction of the postage on local letters to one cent. He also recommends the use of a special stamp, to cost ten cents, which, when affixed to a letter in addition to the proper postage charge, should insure for it as speedy delivery as possible after its reception at any letter-carrier office. This outside distribution, he says, could be effected by employing messenger boys. He renews the recommendation that the unit of weight for first-class matter be made one ounce instead of half an ounce. He would assent to the request of the American Association for the Advancement of Science that the transmission of botanical specimens through the mails should be permitted.

◆

Hirsch, the well known French engineer and author, reports to the Commision Centrale des Machines à Vapeur the results of experiments on the production of the superheated condition in the water of steam-boilers. Studying the history of such phenomena so far as they are recorded, and conducting a somewhat extended series of experiments, the conclusion was finally reached that there is no evidence, up to the present time, that boiler explosions may be caused by the conditions studied, or that such conditions ever arise in practice. If they occur at all, it is only in extremely rare instances, and as a consequence of a coincidence of circumstances seldom to be observed, and which are neither well understood nor well defined. The use of the thermometer is advised to determine the facts bearing upon this question. The commission to which the report is made approve and adopt these conclusions.—*Colliery Engineer.*

◆

EXPLOSION OF A BATTERY OF THREE BOILERS.

Three new boilers recently exploded simultaneously at Bilston, Eng., and the cause is thus alluded to in *Engineering:*

"A careful examination of the fragments revealed the fact that in one boiler, and in one only, was there a longitudinal rent, while to the skilled eye it was at once apparent that the plates at this part had been very severely overheated, and on plotting the position of the rent it was found that it had occurred just at the part which would be overheated in the event of the level of the water in the boiler getting too low. Further consideration showed that it was not probable the shortness of water had been brought about by evaporation in the ordinary way, in consequence of the attendant neglecting his feed supply, but that the level had been in all probability lowered very rapidly from some cause or other, and the evidence at the inquest showed that the most probable explanation of the loss of water, was that the leakage had occurred at a defective joint in the blow-out pipe.

"The fact that a portion of the blow-out pipe on this boiler was made of wrought iron, while those of the other two were of cast iron, enabled it to be identified as the middle boiler of the three which had burst. The evidence, therefore, showed clearly that, in the case of No. 2 boiler at least, the explosion was due to the water level in the boiler getting too low, whereby the plates had become overheated, to so great an extent that they were rendered too weak to withstand the ordinary working pressure.

"The question then arises, what caused the explosion of boilers Nos. 1 and 3? An examination showed there were no signs of shortness of water in either of them, nor had they failed longitudinally. In each case the rents occurred at the ring seams, the boiler on the left being divided into two fragments, and that on the right into three. The explanation suggested was that boilers No. 1 and No. 3 were burst in consequence of the violent shock to which they were subjected on the explosion of boiler No. 2. The reasons which make this explanation conclusive will, we think, be more evident if we briefly consider the strains to which such boilers, as the ones in question, are liable in ordinary work.

"Although the plain, cylindrical, externally fired boiler doubtless possesses some advantages over the internally fired one, of the ordinary Lancashire or Cornish type generally used, still it would be idle to deny that it has not counter-balancing disadvantages. The action of the fire, for instance, in heating the lower half of the shell, while the upper half is only heated to the temperature of the steam, leads, in the first place, to severe straining, and causes the ends to curl upwards. This action is much aggravated when the water with which the boiler is fed is dirty, as the mud or scale naturally settles on the bottom, at the very point on which the flames play with the greatest intensity. Again, when the feed-water is introduced it falls to the bottom, on account of its greater specific gravity, and cools a strip of plating from end to end, causing it to contract. This contraction is resisted by the portions of plating along each side, which are not cooled, so that a shearing action is set up whereby a heavy strain is thrown upon the ring seams of rivets, and we have frequently known boilers of this class to explode in consequence of a sudden steam rip starting at the ring seams of rivets in this way.

"Bearing these facts in mind, therefore, all mystery in connection with the Bilston explosions vanishes, and it is easy to understand how the shock, consequent on the bursting of No. 2 boiler from shortness of water, should have so severely strained the adjoining boilers on each side of it that they exploded in turn. There would in reality be two, if not three, explosions, but the interval of time between each would be so short that they would appear to be simultaneous, rather than successive."

◆

USEFUL DATA FOR ENGINEERS.

By Smoke Arch.

Owing to the limitations of our columns the first paragraph of this article was omitted from our last issue. It is here appended and appertains to the preceding matter on page 297.

Without the use of an indicator it is difficult to estimate even the approximate horse-power necessary to elevate water, as in most cases there are many and varied conditions existing, which have to be known, and deductions must be made for every bend or angle in the pipe. These tend to retard the motion of the liquid and throw extra load on the pump. A fire-engine might elevate a certain amount of water per minute very economically, but if several angles and contractions were introduced the cost of elevation might be increased 50 to 100 per cent. Therefore, discharge pipes should be smooth internally, with as few bends as possible. Suppose we wish to know the diameter of pipe to discharge a given quantity of water per minute: We simply multiply the square root of the number of cubic feet we wish to elevate per minute by .96, and the product equals the required diameter of pipe in inches.

If water for a boiler is taken from a street main, it is a good plan to have a tank large enough to hold sufficient water for a day, for if a pipe bursts, the street supply may be cut off at any time.

To estimate the size of tank for any boiler, multiply the horse-power by 40, and the product will be the capacity of tank in gallons.

In the furnace of a steam boiler combustion is never absolutely perfect, consequently all the heat of coal is not liberated nor utilized to raise the temperature in the furnace. In all cases the loss in efficiency of the furnace cannot be accurately estimated, but the amount of loss will be governed in part by the intelligence of the fireman, construction of the furnace, the volume of air admitted, and manner of conveying it to the burning fuel. The great problem of utilizing every heat-unit contained in coal has not yet been solved. There is a broad chasm between theoretical deductions and practical results which no one has succeeded in filling in or even bridging.

As one heat-unit is equivalent to 772 foot-pounds, the theoretical equivalent of 2565 heat-units will be one horse-power for one hour; and if we divide 2565 into 14,000 (the theoretical value of one pound of the best anthracite coal during complete combustion), we have 5458 horse-power for one hour. But in practice upwards of 3 pounds of good coal are burned in the furnace of a steam boiler each hour for every 1,980,000 foot-pounds of work done by the piston. In other words 42,000 heat-units produce one horse-power for one hour, whereas 3 pounds of coal, or 42,000 heat-units, are theoretically equal to 16,374 horse-power for one hour.

In many instances a horse-power for one hour is produced from two pounds of coal, by protecting the pipes and cylinders from the cooling effects of the atmosphere, using a high grade of expansion in the cylinder, and by a partial vacuum through which about 4-5ths of the total back pressure, above absolute vacuum, is removed. Some ancient slide valve engines, yet in use, admit steam 3-4 of the stroke and require nearly one cubic foot of water per horse-power per hour, and, if it requirs 8 pounds of coal to evaporate one foot of water, from the temperature of the feed, into steam at boiler pressure, 112,000 heat-units are dissipated for each horse-power for one hour; or heat theoretically equivalent to 43.7 horse-power for one hour.

The steam engine though a faithful servant to man, is a very wasteful machine, and even though this waste of heat can, to an extent, be abated, all the heat of combustion cannot be utilized to move the piston, for heat is lost in various ways between the furnace and cylinder and nearly a thousand degrees are rendered latent with each pound of water before it passes into steam. If the heat of combustion could be applied directly to move the piston of an engine without loss, it would be a very simple matter to estimate accurately the amount of carbon necessary to move a known load at a given velocity for a stated time. In all cases the weight moved by the combustion, or heat, of a pound of carbon would be fixed, and we could measure the work done by the heat generated.

There is a definite quantity of energy stored up in a pound of coal but, by any method now employed we can utilize only a small portion of the heat in actual work. The loss at the furnace is great, but the loss in heat-units which accompanies our mode of applying the heat is three fold greater.

(To be continued.)

The Mechanical Engineer,

FORTNIGHTLY.

EGBERT P. WATSON & SON,

Editors and Proprietors.

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No paid notices of any sort or description have ever appeared in THE MECHANICAL ENGINEER. We notice gratuitously any movement that seems useful to our readers.

NOTICE.

The publishers of THE MECHANICAL ENGINEER will be glad to receive serial articles from specialists of experience, who are actually engaged upon the subjects they treat of. These should be strictly in the line of the paper, and written in a plain comprehensive manner; illustrations should be used if possible, when needed. No mechanical essays are desired, but matter which is purely technical, and which will tend to advance others in the same line of business.

Such articles will be paid for when used at regular rates; they will not be required at short notice, but should be submitted for approval by us. The subjects are left to the choice of the writers, but preference will be given to those on shop-pratice, construction of tools, boilers, engines, and experience gained in the care and use of the same. Correspondence is invited from parties on this matter.

Persons intending to write articles as above are requested to communicate the subjects of them in advance, in order to avoid interference with others who may have possibly chanced on a similar one.

☞ *No matter will be entitled to payment unless the price is stated at the time.*

THE LAST ISSUE.

This is the last issue for 1884, closing the current volume. We improve the opportunity to thank our friends—both old and new—for their continued appreciation and support. By this aid we have been enabled to float a trade journal which has some features peculiar to itself, and which seems to have met the requirements of a great many. The number who appreciate our work increases, even in these days of slow trade and curtailment of industrial operations. We aim to reach the people, not specialists, and it is a source of gratification to us to know that this aim is recognized by the leading members of the profession everywhere in the land. THE MECHANICAL ENGINEER numbers among its supporters many whose names are known the world over, and its policy, and treatment of subjects in its range, are cordially approved by them.

We shall endeavor in the coming year to show our appreciation of our friends good will by still greater efforts, some details of our intention being mentioned elsewhere.

With the hope that the year just closing has been as satisfactory to our friends in a material point of view as it has been to us, and renewing our appreciation of their assistance, we wish them a merry Christmas and a happy New Year.

◆

NEW SERIAL ARTICLES.

We have now in course of preparation new serial articles upon subjects of interest to our readers. We shall publish these early in 1885, and request all who wish to secure the articles without interruption to remit now.

William Barnet Le Van will resume the "Indicator" series in Volume IX. with more advanced studies. of interest to those who are already familiar with the indicator. Mr. Le Van is a well known professional engineer whose services are in constant demand for tests. His articles, therefore, will not be theoretical discussions, but practical illustrations of daily practice. We have also a series on "*Boiler Construction and Repair*," by a practical boiler-maker in a responsible position in one of the largest shops in the country. This series is, in some measure, supplementary to that published in Volumes VI. and VII., and will, we think, prove of great benefit to all engineers and steam-users. The series will, however, be complete in itself. We shall also have serial articles on machine construction which will be in narrative form. This will comprise current practice, and not weary the reader with controversial argument or mandatory suggestions.

We shall, also, in the coming year keep our readers well informed concerning events transpiring in the world of engineering and mechanics everywhere.

◆

FIRE.

Our readers came very near not getting their paper on time last week, owing to a fire which pretty effectually riddled our office. By good management, however, THE MECHANICAL ENGINEER came out all right, with only the loss of a little sense and self-respect in the proof-reading. At such times a man is excusable, for a fire in a printing office is nearly as bad as one at sea. We must ask our readers to forgive us for spelling ordnance "*ordinance*," chorus, "*choras*," discipline, "*dicipline*," perceptive, "*preceptive*," and, worst of all, in speaking of Mr. Bliss's hoisting engine of ten horse-power, net effective, as "ten horse-power *not* effective." One would scarcely think the change of a single letter could create such havoc!

In a few words, our proofs were so badly read that we are ashamed, and have to ask our readers' indulgence and pardon, pleading the inevitable as an excuse. This latter, let us say, we mortally detest. We are all right again now, without missing our publication day. This has never yet been lost, and we hope it never will be.

◆

OTHER INSTALLMENTS IN ADVANCE.

As evidence of our intention to make THE MECHANICAL ENGINEER worthy of the good-will shown it, we announce that in future we shall employ only wood-engraving of the best execution for its illustrations. We have heretofore been compelled, through the force of circumstances, to employ cheaper processes, but now that the disability is removed we are glad to announce a change which is, we think, greatly for our readers advantage.

For machine illustration and detail, bold lines and soft shadows are obtained in their perfection only on wood.

Another feature we have lately adopted is the illustration of our correspondence; by this its value is greatly enhanced, for the points made are clearly brought before all. We shall continue to do this wherever the occasion requires it.

Another improvement in THE MECHANICAL ENGINEER is the wire stitch at top and bottom of the pages. This holds the sheets securely in place, and preserves them for future reference. We are also exacting better work from the pressman, and can point to the printing of the engravings in the past two issues, as work which is not surpassed in color, and artistic display, by any other trade paper. These are a few of the betterments we have made, and others will follow in due course. After a while, if the installments are frequent enough, we shall have the debt of good-will we owe our friends reduced somewhat.

◆

A HEAVY OBLIGATION.

The *North-Western Miller* lays us under a heavy obligation in its issue for December 5th. It says more flattering things of our attempts to make bricks without straw than we dare reprint. Any effort upon our part to respond would be a conspicuous failure; we know better than to attempt to paint the lily, and it is sheer waste to gild refined gold.

No men can be said to have lived in vain, when they have such generous recognition of their labor as our contemporary bestows upon us. It seems to us that its holiday number has been issued in advance of its announcement.

◆

WHO BUILT THE ORIGINAL MONITOR.

In Number 1, Volume IX., we shall publish facts in connection with the building of the original *Monitor*, of world-wide fame, which will set the question of our caption at rest. For years, at various intervals, this person and that has made statements in print which are erroneous. As a matter of history the truth should be known, and we will give it, from a source that is authentic.

◆

ENGINEER JACKSON.

Personal heroism is not rare among engineers. We cannot call to mind a single instance where the man at the throttle proved recreant to his trust, and we know, and have shared, many perilous occasions. The beautiful monody appended is contained in a private letter to the editors from J. F. Holloway, President of the American Society of Mechanical Engineers, and it is so feeling a tribute to a brave man and brother, that we are unwilling it should be lost in our portfolio. Brother Holloway has simply given facts, and his plain unvarnished recital of them adds more to their natural pathos than the most didactic sentences could.

"I have, I am sure, no personal ambition to gratify, but I do want to see the engineers of this, and other lands, those who plan and think, and those who execute as well, take rank and station, to which by reason of earnest, patient toil and by the good accomplished, they are so justly entitled. To this end, there must be engendered in all a pride of the profession, that shall so permeate its membership, that each man will feel that to reach the highest planes he too must climb.

"You know, as I do, how much the world and its progress owes to the inventor, and the engineer. You know, as I do, how in many a village hamlet, or more favored surroundings, men in comparative obscurity have labored long, and endured hardships of which the world has known but little, while they were searching for the germs of what in the end became marvelous inventions. These, while they brought blessings to all and wealth to many, gave to the discoverers obscure lives and nameless graves.

"You know, as I do, of more than one who, driving his fiery steed at its utmost pace, has found, as he rounded a curve, an open drawbridge before him: too near to give thought of himself, or home, but only with time to pull levers here and there, and check the rushing train before the fatal gap was reached. And, when all is over, and the passengers gaze at the quiet waters, beneath which the steed and its driver lie, the sole thought is—''Twas only a life lost!'

"It was the life of a hero. Where may be found an example of heroic devotion to duty that shall excel that of Engineer Jackson, who, when that fearful collision on Lake Huron between the '*Meteor*' and '*Pewabic*' took place, stood with his young wife by his side, in the *Meteor's* engine-room? One hand on the throttle, and one on the reversing gear, he awaited signal-bells that never came. Without these duty held him to his post. He did so wait, until the steamer sank beneath Huron's waves, engulfing the bravest among brave engineers, and a wife, devoted unto death.

"I knew Jackson well, and would gladly honor his memory. When one of the survivors told me the tale and said: 'I think I was the last person to leave the main deck, and as I rushed past the engine-room to reach the companion way, I glanced in, and saw Jackson there with one hand on the throttle and the other on the starting-bar, and his eyes fixed on the bells, while his wife was clinging to his neck,' I need not tell you there came into my throat a succession of lumps which like Banquo's ghost, 'would not down,' and to my eyes, tears that would not stay back, and the picture never reverts unaccompanied with the same feeling.

"I have no need to recount the innumerable instances in which the labors of the engineer have made the world his debtor. I only hope the time is not distant when not only his labors will be appreciated, but the man and his profession shall be duly honored; and to that end let us all do our best."

◆

ARTISTIC BRASS WORK.

"Artistic" brass work, as executed by amateurs is peculiar. Apparently they endeavor to bring up work at one operation and sitting, We refer to work known as *repoussé*—that is, struck up with blows from hammers, or "sets." The designs seem not happily chosen, for an amateur never proceeds to learn by easy stages, but boldly grasps that which an expert would hesitate at. Nothing is too difficult for the amateur. As a consequence mail-clad warriors with very scaly armor are chosen; these all appear bow-legged in the finished work, probably from the weight of armor. Faces also are selected, and they scowl fiendishly upon the beholder. Good *repoussé* work is among the most beautiful of art products, but a great difficulty with amateurs is that they will not take time and begin upon simple designs first. They have no experience, and cannot tell what thickness of metal will answer best for certain designs, or what part to begin upon without multiplying all subsequent work.

Repoussé work is beset with difficulties—they are thickly strewn, in fact—and it is by no means easy of execution. It requires long experience to deal with it satisfactorily.

◆

MEMORIAL FOR A NATIONAL LICENSE LAW.

Messrs. Geo. M. Barker, of Nashville, Tenn., Geo. G. Minor, Cincinnati, Ohio, John Trix. Detroit, Mich., and H. D. Cozens, Providence, R. I., have joined in a memorial to Congress praying for a national license law for stationary engineers. The memorial recites that such laws are as much needed on land as in the Marine service, and it represents the growing necessity for some stringent law preventing the employment of reckless men. Owing to our index, and the curtailment of reading matter in this issue, we cannot give the text of the memorial in full, but we append a portion which will give an idea of the tenor of the document:

1. That in our associated capacity, we represent thousands of the educated, enlightened, and intelligent mechanical engineers of the country; men upon whom, more than upon any other one profession or class, the manufacturing industries of the country are dependent for their successful prosecution.

2. We recognize the fact that education and intelligence, disseminated among the individual members of any profession, is the corner-stone, on which to build a name and career which shall be an honor and a benefit to the profession represented, as well as an influential element for good government, sobriety, and moral rectitude in the community in which it exists.

3. We represent to your honorable bodies that the various engineer's associations throughout the land, through the National Association, are powerful elements for good in the numerous cities in which they exist, in that, to a large extent, they furnish to the engineers composing them an opportunity to advance and perfect themselves in a knowledge of the science of steam, its application, and economic manipulation for the many purposes for which it may be designed; in short, to comprehend the tremendous force of the power which they constantly hold under their control.

4. We represent that human life and capitalized property are equally dear, and equally valuable on land and water. We look with enviable pride at the protection our country extends to steamship owners, both on sea and inland waters. They have the assurance of the government that their engineers are reliable and trusty, know their business, are men of experience, and are safe men to be trusted with the mighty power they have to control.

We ask the same protection for life and property on the land. We ask that no man be allowed to imperil the life and property about him, by taking charge of a steam plant of any dimensions, who cannot show by a certificate of a United States inspector that he is competent to be entrusted therewith.

We ask that every man in the United States desiring to follow the occupation of a stationary engineer be required to pass an examination as to his fitness, and ability as an engineer, in exactly the same way and manner as our marine engineers are obliged to do; that their license to serve as an engineer shall issue from and by a representative of the United States Government, in the same manner as the marine engineer's license issues; that the same fines and punishments may be inflicted for a violation of such law, or for acting as an engineer without holding a license to so act.

We are aware that it may be urged that Congress cannot regulate this matter by legislating for the several States, but we submit that the law, as applied to marine engineers is as binding and as stringent if a boat never leaves the waters of any one State, as it is in case she does—as on the Western rivers; also steam ferry-boats.

This memorial will doubtless be acted upon if presented at a favorable time for consideration. The coming change of policy and of persons may prevent, for the moment, its serious deliberation.

◆

AN ECONOMICAL AMERICAN STEAMSHIP.

The *Railroad Gazette* recently made a curious calculation, according to which the heat derived from burning a sheet of letter paper might move a ton a mile if the ton were a part of the cargo of the British steamer *Burgos*, and the letter was burned in one of her furnaces. That is to say: in the early part of a recent voyage the fuel cost of propulsion was half an ounce per ton per mile, the speed being ten nautical miles per hour.

The figures given are these: Weight of cargo, 5,600,000 pounds. Coal consumed in a run of 3380 miles, 282,240 pounds. Speed supposed to be ten nautical miles per hour. This equals 83.5 pounds of coal per mile. The cargo weighs 2800 tons of 2000 lbs., so that the fuel per ton per mile was .02982 of a pound which is .4771 of an ounce. We may accept the data given us without endorsing it. In that case there would have to be burned about two old letters, to drive a ton a mile in six minutes, instead of one; we may as well be particular while we are about it.

Now a fraction of an ounce of fuel in relation to a ton of goods does not appear important, but when there are thousands of tons and thousands of miles involved, the half ounces amount to hundreds of tons, and the ultimate profit or loss in running a ship, in these days of competition, depends upon the saving, or wasting, of hundredths of an ounce of fuel per ton of freight per mile. The decisive factors in steamship management now-a-days are not so much in the commercial as in the engineering domain.

The average British steamship built, say twelve years ago, requires a whole ounce, or more, of fuel per freight-ton per mile, and now, when freight rates are a little lower than they were, many of the old ships are laid up and offered for sale, while the economical ships are steadily employed, and more are being built to crowd out of business the whole ouncers.

Foreigners have a belief that we in this country do not know how to build any better ships now than they did in Britain twelve or fifteen years ago, and conclude that, were it not for our exclusive navigation laws as they apply to our coastwise trade, there would be a good market for their obsolete craft for that trade, and that Americans would know no better than to buy them. If the laws which prevent foreign-built ships being used in our coastwise trade were repealed, a few Americans would doubtless attempt to get trusted for some of the useless foreign craft, but not many would buy and pay for them, because as good ships can be built at home as anywhere, and well informed people know it. Merchants who are wise and prompt enough to gain profit from running ships on the sea, are wise enough to see that home-built ships are the best for their use, because if home built, and badly built, the builders are within range of commercial cures—which do not reach a distance of three of four thousand miles; and they will continue to place their orders near home, so that the builder will suffer severely in reputation, if he cheats in the building of a ship.

But we need not go to the English or Scotch building yards for specimens of half-ounce per ton-mile ships. We can find them running on our coasts and across the Pacific Ocean. We can even find a specimen or two in the back country—upon the great lakes. Take, for instance, the *H. J. Jewett* which came out in 1882.

She carries 2300 tons of 2000 lbs. each. She runs in deep water fourteen statute miles per hour, which is almost exactly twelve nautical miles. Her course between Buffalo and Chicago covers long reaches of shallow water, which has the effect of reducing speed and increasing coal consumption per mile. She makes the round trip between Buffalo and Chicago with an average of 80 tons of Ohio coal—including the coal burned in port, steam being always kept on one of her two boilers. The shortest possible distance to be run on a round trip is 1800 statute miles, which is equal to 1564 nautical miles. Coal per mile equals 102.3 pounds, equal to .0445 of a pound per ton, per mile, making fuel cost per ton-mile .71 of an ounce, at twelve knots per hour. Now the required powers for different speeds are as the squares of the speeds, so that the consumption at ten miles equals 100÷144×.71 ounce, which gives us .497 of an ounce of coal per ton, moved one mile in six minutes, saying nothing of shallow water resistance, and coal burned in port.

Upon the whole, it seems that our friends over the way have a faint prospect for selling to us their old one and two-ouncers, after we have built for ourselves half-ouncers, even away back upon the lakes. NORMAN W. WHEELER.

◆

THE PROFESSOR IN THE MACHINE-SHOP.

NUMBER 71.

Those who think that Patent Office Reform will come from memorials, and mutterings, will be disappointed. No improvement will be noticed until some one compels those who do the actual work of examining claims to *work*, and keep business hours. There may or not be force enough for the business, but the probabilities are that there is force enough to accomplish a great deal more than is now obtained. I say this from a knowledge of government employees generally, and the perfunctory methods of departments. No department of government carries on its work as a private business is carried on. There is Mr. Greatman this and Mr. Littleman that, who has to be approached with great awe, and with fear and trembling, lest his dignity be ruffled. If these employees of the people were born to the purple, and nurtured in tradition, there might be some excuse for walking backwards before them, but what are the facts? These high and mighty pomposities who stand in the way and block the legitimate business of the people were up-country pedagogues, and lawyers, plain yankee citizens, who climbed rail fences, trotted over bogs, and fell into puddles, just exactly as the average man has. Lord, how it does gall me when I see a chap of this calibre posing as a great man, "playing such fantastic tricks before high Heaven as make the angels weep!" I want to drop him out of the window. Dignity, forsooth! He is an offense to the dignity and self-respect which invests every man who does his duty in this world. The people of the United States hampered in trade, and disappointed in enterprises by what? In nine cases out of ten by the the laziness of Mr. High Jinks, who holds an office. It is true and it is monstrous.

I don't know Mr. Munn, of Munn and Company, nor does he know me, I went into his office once, many years ago, on some business and there he sat, about 4 P.M. of a winter's afternoon, placidly signing—what? Just trade circulars. I took a liberty, for I wondered how a man like him could do such task-work, and I ventured to say: "I should think that you would employ a clerk to do that work."

"Oh no," said the gentleman, "It is work; but I like to work." I hope he will excuse me for this prominent mention of his name, but it comes in so pertinently that perhaps he will not be offended.

What is needed in the Patent Office is just such men. Men who like to work, and will do what they are paid to do. Men are also needed who have some executive ability, and will make others do what they undertake. "Sweetness and light" are charming in a drawing room, or social circle, but for every day use let us have men whose orders are carried out, or who know the reason why if they are not.

I am not barking up the wrong tree. I have made these assertions, or observations, upon the strength of official human nature everywhere. It does not vary much in any country, and until there is a clearing out of nincompoops, with light weight brains, and ponderous "dignities" to support, the business of the Patent Office will get further behind still.

Do you know what I would do if I were Commissioner of Patents, with power to act? I would do this, for one thing, to-morrow. I would put up a notice in the departments that were badly behind, reading thus:

> SPECIAL NOTICE.
>
> On and after this date the hours for business will be from 8 A. M. to 5 P. M. and every person, without exception, must conform to them.

I would keep these hours myself, and I would haunt those departments in person until the work was going forward rapidly. I would spot the individual laggard, if there was any, and I would go to him and say:

"Mr. Laggard; it is possible that you do not comprehend the mischief you are doing, or the immense injury to vested interests everywhere, caused by your inaction and dilatoriness. This work must proceed faster."

If Mr. Laggard was deaf to this appeal he would be requested to resign, and some worthy man would be put in his place. This is only one thing that I would do; there are plenty of others to require attention that would expedite business.

You cannot make me believe that energy and intention, cannot overset even the routine and red tape of government offices.

◆

A RATIONAL VIEW OF BOILER EXPLOSIONS.

When the cork of a soda-water bottle is set free it escapes with considerable violence and noise. It behaves in a manner like a projectile shot from a gun. There is this great difference, however, between the projectile and the cork—that the whole of the projecting work must be done on the latter after it has left the neck of the bottle. In the case of a gun, the work is done on the shot while it is moving up the barrel and acquiring velocity. The motion of the cork is extremely slow until it escapes from the bottle. The motion of the projectile from the gun is most rapid at the moment it leaves the muzzle. We have a strict analogy between the flight of a soda-water bottle cork and that of a bit of boiler plate. The cast iron top of the dome of a locomotive was a few years ago blown through the roof of a station. All the bolts securing the dome top gave way, and it sailed through the air some hundreds of feet.

Now, it is very easy to say that the flight of this mass of cast iron is readily explained. "It was blown into the air," "It was violently forced off by the steam," "The steam shot it off," and a dozen similar explanations may be given. But engineers do not rest content with vague statements of this kind. They see that the cast iron must have been put into very rapid motion indeed in a very minute fraction of time, and they want to know how the motion was actively impressed on it. As soon as we begin to use figures, we discover that vague generalities really convey no adequate idea at all of what takes place.

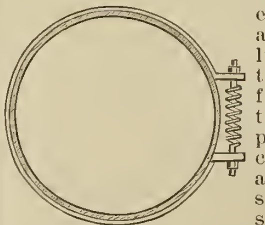
Let us suppose, for the sake of illustration, that the cast iron dome was 18 inches in diameter, 24 inches area, and that it weighed 100 lbs. Also, we shall assume that it was projected to a height of 100 feet. In order that it should attain to this altitude, it must have an initial velocity at least as great as that which it would acquire if it fell 100 ft. Allowing a little for the retarding influence of the air, the initial velocity must have been 82 ft. per second. The boiler pressure being 120 lbs. on the square inch, the total effort lifting the dome would be 30,480 lbs. We have therefore a force of 30,480 lbs., a velocity of 82 ft., and a weight of 100 lbs. Through what space must this force operate on the weight? A very simple calculation suffices to show that the force of 30,480 lbs. must act through a space of about .32 of a foot. It will be seen from this that the steam must have exerted its full pressure of 120 lbs. on the square inch until the lid of the dome had been parted from it by a distance of about 4 in.

In boiler explosions the same thing happens. The pressure follows, so to speak, the flying fragments for a certain distance after disruption takes place. In the same way, the column of escaping carbonic acid gas rising from the neck of a soda-water bottle imparts a high velocity to the cork after this last is quite free of the bottle. It is in this way that the projection of fragments to a great distance is brought about, and we do not think it is necessary that water should be called into play, for the mere projection of portions of the plates. As we should state the case, the phenomenon of a boiler explosion would be somewhat as follows: First, rending takes place through a weak joint or corroded plate; secondly, there is a violent outburst of steam; thirdly, there is a fall in pressure; fourthly, portions of the water are propelled with great violence against the boiler shell, which is shattered thereby; fifthly, the steam generated from the liberated water imparts, in the way we have tried to explain, high initial velocities to the fragments, converts them into so many projectiles, and spreads ruin around.

The point worth special notice about all this is that the steam keeps together, so to speak, and does not escape by fissures or cracks. It might be thought that the moment the steam dome cover, which we have already used for the purpose of illustration, was raised at all, the steam would all rush out sideways, and that the cover would be projected but a few feet. This is not the case; the steam does not diverge to the right or left; its molecules advance, each in a straight line, behaving like a minute projectile; and this columnar advance of a gas, free to diverge right or left, but going straight on, is the main cause of the violence of boiler explosions as manifested by the flight of fragments to great distances.—*London Engineer.*

◆

THE CRANK is not indigenous, he is found in all countries. We have some here, but the one we now celebrate is English. Listen to his words of wisdom on boiler explosions! He writes to the London *Engineer* as follows:



"In your article on boiler explosions, November 14th, you compare a boiler explosion to the escaping of a soda-water cork. The illustration is as simple as it is true, and you show that the fragments of a boiler receive their velocity after they have parted with the boiler. Now could the fragments not be arrested in their flight by such an arrangement as shown in the accompanying sketch, which shows a boiler in section, and hoop joined by a spiral spring encircling the boiler? By using a sufficient number of these hoops, would they not arrest the fragments of a boiler in the event of its bursting? WINTER."

Winter is a good name for such a cool proposition.

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AN ADVERTISEMENT, exactly 8 inches square, is headed with a request to the reader, to cut it out and paste it in his hat! It would be a curious hat that would hold it.

AS SHOWING the excellent quality of American steel ship-plate and boiler-plate, this is interesting:

Mr. John Haug presented at the meeting of the Engineers' Club, of Philadelphia, a description of Astor's steam yacht, the first sea-going steamship built of steel in this country. She is 235ft. long, 30ft. beam, and 20ft. deep. Her machinery consists of a compound engine with cylinders 34 and 60 ins. diameter and 36 ins. stroke, supplied with steam of 85 lbs. pressure by 4 oval steel boilers, and having 170 sq. ft. grate surface and 4200 sq. ft. heating surface, The plating, supplied by the Danville Iron and Steel Company, of Danville, Pa., was found to be of very good quality, the tensile strength varying from 62,000 to 72,000 lbs. per sq. in., the extension (in 8 ins. length) from 20 to 24% as shown by several samples. Some samples showed as high as [illegible]0,000 lbs. tensile strength, but the extension was only 6 to 10%, rendering it unfit for use. The steel for the boilers was also of superior quality; one test piece, cut diagonally from a plate, showed no difference from others cut lengthwise. A test piece with punched hole broke at 57,000 lbs., while one with a drilled hole broke at 61,000 lbs., showing less difference than is generally supposed. Some pieces, bent double, after having been heated and quenched in water, showed a remarkable softness and ductility.

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REDUCED RATES FOR 1885.

In common with many other publishers, at this season, we have been in the habit of giving the last four issues of the current volume gratuitously to all new subscribers, and we herewith announce that we will do the same this year. We will furnish this paper from the current issue until Jan. 1st, 1886, to all new subscribers who may send in their names prior to Jan. 1st, 1885, and we hope that the number who will take advantage of these terms will be large. This offer will not extend beyond the period named, and we shall not be bound by it for any favors arriving after Jan. 1st.

Also, we announce, as a concession to old subscribers, that we will send two [illegible] paper for $3.50, or $1.75 each. I[illegible]tuents, who have so long encourag[illegible] can see their way to obtaining a friend to join them, they can save a trifle by so doing.

We have also reduced our club rates in accordance with the times. Realizing that many are out of work, and that those who are employed have been cut down, we have cut ourselves down as well.

Our club rates for 1885 will be as follows:

Five copies to any address each	$1.60
Ten " " " each	1.40
Fifteen " " " each	1.30
Thirty " " " each	1.20
Fifty " " " each	1.00

☞ Where lists of 12 names are sent, the rate for 10 names will apply, not that for 15 names. In no case will lower rates be accepted than those given, unless in the rates for 30 names, where 28 will be accepted. On the 50 rate the full number must be sent and no lower rate than $1 will be taken for any number of names.

These rates, it will be observed, are a material reduction from last year all through, and we hope to be favored with a response to them in such increased ratio as to, at least, cover the reduction. Those who feel that they are willing to aid us in our enterprise to the extent of soliciting their friends to come in, can merely send the names with the money, being particular to have the addresses distinctly written and correct.

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RATES AT WHICH WE FURNISH OTHER PAPERS WITH THE MECHANICAL ENGINEER.

Subjoined will be found our clubbing rates with other papers, the proprietors of which make a reduction in their rates in connection with us.

All complaints of irregularity in receiving other papers should be made directly to the publishers of them, not to us.

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Railroad Gazette	$4.20	$5.25
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North-Western Miller	2.00	3.50
American Miller............	1.00	2.75
Modern Miller	1.00	2.75
Builder and Wood-Worker.	1.00	2.75
Manufacturer and Builder..	2.00	3.50
American Machinist........	2.50	4.20
Trade Review	3.00	4.50
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